CRC Handbook of tables for Organic Compound Identification

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ORGANIC COMPOUND IDENTIFICATION

Third Edition

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PREFACE

The present volume is a revised and enlarged third edition of the book formerly titled TABLES FOR IDENTIFICATION OF ORGANIC COMPOUNDS. Four new classes of compounds, i.e., sulfonyl chlorides, sulfonamides, thiols and thioethers were added, bringing the number of classes included in the book to twenty-six. The tables of alkanes, alkenes, alkynes, aromatic hydrocarbons, phenols, nitriles and sulfonic acids were all thoroughly revised and considerably enlarged. In all, the addition of 2400 compounds to the third edition, raised the total number of parent compounds in the book to over 8150.

Three tables containing the dissociation constants of more than 1050 phenols, organic acids and organic bases were added. Correlation charts for I.R., Far I.R. and N.M.R. were also included.

Explanatory sections entitled "Explanations and References" precede the tables. In these sections the formulas of the derivatives and the full reaction equations for their preparation by the most important methods, together with some essential details and references to their preparations, are given.

An index covering both the names and synonyms of the compounds was added at the end of the book. An index listing the names of all tables and major subjects was also added.

The main objective of this book is to assist chemists in the identification of organic compounds. The organization of the compounds in classes according to increasing boiling points should also assist in the search for standard vapor phase chromatography work.

For further information of techniques of organic analysis one or more of the following books should be consulted:

N. D. Cheronis, J. B. Entrikin and E. M. Hodnett, *Semimicro Qualitative Organic Analysis*, 3rd Ed., Interscience Publishers, New York, 1965.

L. Meites, *Handbook of Analytical Chemistry*, McGraw Hill Book Co., 1963.

F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., 1960.

A. I. Vogel, *A Textbook of Practical Organic Chemistry*, 3rd Ed., Longmans Green and Co., London, 1957.

R. L. Shriner, R. C. Fuson and D. Y. Curtin, *The Systematic Identification of Organic Compounds*, 4th Ed., John Wiley and Sons, New York, 1956.

F. Wild, *Characterization of Organic Compounds*, 2nd Ed., Cambridge University Press, 1958.

The publication of the third edition would not have been possible without the work of those involved in the preparation of the earlier editions. The editor is thankful for the part in the earlier work contributed by Professors M. Frankel, S. Patai and A. Zilkha, and the late Mr. R. Farkas-Kadmon. Thanks are due also to Mrs. E. Shohamy and Mr. A. Glazer for assisting in collection of new data, to Mrs. Y. Elmaleh for typing the index, and especially to Prof. S. Patai, who as consulting editor, read all the new material and gave many helpful suggestions. The cooperation of Dr. Robert C. Weast and Mrs. F. Thomas in the publication of the book is gratefully acknowledged.

Z. R.

Jerusalem
January 1967

LIST OF ABBREVIATIONS USED

$[\alpha]_D^t$	specific rotation
a	acid
abs	absolute
abt	about
ac a	acetic acid
ac anh	acetic anhydride
acet	acetone
add	addition
al	alcohol
alk	alkali
amor	amorphous
anh	anhydrous
arom	aromatic
aqu	aqueous
asym , *as*	asymmetric
bl	blue
blk	black
boil	boiling
b p , B P	boiling point
br	brown
bz	benzene
brt	bright
brnsh	brownish
c	cold
ca	about
caust	caustic
chl	chloroform
cl -bz	chlorobenzene
col	colorless
comp	compound
conc	concentrated
cor	corrected
cr , cryst	crystals
d	decomposes
d , D	dextrorotatory (or D-configuration)
deriv	derivative
deliq	deliquescent
dil	dilute
dist	distillate
dk	dark
dl , d,l, D,L	racemic
efflor	efflorescent
et	ethyl
et ac	ethyl acetate
eth	ether
exp	explodes
f	from
fl	flakes
fluores	fluorescent
f p	freezing point
frz	freezes
fum	fuming
glac	glacial
glit	glittering
glyc	glycerol
gran	granular
grn	green
h	hot
htng	heating
hyd	hydrate or hydrolyses
hyg , hygr	hygroscopic
i	inactive
i	insoluble
ign	ignites
insol	insoluble
l , L	levorotatory (or L-configuration)
leaf , lf	leaflets
lg	large
lgr	ligroin
liq	liquid
lng	long
lt	light
lvs	leaves
m-	meta
me , meth	methyl
micr	microscopic
mixt	mixture
ml	milliliter
mod	modification
monohyd	monohydrate
monocl	monoclinic
m p , M P	melting point
need , nd	needles
o-	ortho
ol	olive
or	orange
ord	ordinary
org	organic
orth	orthorhombic
oxid	oxidation
p-	para
pa	pale
part	partly
pet	petroleum
pet eth	petroleum ether
ph	phenyl
ph hydraz	phenyl hydrazine
$PhNO_2$	nitrobenzene
pl	plates
powd	powder
pr	prisms
purp	purple
pyr	pyridine
rac	racemic (or racemate)
rect	rectangular
recr	recrystallization
redsh	reddish
rhomb	rhombic
r	rapid
r h	rapid heating
s	soluble
sec	secondary
scar	scarcely
s h	slow heating
sh	short
sl	slightly
sld	solid
slend	slender
sm	small
soft	softens
sol , soln	solution(s)
solv	solvent(s)
st	steel
stab	stable
subl	sublimes
sym	symmetrical
tab , tabl	tablet(s), tables
tert	tertiary
tetr	tetragonal
tol	toluene
trans	transparent
thk	thick
tricl	triclinic
trim	trimeric
uns	unsymmetrical
unst	unstable
vac	vacuum, in vacuo
v	very
var	variable
vic-	vicinal
visc	viscous
volat	volatile or volatilizes
vlt	violet
w	water
wh	white
yel	yellow
yelsh, ylsh	yellowish
>	above, greater than
<	below, smaller than
∞	miscible
xyl	xylene

EXPLANATIONS AND REFERENCES TO THE TABLES

The following section gives explanations and references for the preparation of the derivatives appearing in the Tables Formulas of the derivatives as well as the main methods for their preparation are given Usually, only the reagents and the solvents required for the preparation of a derivative are mentioned without specific details for the reaction conditions and the exact procedure The aim of these notes is mainly to enable the worker to choose the method preferable in the conditions and the reagents available to him in his laboratory for the derivatization of his specific compound However, THIS IS ONLY A REFERENCE SECTION AND NOT AN INSTRUCTION MANUAL AND THE QUOTED REFERENCES SHOULD BE CONSULTED FOR THE ACTUAL PREPARATION OF DERIVATIVES, ESPECIALLY REGARDING SAFETY HAZARDS INVOLVED IN THE WORK

References are usually given for the preparation of all the derivatives having separate columns in the Tables, as well as for important ones listed in the "miscellaneous" section of the Tables References to five different popular analytical textbooks are given, assuming that at least one of them, or another equivalent publication, would be available to the worker These are

N D Cheronis, J B Entrikin and E M Hodnett, *Semimicro Qualitative Organic Analysis*, 3rd edition, Interscience, New York, 1965, quoted in the text as "Cheronis "

R P Linstead and B C L Weedon, *A Guide to Qualitative Organic Chemical Analysis*, Butterworth Scientific Publication, London, 1956, quoted in the text as "Linstead "

R L Shriner, R C Fuson and D Y Curtin, *The Systematic Identification of Organic Compounds*, 4th edition, John Wiley and Sons, New York, 1956, quoted in the text as "Shriner "

A I Vogel, *A Textbook of Practical Organic Chemistry*, 3rd edition, Longmans, Green and Co , London, 1957, quoted in the text as "Vogel "

F Wild, *Characterization of Organic Compounds*, 2nd edition, Cambridge University Press, Cambridge, 1958, quoted in the text as "Wild "

In addition, leading references from the original literature are also given Although the literature coverage is not complete (especially for the common derivatives) it was attempted to describe different methods, and to give as many references as possible to less common derivatives having limited scope More references can be found in the textbooks mentioned above

Derivatives appear either in a separate column or in the "miscellaneous" section in the Tables, where separate columns are usually given for derivatives which should be tried first, and for which enough data are available Derivatives which should be tried as a second choice, or preferred derivatives for which not enough data are available appear in the "miscellaneous" section The explanations and the references for the different derivatives are arranged usually in the same order as in the Tables Occasionally, this order is changed in the explanatory notes in order to describe the derivatives in a logical order (e g , in Table 17 the phenylurethane appears in a separate column, while the phenylhydantoin appears in the "miscellaneous" section in the "explanations and references" section the phenylhydantoin appears directly after the phenylurethane)

Derivatives which are followed by an asterisk are those recommended for first trial Other derivatives should be tried after these

Although "Ar" usually stands for monovalent aromatic group, we used it a few times in the following sections as a polyvalent aromatic residue This was done only for demonstration purposes

EXPLANATIONS AND REFERENCES TO TABLE I

As a result of their inertness no general suitable derivative exists for alkanes and cycloalkanes Characterization is based only on the physical constants given in the Table melting and boiling points, index of refraction and density Any laboratory text-book will give adequate directions for the determination of these constants

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE I. ALKANES AND CYCLOALKANES

a) Gases and Liquids (Listed in order of increasing b.p.*)**

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}
1	**Methane**	−161 49	−182 48[T]		
2	**Ethane**	−88 63	−183 27[T]		
3	**Propane**	−42 07	−187 69[T]		0 5005[S]
4	**Cyclopropane**	−32 86	−127 42		0 720[−79]
5	**2-Methylpropane** (Isobutane)	−11 73	−159 6		0 5572[S]
6	***n*-Butane**	−0 50	−138 35	1 3326[S]	0 5788[S]
7	**2,2-Dimethylpropane** (Neopentane)	9 503	−16 55	1 342[S]	0 5910[S]
8	**Cyclobutane**	13 08[741], 12 5	−80	1 37520[0]	0 7038[0]
9	**1,1-Dimethylcyclopropane**	20 63	−108 96	1 3668	0 6589
10	**2-Methylbutane**	27 852	−159 9	1 35373	0 61967
11	***trans*-1,2-Dimethylcyclopropane**	29		1 3713	0 6769
12	**Ethylcyclopropane**	35 94	−149 41	1 3786	0 6839
13	***n*-Pentane**	36 074	−129 721	1 35748	0 62624
14	**Methylcyclobutane**	36 3		1 3830	0 6933
15	***cis*-1,2-Dimethylcyclopropane**	37	−140 9	1 3822	0 6928
16	**Spiropentane**	38 977	−107 06	1 41200	0 755
17	**Cyclopentane**	49 262	−93 879	1 40645	0 74538
18	**2,2-Dimethylbutane**	49 741	−99 87	1 36876	0 64916
19	**1,1,2-Trimethylcyclopropane**	56 7[750]		1 3848[19 5]	0 6822[19 5]
20	**2,3-Dimethylbutane**	57 988	−128 538	1 37495	0 66164
21	**2-Methylpentane**	60 271	−153 67	1 37145	0 65315
22	**3-Methylpentane**	63 282		1 37652	0 66431
23	**1,2,3-Trimethylcyclopropane**	65 7[755]		1 3945[18]	0 6946[18]
24	***n*-Hexane**	68 74	−95 348	1 37486	0 65937
25	**Ethylcyclobutane**	70 64	−142 85	1 4020	0 7280
26	**Methylcyclopentane**	71 812	−142 455	1 4097	0 74864
27	**2,2-Dimethylpentane**	79 197	−123 811	1 38215	0 67385
28	**2,4-Dimethylpentane**	80 5	−119 242	1 38145	0 67270
29	**Cyclohexane**	80 738	6 554	1 42623	0 77855
30	**2,2,3-Trimethylbutane**	80 882	−24 912	1 38944	0 69011
31	**3,3-Dimethylpentane**	86 064	−134 46	1 39092	0 69327
32	**1,1-Dimethylcyclopentane**	87 846	−69 795	1 41356	0 75448
33	**2,3-Dimethylpentane**	89 784		1 39196	0 69508
34	**2-Methylhexane**	90 052	−118 276	1 38485	0 67859
35	***trans*-1,3-Dimethylcyclopentane**	90 773	−133 702	1 40894	0 74479
36	***cis*-1,3-Dimethylcyclopentane**	91 725	−133 975	1 41074	0 74880
37	**3-Methylhexane**	91 850		1 38864	0 68713
38	***trans*-1,2-Dimethylcyclopentane**	91 869	−117 58	1 41200	0 75144
39	**3-Ethylpentane**	93 475	−118 604	1 39339	0 69816
40	**Quadricyclane** (Quadricyclo [2,2,1,$0^{2,6}$,$0^{3,5}$] heptane)	98		1 4804	
41	***n*-Heptane**	98 427	−90 61	1 38764	0 68376
42	**2,2,4-Trimethylpentane**	99 238	−107 38	1 39145	0 69192
43	***cis*-1,2-Dimethylcyclopentane**	99 532	−53 892	1 42217	0 77262
44	**Methylcyclohexane**	100 934	−126 593	1 42312	0 76939
45	**Ethylcyclopentane**	103 466	−138 446	1 41981	0 76647
46	**1,1,3-Trimethylcyclopentane**	104 893	−142 44	1 41119	0 74825
47	**2,2-Dimethylhexane**	106 84	−121 18	1 39349	0 69528
48	**2,5-Dimethylhexane**	109 103	−91 20	1 39246	0 69354
49	**1,*trans*-2,*cis*-4-Trimethylcyclopentane**	109 29	−130 78	1 41060	0 74727
50	**2,4-Dimethylhexane**	109 429		1 39534	0 70036
51	**2,2,3-Trimethylpentane**	109 841	−112 27	1 40295	0 71602
52	**1,*trans*-2,*cis*-3-Trimethylcyclopentane**	110 2	−112 705	1 4138	0 7535
53	**3,3-Dimethylhexane**	111 969	−126 1	1 40009	0 7100
54	**2,3,4-Trimethylpentane**	113 467	−109 21	1 40422	0 71906
55	**1,1,2-Trimethylcyclopentane**	113 729	−21 64	1 42298	0 77252
56	**2,3,3-Trimethylpentane**	114 76	−100 70	1 40750	0 72619
57	**2,3-Dimethylhexane**	115 607		1 40113	0 71214
58	**3-Ethyl-2-methylpentane**	115 65	−114 96	1 40401	0 71932

*Derivative data given in order m p , crystal color, solvent from which crystallized

**T = triple point, S = at saturation pressure

TABLE I. ALKANES AND CYCLOALKANES

a) Gases and Liquids (Listed in order of increasing b.p.*) (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}
59	1,*cis*-2,*trans*-4-Trimethylcyclopentane	116 731	−132 55	1 41855	0 76345
60	1,*cis*-2,*trans*-3-Trimethylcyclopentane	117 5	−112	1 4218	0 7704
61	2-Methylheptane	117 647	−109 04	1 39494	0 69792
62	4-Methylheptane	117 709	−120 955	1 39792	0 70463
63	3,4-Dimethylhexane	117 725		1 40406	0 71923
64	1,*cis*-2,*cis*-4-Trimethylcyclopentane	118		1 422	0 766
65	3-Ethyl-3-methylpentane	118 259	−90 87	1 40775	0 72742
66	3-Ethylhexane	118 534		1 40162	0 71358
67	3-Methylheptane	118 925	−120 5	1 39848	0 70582
68	Cycloheptane (Suberane)	118 20	−7 98	1 4449	0 8275[0]
69	*trans*-1,4-Dimethylcyclohexane	119 351	−36 962	1 42090	0 76255
70	1,1-Dimethylcyclohexane	119 543	−33 495	1 42900	0 78094
71	*cis*-1,3-Dimethylcyclohexane	120 088	−75 573	1 42294	0 76603
72	*trans*-1-Ethyl-3-methylcyclopentane	120 8	−108	1 4186	0 7619
73	*trans*-1-Ethyl-2-methylcyclopentane	121 2		1 4219	0 7690
74	*cis*-1-Ethyl-3-methylcyclopentane	121 4		1 4203	0 7724
75	1-Ethyl-1-methylcyclopentane	121 522	−143 80	1 42718	0 78093
76	2,2,4,4-Tetramethylpentane	122 284	−66 54	1 40694	0 71947
77	1,*cis*-2,*cis*-3-Trimethylcyclopentane	123 0	−116 43	1 4262	0 7792
78	*trans*-1,2-Dimethylcyclohexane	123 419	−88 194	1 42695	0 77601
79	2,2,5-Trimethylhexane	124 084	−105 78	1 39972	0 70721
80	*cis*-1,4-Dimethylcyclohexane	124 321	−87 436	1 42966	0 78285
81	*trans*-1,3-Dimethylcyclohexane	124 45	−90 108	1 43085	0 78472
82	*n*-Octane	125 665	−56 795	1 39743	0 70252
83	Isopropylcyclopentane	126 419	−111 375	1 42582	0 77653
84	2,2,4-Trimethylhexane	126 54	−120	1 4033	0 7156
85	*cis*-1-Ethyl-2-methylcyclopentane	128 050	−105 95	1 42933	0 78522
86	*cis*-1,2-Dimethylcyclohexane	129 728	−50 023	1 43596	0 79627
87	2,4,4-Trimethylhexane	130 38	−113 38	1 40745	0 72381
88	*n*-Propylcyclopentane	130 8	−118 7	1 4266	0 7761
89	2,3,5-Trimethylhexane	131 34	−127 8	1 4061	0 7219
90	Ethylcyclohexane	131 783	−111 323	1 43304	0 78792
91	2,2-Dimethylheptane	132 69	−113 0	1 4016	0 7105
92	2,2,3,4-Tetramethylpentane	133 016	−121 09	1 41472	0 73895
93	2,4-Dimethylheptane	133 5		1 4033	0 716
94	Methylcycloheptane	133 5		1 4410	0 8052
95	2,2,3-Trimethylhexane	133 6		1 4105	0 7292
96	4-Ethyl-2-methylhexane	133 8		1 4068	0 723
97	3-Ethyl-2,2-dimethylpentane	133 83	−99 2	1 4123	0 7348
98	4,4-Dimethylheptane	135 2		1 4076	0 725
99	2,6-Dimethylheptane	135 21	−102 9	1 4007	0 7089
100	2,5-Dimethylheptane	136 0		1 4038	0 715
101	3,5-Dimethylheptane	136 0		1 4067	0 723
102	Bicyclo[4.2.0]octane	136 0		1 4613	0 8573
103	*cis*-Bicyclo[3.3.0]octane	136–6 5		$1\ 4595^{25}$	$0\ 8638^{25}$
104	2,4-Dimethyl-3-ethylpentane	136 73	−122 2	1 4137	0 7379
105	1,1,3-Trimethylcyclohexane	137–8		1 4362	$0\ 7868^{25}$
106	3,3-Dimethylheptane	137 3		1 4085	0 725
107	2,2,5,5-Tetramethylhexane	137 5		1 40550	0 71875
108	2,3,3-Trimethylhexane	137 68	−116 80	1 4141	0 738
109	3-Ethyl-2-methylhexane	138		1 4120	0 731
110	*trans*-1,3,5-Trimethylcyclohexane	$138\ 5\text{–}9^{754}$		$1\ 42740_H$	0 7720
111	2,3,4-Trimethylhexane	139 0		1 4144	0 7392
112	*cis*-1,3,5-Trimethylcyclohexane	$140\text{–}0\ 5^{752}$		$1\ 43010_H$	0 7773
113	*trans*-1,2,4-Trimethylcyclohexane	140–1		$1\ 43121_{He}$	0 7813
114	2,2,3,3-Tetramethylpentane	140 274	−9 9	1 42360	0 75666
115	4-Ethyl-3-methylhexane	140 4		1 416	0 742
116	3,3,4-Trimethylhexane	140 46	−101 2	1 4178	0 7454
117	2,3-Dimethylheptane	140 5		1 4085	0 7260

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE I. ALKANES AND CYCLOALKANES

a) Gases and Liquids (Listed in order of increasing b.p.*) (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}
118	**3,4-Dimethylheptane**	140 6		1 4111	0 7314
119	**3-Ethyl-3-methylhexane**	140 6		1 4142	0 741
120	**4-Ethylheptane**	141 2		1 4096	0 730
121	**2,3,3,4-Tetramethylpentane**	141 551	− 102 123	1 42222	0 75473
122	**2,3-Dimethyl-3-ethylpentane**	142		1 419	0 754
123	***trans*-1,2,3-Trimethylcyclohexane**	142 3 5[762]		1 43582$_{He}$	0 7914
124	**1-Isopropyl-3-methylcyclopentane** (Pulegan)	142 4		1 4236	0 7730[22]
125	**4-Methyloctane**	142 48	− 113 2	1 4061	0 7199
126	**1-Isopropyl-2-methylcyclopentane**	142 5[759]		1 4279	0 7792
127	**3-Ethylheptane**	143 0		1 4093	0 727
128	**2-Methyloctane**	143 26	− 80 4	1 4031	0 7134
129	***cis*-1,2,3-Trimethylcyclohexane**	144−6[753]		1 43682$_{He}$	0 7930
130	**3-Methyloctane**	144 18	− 107 6	1 4062	0 7207
131	**2,4,6-Trimethylheptane**	144 8		1 4071	0 7225
132	***cis*-1,2,4-Trimethylcyclohexane**	146		1 43209	0 786
133	**3,3-Diethylpentane**	146 168	− 33 11	1 42051	0 75359
134	**2,2-Dimethyl-4-ethylhexane**	147		1 4131	0 733
135	**2,2,4-Trimethylheptane**	147 7		1 4092	0 7275
136	**2,2,4,5-Tetramethylhexane**	147 8		1 41318	0 73546
137	**2,2,5-Trimethylheptane**	148		1 409	0 726
138	**2,2,6-Trimethylheptane**	148 2		1 4059	0 7195
139	**2,2,3,5-Tetramethylhexane**	148 4		1 4142	0 7378
140	**Nopinane** (7,7-Dimethylbicyclo[3 1 1]heptane)	149[747]		1 4641	0 8611$^{22}_{22}$
141	***trans*-1-Ethyl-4-methylcyclohexane**	149 05− 15	− 80 8	1 4304	0 7798
142	**Cyclooctane**	150[750]	14 (4 3)	1 4586	0 8349
143	**1-Ethyl-2-methylcyclohexane**	150 2		1 432	0 784
144	***n*-Nonane**	150 81	− 53 519	1 40542	0 71763
145	**1,3,3-Trimethylbicyclo[2.2.1]heptane** (Fenchane)	151 2		1 44714	0 8345
146	***trans*-1-Ethyl-4-methylcyclohexane**	151 69		1 4382	0 7972
147	***cis*-1,1,3,5-Tetramethylcyclohexane**	152 4− 5		1 4319	0 7813
148	***cis*-1-Ethyl-4-methylcyclohexane**	152 55 60		1 4374	0 7969
149	**2,5,5-Trimethylheptane**	152 8		1 4136	0 7368
150	**2,4,4-Trimethylheptane**	153		1 412	0 733
151	**2,3,3,5-Tetramethylhexane**	153		1 4196	0 746
152	**2,2,4,4-Tetramethylhexane**	153 3		1 4208	0 7470
153	**Isopropylcyclohexane**	154 5	− 89 8	1 44095	0 80232
154	**1,1,3,3-Tetramethylcyclohexane**	154 8−5 0		1 4374	0 7936
155	**2,2,3,4-Tetramethylhexane**	154 9		1 4226	0 7548
156	**2,2-Dimethyloctane**	155		1 4082	0 7245
157	**3-Ethyl-2,2,4-trimethylpentane**	155 3		1 4223	0 7571
158	**3,3,5-Trimethylheptane**	155 6		1 4170	0 7428
159	**2,3,6-Trimethylheptane**	155 7		1 4125	0 7345
160	**2,4-Dimethyloctane**	155 8 6 0		1 4090	0 7259$^{20}_{20}$
161	***d,l-cis*-1-Ethyl-3-methylcyclohexane**	155 97		1 4432	0 8094
162	***d,l*-2,5-Dimethyloctane**	156−8		1 4160	0 7370
163	**1,1,3,5-Tetramethylcyclohexane**	156 4 5		1 4370	0 7929
164	***n*-Butylcyclopentane**	156 56	− 107 985	1 4316	0 7846
165	***n*-Propylcyclohexane**	156 724	− 94 90	1 43705	0 79360
166	**2,3,5-Trimethylheptane**	157		1 416	0 741
167	**2,5-Dimethyl-3-ethylhexane**	157		1 416	0 741
168	**2,4,5-Trimethylheptane**	157		1 4160	0 741
169	**2,4-Dimethyl-3-isopropylpentane**	157		1 42463	0 75830
170	**2,2,3-Trimethylheptane**	158		1 417	0 7420
171	**2,4-Dimethyl-4-ethylhexane**	158		1 419	0 747
172	**2,2-Dimethyl-3-ethylhexane**	159		1 420	0 749
173	**2,2,3,4,4-Pentamethylpentane**	159 3		1 43069	0 76703
174	**1,1,3,4-Tetramethylcyclohexane**	159 5−6 1		1 4380	0 7976
175	**5-Ethyl-2-methylheptane**	159 7		1 4134	0 736
176	**2,7-Dimethyloctane**	159 9		1 4086	0 7242

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE I. ALKANES AND CYCLOALKANES

a) Gases and Liquids (Listed in order of increasing b.p.*) (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^t
177	**3,6-Dimethyloctane**	160		1 4145[18]	0 7363
178	**3,5-Dimethyloctane**	160		1 413	0 736
179	**4-Isopropylheptane**	160		1 417	0 741
180	**2,3,3-Trimethylheptane**	160		1 4202	0 7488
181	**4-Ethyl-2-methylheptane**	160		1 413	0 736
182	**2,6-Dimethyloctane**	160-0 5		1 4113	0 7285
183	**2,2,3,3-Tetramethylhexane**	160 3		1 42818	0 76446
184	***trans*-1-Isopropyl-4-methylcyclohexane** (*p*-Menthane)	161		1 4393	0 792
185	**4,4-Dimethyloctane**	161		1 4144	0 7347
186	**2,3,4,5-Tetramethylhexane**	161		1 424	0 757
187	**5-Ethyl-3-methylheptane**	161		1 414	0 737
188	**3,3-Dimethyloctane**	161 2		1 4165	0 7390
189	**4,5-Dimethyloctane**	162		1 4173	0 7458
190	**3,4-Diethylhexane**	162		1 420	0 754
191	**4-Propylheptane**	162		1 4150	0 7364
192	**1,1,4-Trimethylcycloheptane** (Eucarvane)	162 3[720]		1 4420	0 8011
193	***trans*-1,2,3,5-Tetramethylcyclohexane**	162 4		$1\ 44657_{He}$	0 8140
194	**2,3,4,4-Tetramethylhexane**	162 2		1 4270	0 7639
195	**2,3,4-Trimethylheptane**	163		1 421	0 751
196	**3-Isopropyl-2-methylhexane**	163		1 421	0 751
197	**2,2,7-Trimethylbicyclo[2.2.1]heptane** (α-Fenchane)	163 5 4 5[753]		1 4590	0 8579
198	**3-Ethyl-3-methylheptane**	163 8		1 4208	0 7501
199	**2,4-Dimethyl-3-ethylhexane**	164		1 424	0 759
200	**3,4,4-Trimethylheptane**	164		1 424	0 757
201	**3,3,4-Trimethylheptane**	164		1 424	0 757
202	**3,4,5-Trimethylheptane**	164		1 424	0 759
203	**2,3-Dimethyl-4-ethylhexane**	164		1 424	0 759
204	**1-Methyl-3-propylcyclohexane**	164-5 (171 3)		1 4377	0 7895[21]
205	**2,3-Dimethyloctane**	164 4 4 6[764]		1 4152	0 7377
206	***d,l*-Pinane**	164 5 5 0		1 4609	0 8551
207	**2,3,3,4-Tetramethylhexane**	164 6		1 4297	0 7694
208	**3,3-Dimethyl-4-ethylhexane**	165		1 427	0 764
209	**5-Methylnonane**	165 1	−87 7	1 4122	0 7326
210	**4-Methylnonane**	165 7	−98 7	1 4123	0 7323
211	**3-Ethyl-2-methylheptane**	166		1 418	0 746
212	**3,4-Dimethyloctane**	166		1 4182	0 746
213	***d*-α-Pinane**	166 6 5[762]		1 4630	0 8560
214	***d,l*-1-Isopropyl-3-methylcyclohexane** (*d,l-m*-Menthane)	166 7		1 44[24]	0 7965[24]
215	**2,2,3,3,4-Pentamethylpentane**	166 1		1 43606	0 78009
216	***trans*-1,2,4,5-Tetramethylcyclohexane**	166 2-8 0		$1\ 44446_{He}$	0 8100
217	**3,3-Diethylhexane**	166 3		1 428	0 767
218	**2-Methylnonane**	166 8	−74 5	1 4099	0 7281
219	***d*-1-Isopropyl-3-methylcyclohexane** (*d-m*-Menthane)	167		1 446[23]	0 8116[23]
220	**3-Ethyl-4-methylheptane**	167		1 422	0 753
221	**4-Ethyl-3-methylheptane**	167		1 422	0 753
222	**4-Ethyl-4-methylheptane**	167		1 421	0 752
223	***l*-β-Pinane**	167 5-8[748]		1 4605	0 8567
224	**3-Methylnonane**	167 8	−84 8	1 4125	0 7334
225	**3-Ethyloctane**	168		1 416	0 740
226	**4-Ethyloctane**	168		1 416	0 740
227	**3-Ethyl-2,2,3-trimethylpentane**	168		1 436	0 781
228	***l*-1-Isopropyl-3-methylcyclohexane** (*l-m*-Menthane)	168		1 4358	0 7938
229	***cis*-1-Isopropyl-4-methylcyclohexane** (*cis-p*-Menthane)	168 5		1 4515	0 816
230	***cis*-1,2,3,5-Tetramethylcyclohexane**	168-70[762]		$1\ 44847_{He}$	0 8166
231	**2,3-Dimethyl-3-ethylhexane**	169		1 427	0 765

*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE I. ALKANES AND CYCLOALKANES
a) Gases and Liquids (Listed in order of increasing b.p.*) (Continued)

No	Name		Boiling point, °C	n_D^{20}	D_4^{20}
232	**1-Isopropyl-4-methylcyclohexane** (*p*-Menthane)	169 70		1 4375[21]	0 7929
233	**3,4-Dimethyl-3-ethylhexane**	170		1 431	0 772
234	**3,3,4,4-Tetramethylhexane**	170		1 4368	0 7824
235	**Cyclononane**	170–2	9 7	1 4328[16]	0 8534[15 2]
236	**1-Isopropyl-2-methylcyclohexane** (*o*-Menthane)	171		1 447[21]	0 8135[21]
237	***cis*-1,2,4,5-Tetramethylcyclohexane**	171[755]		1 44647$_{He}$	0 8122
238	**1-Methyl-1-propylcyclohexane**	172		1 4440	0 8101
239	***n*-Decane**	174 123	– 29 661	1 41189	0 73005
240	**1-Methyl-4-propylcyclohexane**	174 3–7 1		1 4393	0 798
241	**1-Methyl-2-propylcyclohexane**	175 5 6 0[7 6]		1 4468[19]	0 8130[19]
242	***n*-Pentylcyclopentane**	180 60[10]	– 83	1 4358	0 7912
243	***n*-Butylcyclohexane**	180 947	– 74 725	1 44075	0 79918
244	***trans*-Decahydronaphthalene** (*trans*-Decalin)	187 25	– 30 40	1 4695	0 8699
245	**Isoamylcyclohexane**	193		1 4423	0 8023
246	***cis*-Decahydronaphthalene** (*cis*-Decalin)	195 69	– 43 01	1 4810	0 8965
247	***n*-Undecane** (*n* Hendecane)	195 89	– 25 594	1 41716	0 74017
248	**Cyclodecane**	201	9 6	1 4692	0 8577[20 4]
249	***n*-Pentylcyclohexane**	202 8	– 57 5	1 4437	0 8037
250	***n*-Hexylcyclopentane**	203		1 4392	0 7965
251	**9-Methyl-*trans*-decahydronaphthalene**	205, 77[10]		1 4631	0 8620
252	**1,10-Dimethyl-*trans*-decahydronaphthalene**	213 83[10]		1 4659	0 8633
253	**9-Methyl-*cis*-decahydronaphthalene**	215 85[10]		1 4804	0 8910
254	***n*-Dodecane**	216 278, 51 84[1]	– 9 587 (– 12)	1 42160	0 74869
255	**1,10-Dimethyl-*cis*-decahydronaphthalene**	220, 88 99[10]		1 4812	0 8896
256	***n*-Hexylcyclohexane**	224 0, 92 0[10]	– 43	1 4462	0 8076
257	***n*-Heptylcyclopentane**	224		1 4421	0 8010
258	**9-Ethyl-*trans*-decahydronaphthalene**	225 93 06[10]		1 466	0 8610
259	**9-Ethyl-*cis*-decahydronaphthalene**	233 99[10]		1 480	0 8860
260	**1-Methyl-*trans*-decahydronaphthalene**	235, 101[10]		1 4270	
261	***n*-Tridecane**	235 44 66 35[1]	– 5 392	1 4256	0 7564
262	**Bicyclohexyl**	236 5 7 5, 100[10]	3 5–4 0	1 4795	0 8848
263	***n*-Octylcyclopentane**	243		1 4446	0 8048
264	***n*-Heptylcyclohexane**	244		1 4484	0 8109
265	***n*-Tetradecane**	235 57, 80 13[1]	5 863	1 4289	0 7628
266	***n*-Nonylcyclopentane**	262		1 4467	0 8081
267	***n*-Octylcyclohexane**	264		1 4503	0 8138
268	***n*-Pentadecane**	270 63, 93 26[1]	9 926	1 4319	0 7685
269	***n*-Decylcyclopentane**	279 3		1 44862	0 81097
270	***n*-Nonylcyclohexane**	282		1 4519	0 8163
271	***n*-Undecylcyclopentane** (*n*-Hendecylcyclopentane)	296		1 4503	0 8135
272	***n*-Decylcyclohexane**	299		1 45338	0 81858
273	**2-Methylheptadecane**	311, 178 5[15]		1 4394[14]	0 7838[15]
274	***n*-Dodecylcyclopentane**	312		1 4518	0 8158
275	***n*-Undecylcyclohexane** (*n*-Hendecylcyclohexane)	316	5 8	1 4547	0 8206
276	***n*-Tridecylcyclopentane**	327	5	1 4531	0 8178
277	***n*-Dodecylcyclohexane**	331	12 5	1 4559	0 8223
278	***n*-Tetradecylcyclopentane**	341	9	1 4543	0 8196

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE I. ALKANES AND CYCLOALKANES

b) Solids (Listed in order of increasing m.p.*)**

No.	Name	Melting point, °C	Boiling point, °C	n_D	D_4
1	**Pentadecylcyclopentane**	17	355	1.4554^{20}	0.8213^{20}
2	***n*-Hexadecane** (Cetane)	18.165	286.793; 105.20[1]	1.43453^{20}	0.7734^{20}
3	**Tridecylcyclohexane**	18.5	346	1.4570^{20}	0.8239^{20}
4	**Hexadecylcyclopentane**	21		1.4543^{25}	0.8194^{25}
5	***n*-Heptadecane**	21.98	301.82; 117.26[1]	1.4348^{25}; 1.4369^{20}_{U}	0.7745^{25}; 0.7780^{20}_{U}
6	**Tetradecylcyclohexane**	24		1.4559^{25}	0.8221^{25}
7	**Heptadecylcyclopentane**	27		1.4532^{30}	0.8173^{30}
8	***n*-Octadecane**	28.18	316.12; 128.28[1]	1.4191^{70}; 1.4390^{20}_{U}	0.7751^{30}; 0.7819^{20}_{U}
9	**Pentadecylcyclohexane**	29		1.4545^{30}	0.8201^{30}
10	**Octadecylcyclopentane**	30		1.4541^{30}	0.8186^{30}
11	***n*-Nonadecane**	32.1	329.7; 138.8[1]	1.4211^{70}; 1.4409^{20}_{U}	0.7787^{30}; 0.7855^{20}_{U}
12	**Hexadecylcyclohexane**	33.6		1.4596^{20}_{U}	0.8279^{20}_{U}
13	**Nonadecylcyclopentane**	35		1.4588^{20}_{U}	0.8266^{20}_{U}
14	***n*-Eicosane**	36.8	342.7; 148.9[1]	1.4230^{70}; 1.4426^{20}_{U}	0.7550^{70}; 0.7887^{20}_{U}
15	**Heptadecylcyclohexane**	37.8		1.4603^{20}_{U}	0.8290^{20}_{U}
16	**Eicosylcyclopentane**	38		1.4595^{20}_{U}	0.8276^{20}_{U}
17	***n*-Heneicosane**	40.5	356.5; 152.94[1]	1.4247^{70}; 1.4441^{20}_{U}	0.7583^{70}; 0.7917^{20}_{U}
18	**Octadecylcyclohexane**	41.6		1.4610^{20}_{U}	0.8300^{20}_{U}
19	**Heneicosylcyclopentane**	42		1.4602^{20}_{U}	0.8286^{20}_{U}
20	***n*-Docosane**	44.4 (47)	368.6; 161.88[1]	1.4260^{70}; 1.4455^{20}_{U}	0.7631^{70}
21	**Docosylcyclopentane**	45		1.4608^{20}_{U}	0.8295^{20}_{U}
22	**Nonadecylcyclohexane**	45.2		1.4616^{20}_{U}	0.8310^{20}_{U}
23	***n*-Tricosane**	47.6	380.2; 170.48[1]	1.4276^{20}; 1.4468^{20}_{U}	0.7641^{70}; 0.7969^{20}_{U}
24	**Eicosylcyclohexane**	48.5		1.4622^{20}_{U}	0.8318^{20}_{U}
25	**Tricosylcyclopentane**	49		1.4614^{20}_{U}	0.8304^{20}_{U}
26	***n*-Tetracosane**	50.9	391.3; 178.7[1]	1.4286^{70}; 1.4480^{20}_{U}	0.7657^{70}; 0.7991^{20}_{U}
27	**Tetracosylcyclopentane**	51		1.4619^{20}_{U}	0.8312^{20}_{U}
28	**Heneicosylcyclohexane**	51.5		1.4627^{20}_{U}	0.8326^{20}_{U}
29	***n*-Pentacosane**	53.7	401.9; 186.55[1]	1.4302^{70}; 1.4491^{20}_{U}	0.7693^{70}; 0.8012^{20}_{U}
30	**Pentacosylcyclopentane**	54		1.4624^{20}_{U}	0.8319^{20}_{U}
31	**Docosylcyclohexane**	54.4		1.4632^{20}_{U}	0.8334^{20}_{U}
32	**Hexacosylcyclopentane**	56		1.4628^{20}_{U}	0.8326^{20}_{U}
33	**Nortricyclene** (Tricyclo[2.2.1.$0^{2,6}$]heptane)	56	106–7		
34	***n*-Hexacosane**	56.4	412.2; 194.18[1]	1.4310^{70}; 1.4501^{20}_{U}	0.7704^{70}; 0.8032^{20}_{U}
35	**Cyclohexadecane**	57	$93–8^{0.8}$		
36	**Tricosylcyclohexane**	57		1.4637^{20}_{U}	0.8341^{20}_{U}
37	**Heptacosylcyclopentane**	59		1.4633^{20}_{U}	0.8333^{20}_{U}
38	***n*-Heptacosane**	59.0	422.1; 201.54[1]	1.4321^{70}; 1.4511^{20}_{U}	0.7732^{70}; 0.8050^{20}_{U}
39	**Tetracosylcyclohexane**	59.5		1.4641^{20}_{U}	0.8347^{20}_{U}
40	**Cyclopentadecane**	60–1		$1.4592^{61.5}$	$0.8634^{61.5}$
41	**Octacosylcyclopentane**	61		1.4637^{20}_{U}	0.8339^{20}_{U}
42	***n*-Octacosane**	61.4	431.6; 208.58[1]	1.4330^{70}; 1.4520^{20}_{U}	0.7750^{70}; 0.8067^{20}_{U}
43	**Pentacosylcyclohexane**	61.9		1.4645^{20}_{U}	0.8353^{20}_{U}
44	**Nonacosylcyclopentane**	63		1.4640^{20}_{U}	0.8345^{20}_{U}
45	***n*-Nonacosane**	63.7	440.8; $172.36^{0.1}$	0.7797^{65}; 1.4529^{20}_{U}	1.4361^{65}; 0.8083^{20}_{U}

*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

**U = undercooled liquid.

TABLE I. ALKANES AND CYCLOALKANES
b) Solids (Listed in order of increasing m.p.*)** (Continued)

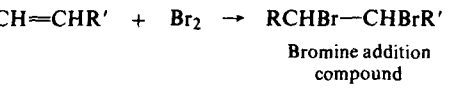
No	Name	Melting point, °C	Boiling point, °C	n_D	D_4
46	**Hexacosylcyclohexane**	64		1.4649^{20}_{U}	0.8359^{20}_{U}
47	**Triacontylcyclopentane**	65		1.4644^{20}_{U}	0.8350^{20}_{U}
48	***d,l*-Isobornane** (2,2,3-Trimethylbicyclo[2.2.1]heptane)	65–7		1.44186^{67}	0.82757^{67}
49	***n*-Triacontane**	65.8	449.7, 222.00[1]	1.4348^{70}, 1.4536^{20}_{U}	0.7797^{70}, 0.8097^{20}_{U}
50	**Heptacosylcyclohexane**	66.1		1.4653^{20}_{U}	0.8365^{20}_{U}
51	**Hentriacontylcyclopentane**	67		1.4648^{20}_{U}	0.8356^{20}_{U}
52	***n*-Hentriacontane**	67.9	458, 184.17[0.1]	1.4543^{20}_{U}	0.8111^{20}_{U}
53	**Octacosylcyclohexane**	68		1.4656^{20}_{U}	0.8370^{20}_{U}
54	**Dotriacontylcyclopentane**	69		1.4651^{20}_{U}	0.8360^{20}_{U}
55	***n*-Dotriacontane** (Bicetyl)	69.7	467, 234.8[1]	1.4550^{20}_{U}	0.7791^{75}, 0.8124^{20}_{U}
56	**Nonacosylcyclohexane**	69.9		1.4659^{20}_{U}	0.8374^{20}_{U}
57	**Tritriacontylcyclopentane**	70		1.4654^{20}_{U}	0.8365^{20}_{U}
58	**Tritriacontane**	71.4		1.4557^{20}_{U}	0.8136^{20}_{U}
59	**Triacontylcyclohexane**	71.6		1.4662^{20}_{U}	0.8379^{20}_{U}
60	**Tetratriacontylcyclopentane**	72		1.4657^{20}_{U}	0.8370^{20}_{U}
61	**Tetratriacontane**	72.6, 73.1	285.4[3]	1.4296^{90}, 1.4563^{20}_{U}	0.7728^{90}, 0.8148^{20}_{U}
62	**28-Methylnonacosane**	73.4	222[0.3]		
63	**Hentriacontylcyclohexane**	73.3		1.4665^{20}_{U}	0.8383^{20}_{U}
64	**Pentatriacontylcyclopentane**	74		1.4660^{20}_{U}	0.8374^{20}_{U}
65	**Pentatriacontane**	74.7	331	1.4568^{20}_{U}	0.8157^{20}_{U}
66	**Dotriacontylcyclohexane**	74.8		1.4668^{20}_{U}	0.8388^{20}_{U}
67	**Hexatriacontylcyclopentane**	75		1.4662^{20}_{U}	0.8378^{20}_{U}
68	**Hexatriacontane**	76.2		1.4573^{20}_{U}	0.8169^{20}_{U}
69	**Tritriacontylcyclohexane**	76.3		1.4670^{20}_{U}	0.8391^{20}_{U}
70	**Heptatriacontane**	77.7		1.4578^{20}_{U}	0.8179^{20}_{U}
71	**Tetratriacontylcyclohexane**	77.7		1.4673^{20}_{U}	0.8395^{20}_{U}
72	**Octatriacontane**	79		1.4583^{20}_{U}	0.8188^{20}_{U}
73	**Pentatriacontylcyclohexane**	79.1		1.4675^{20}_{U}	0.8399^{20}_{U}
74	**Nonatriacontane**	80.3		1.4588^{20}_{U}	0.8197^{20}_{U}
75	**Hexatriacontylcyclohexane**	80.4		1.4678^{20}_{U}	0.8402^{20}_{U}
76	**Tetracontane**	81.5		1.4593^{20}_{U}	0.8205^{20}_{U}
77	**Norbornane** (Bicyclo[2.2.1]heptane)	86–7, subl			
78	**2,2,3,3-Tetramethylbutane**	100.69	106.47	1.4695^{20}	0.8242^{23}_{solid}
79	**Bornane** (Camphane)	158.9, subl			
80	***Adamantane***	268 (252.3)		1.568	1.07_{solid}

*Derivative data given in order m.p., crystal color, solvent from which crystallized

**U = undercooled liquid

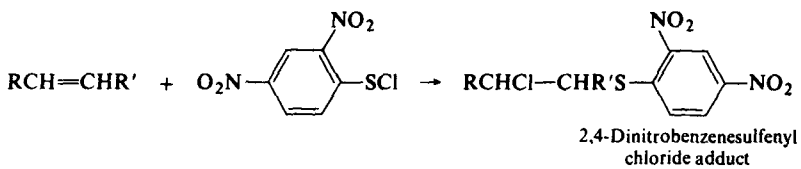
EXPLANATIONS AND REFERENCES TO TABLE II

*Bromine addition compound.**



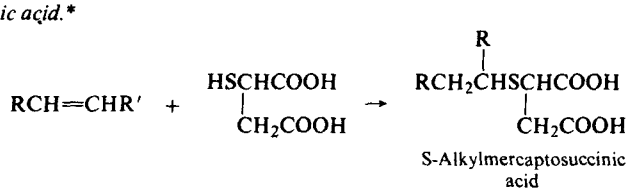
From the alkene and bromine in carbon tetrachloride.
For directions and examples see: Cheronis, p. 576; Shriner, p. 106.
From the alkene and bromine in water.
See: Vogel, p. 241.
From the alkene and bromine in chloroform.
See: C. G. Schmitt and C. E. Boord, *J. Amer. Chem. Soc.*, **54**, 751 (1932).

*2,4-Dinitrobenzenesulfenyl chloride addition compound.**



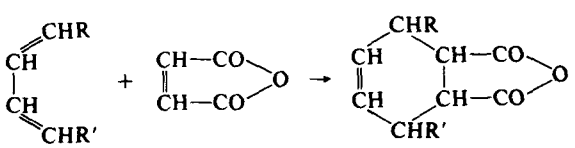
From the alkene and 2,4-dinitrobenzenesulfenyl chloride in glacial acetic acid.
For directions and examples see: Cheronis, p. 577; N. Kharasch and C. M. Buess, *J. Amer. Chem. Soc.*, **71**, 2724 (1949); D. J. Cram, *J. Amer. Chem. Soc.*, **71**, 3883 (1949); N. Kharasch, C. M. Buess and S. I. Strashun, *J. Amer. Chem. Soc.*, **74**, 3422 (1952).
From the alkene and 2,4-dinitrobenzenesulfenyl chloride in benzene or in carbon tetrachloride.
See: N. Kharasch and C. M. Buess, *J. Amer. Chem. Soc.*, **71**, 2724 (1949).

*S-Alkylmercaptosuccinic acid.**



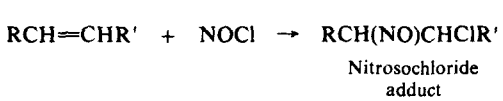
From the alkene, mercaptosuccinic acid and benzoyl peroxide in methanol.
For directions and examples see: J. G. Hendrickson and L. F. Hatch, *J. Org. Chem.*, **25**, 1747 (1960).

Maleic anhydride adduct (from dienes).



From the diene and maleic anhydride in benzene.
For directions and examples see: Linstead, p. 51; Vogel, p. 943.
From the diene and maleic anhydride in xylene.
See: Linstead, p. 51.
For general references see: M. C. Kloetzel in *Organic Reactions*, Vol. 4 (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 1; H. L. Holmes in *Organic Reactions*, Vol. 4, (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 60; O. Diels and K. Alder, *Chem. Ber.*, **62**, 2081 (1929).

Nitrosochloride addition compound.



*Derivatives recommended for first trial.
WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLE II (Continued)

From the alkene and nitrosyl chloride (prepared from sodium nitrite in concentrated hydrochloric acid) in ether-acetic acid mixture.

For directions and examples see: Linstead, p. 52; R. Perrot, *Compt. Rend.*, **203**, 329 (1936).

From the alkene and nitrosyl chloride (prepared from thionyl chloride and nitrogen trioxide) in ether.

See: M. Tuot, *Compt. Rend.*, **204**, 697 (1937).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.*)**

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P , °C	M P , °C	n_D^{20}	D_4^{20}	
1	**Ethene** (Ethylene)	−103 71	−169 15[T]		0 384[0]	*di-*	131 36	9 8ɔ	1 53868	2 1792	
2	**Propene** (Propylene)	−47 70	−185 25[T]		0 5139	*di-*	141 99	−55 5	1 52004	1 93268	
3	**Cyclopropene**	−36[741]									
4	**Allene**	−34 5	−136			*tetra-*		10 7	1 6200	2 703	
5	**2-Methylpropene**	−6 90	−140 35	1 3467	0 5942[S]	*di-*	149		1 5080	1 7595	2,4 Dinitrophenyl-sulfenyl chloride, 86 7
6	**1-Butene**	−6 26	−185 35	1 3465	0 5951	*di-*	166 3		1 5150	1 7951	2,4-Dinitrophenyl-sulfenyl chloride, 77 5 8 5
7	**1,3-Butadiene**	−4 41	−108 92	1 4292[2] 0 650 [t]	0 6255 [t]	*tetra-*		118 lgr			
8	*trans*-**2-Butene**	0 88	−105 55		0 6042[S]	*di-*	161 0		1 5110	1 7852	
9	**Cyclobutene**	2 4			0 733[0]						
10	*cis* **2-Butene**	3 72	−138 91		0 6306[t]	*di-*	161 0		1 5110	1 7852	
11	**1,2-Butadiene** (Methylallene)	10 85	−136 19	1 4208[5]	0 652[S]	*tetra-*	97 5	−2	1 6070	2 5085	
12	**3-Methyl-1-butene**	20 06	−168 49	1 3643	0 6272	*di-*	61 2[12]		1 50932	1 6776	
13	**1,4-Pentadiene**	25 97	−148 28	1 38876	0 66706	*tetra*		85 5 6 0, eth			
14	**1-Pentene**	29 97	−165 22	1 37148	0 64050	*di-*	68[12]		1 5012[12]	1 592[19]	Mercaptosuccinic acid adduct, 107 3 6
15	**2-Methyl-1-butene**	31 16	−137 56	1 3778	0 6504	*di-*	47 4 48[9]		1 5088	1 6711	Mercaptosuccinic acid adduct, 122 3- 6
16	**3-Methylcyclobutene**	32		1 4005							
17	**2-Methyl-1,3-butadiene** (Isoprene)	34 07	−145 95	1 42194	0 68095	*di-* *tetra-*	90-6[12] 155 60[12]				Maleic anh adduct, 63-4, lgr
18	*trans*-**2-Pentene**	36 35	−140 24	1 3793	0 6482	*di-*	91 0[50]		1 5096	1 6809	
19	*cis*-**2-Pentene**	36 94	−151 39	1 3830	0 6556	*di-*	92 4[50]		1 5096	1 6817	
20	**1-Methyl-1-cyclobutene**	37 1		1 4088	0 7244						
21	**2-Methyl-2-butene**	38 57	−133 77	1 3874	0 6623						Nitrosochloride, 74, Mercaptosuccinic acid adduct, 153 7-4 0
22	**3-Methyl-1,2-butadiene** (1 1 Dimethylallene)	40		1 410	0 680	*tetra-*	150 2[1]		1 594[17]	2 305[17]	
23	**Cyclopentadiene**	40 83 [2]	−85	1 4398[19 5]	0 7983[19]						Dimer 32, Maleic anh adduct, 164 5 Benzoquinone adduct, 75 6
24	**1,3-Pentadiene** (Piperylene)	41 1	−88 9	1 4309	0 6803	*tetra-*		114 5, al			Maleic anh adduct, 61, pet eth , Oxid by $KMnO_4$ → HCOOH + CH_3COOH
25	**3,3-Dimethyl-1-butene**	41 24	−115 2	1 3760	0 6529	*di-*	95 3 5 6[10]		1 5109	1 5615	
26	**1,** *trans*-**3-Pentadiene**	42 03	−87 47	1 43008	0 67603	*tetra-*	131[3]	115, al			
27	**1,***cis*-**3-Pentadiene**	44 07	−140 82	1 43634	0 69102	*tetra-*	131[3]	115, al			

*Derivative data given in order m p , crystal color, solvent from which crystallized

**T = triple point, S = at saturation pressure

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x Bromo-	B P °C	M P °C	n_D^{20}	D_4^{20}	
28	**Cyclopentene**	44 24	−135 08	1 42246	0 77199	*dl-*	71 5[12]		1 5510[11]	1 8713[11]	Mercaptosuccinic acid adduct 142 8 3 1 Pseudonitrosite 69 70 Perbenzoic acid oxid → epoxycyclopentane b p 102 3
29	**1,2-Pentadiene** (Ethylallene)	44 86	−137 26	1 42091	0 69257	*tetra-*	94 6[0 1]			2 3469[15]	
30	**2,3-Pentadiene** (1 3-Dimethylallene)	48 27	−125 26	1 42842	0 69502						
31	**4-Methyl-1-pentene**	53 88	−153 63	1 3828	0 6642	*dl*	87[21]		1 4980	1 5689	Mercaptosuccinic acid adduct 102 6 9
32	**3-Methyl-1-pentene**	54 14	−153 0	1 3842	0 6675	*dl*	99[30]		1 5060	1 6016	
33	**3-Methyl-1,4-pentadiene**	55		1 405	0 695						
34	**2,3-Dimethyl-1-butene**	55 67	−157 27	1 3904	0 6779	*dl-*	80[1]		1 5105	1 6033	
35	**2-Methyl-1,4-pentadiene**	56		1 405	0 694						
36	**4-Methyl-*cis*-2-pentene**	56 3	−134 43	1 3880	0 6690	*dl*	72 3[18]		1 5060	1 5983	
37	**4-Methyl-*trans*-2-pentene**	58 55	−140 81	1 3889	0 6686	*dl-*	78[22]		1 5070	1 5996	
38	**1,5-Hexadiene** (Biallyl)	59 46	−140 8	1 4042	0 6923	*tetra-*		52			Dil HNO_3 → succinic ac 185
39	**2-Methyl-1-pentene**	60 7	−135 72	1 3920	0 6817	*dl*	87 8[20]		1 5015	1 5581	
40	**1-Hexene**	63 49	−139 82	1 38788	0 67317	*dl-*	89 90[18]		1 5024	1 5774	2,4-Dinitrophenylsulfenyl chloride 61 2 Mercaptosuccinic acid adduct, 94 5 5 7
41	**2-Ethyl-1-butene**	64 6	−131 53	1 3969	0 6894	*dl-*	87[21]		1 5112	1 6045	
42	***trans*-1,3-Hexadiene**	64 5 5 5		1 4060[19]	0 6925[19]	*tetra-*		19			
43	**3-Methylcyclopentene**	65 0		1 4207	0 7622						
44	***cis*-3-Hexene**	66 44	−137 82	1 3947	0 6796	*dl*	80 1[13]		1 5045	1 6027	
45	**3-Hexene** (*cis-trans* mixture)	66 6-67		1 3942	0 6816	*dl-*	80 1[13]		1 5045	1 6027	
46	***trans*-3-Hexene**	67 08	−113 43	1 3943	0 6772	*dl-*	80 1[13]		1 5045	1 6027	
47	**2-Methyl-2-pentene**	67 29	−135 7	1 4004	0 6863	*dl-*	71-2[18]		1 5063	1 5849	Mercaptosuccinic acid adduct, 152 1 6
48	**3-Methyl-*trans*-2-pentene**	67 63	−134 84	1 4016	0 6942	*dl-*	72 4[15]		1 5085		
49	***trans*-2-Hexene**	67 87	−132 97	1 3935	0 6784	*dl-*	90[16]		1 5025	1 5812	
50	**2-Hexene** (*cis-trans* mixture)	67 9 8 1		1 3928	0 6813	*dl-*	90[16]		1 5025	1 5812	
51	**2,3-Hexadiene**	68		1 395	0 680						
52	**2,3-Dimethyl-1,3-butadiene**	68 78	−76 01	1 4394	0 7267	*dl-* *tetra-*		47, lgr 138, bz			Maleic anh adduct, 78-9
53	***cis*-2-Hexene**	68 84	−141 14	1 3977	0 6869	*dl-*	90[16]		1 5025	1 5812	
54	**4-Methyl-1,2-pentadiene** (1-Isopropylallene)	70		1 424	0 708						
55	**3-Methyl-*cis*-2-pentene**	70 45	−138 45	1 4045	0 6986	*dl-*	72-4[15]		1 5085		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P , °C	M P , °C	n_D^{20}	D_4^{20}	
56	**2-Methyl-2,3-pentadiene** (Trimethyl allene)	72		1 425	0 711						
57	**1,4-Hexadiene**	72 3 2 5		1 4402[19]	0 7057[19]	*tetra-* 2 forms		a) 63 4 b) f p <-50			
58	**4,4-Dimethyl-1-pentene**	72 49	-136 6	1 3918	0 6827	*di*	77-8[9]		1 4970	1 5129	Mercaptosuccinic acid adduct, 119 0 5
59	**1, (*cis* and/or *trans*)-3-hexadiene**	73		1 438	0 705						
60	**2,3-Dimethyl-2-butene**	73 21	-74 28	1 4122	0 7080	*di*		173 4 121			
61	**2-Ethyl-1,3-butadiene**	75		1 445	0 717						
62	**4-Methylcyclopentene**	75 2		1 4306	0 7796						
63	**1-Methylcyclopentene**	75 8	-127	1 4330	0 7802						
64	**2-Methyl-1,(*cis* and/or *trans*)-3-pentadiene**	76		1 446	0 719						
65	**1,2-Hexadiene** (*n*-Propylallene)	76		1 4282	0 7149	*tetra-*	130[3]		1 5850	2 1873	
66	**2-Methyl-1,(*cis* and/or *trans*)-3-pentadiene**	76		1 446	0 719						
67	**4-Methyl-1,3-pentadiene**	76 3		1 451	0 719						
68	**4,4-Dimethyl-*trans*-2-pentene**	76 75	-115 24	1 3982	0 6889	*di-*	92 8-93[14]		1 5080	1 5538	
69	**3,3-Dimethyl-1-pentene**	77 54	-134 3	1 3984	0 6974	*di-*	95 3 6[10]		1 5109	1 5615	
70	**2,3,3-Trimethyl-1-butene**	77 87	-109 85	1 4029	0 7050	*di-*	98-9[14]	38-9			
71	**3-Methyl-1,3-pentadiene**	78 0 3		1 4494	0 7499						
72	***trans*-1,3,5-Hexatriene**	78 5, 77 8 5		1 4884[13 5]	0 74229[15/15]	*hexa-*		78			
73	***cis*-1,3,5-Hexatriene**	78 5		1 4577	0 7179						
74	**3-Methyl-1,2-pentadiene**	79 70		1 425	0 715						
75	**2,4-Hexadiene**	79 4 81 6[765]	-79	1 4493	0 7152	2,5-*di-* *tetra-*	85[11]	182	1 534[19]	1 622[19]	Maleic anh adduct, 95 6, lgr , SO_2 adduct, 43-3 5
76	**3-Methyl-1,5-hexadiene**	80-1		1 4116	0 7103						
77	**4,4-Dimethyl-1,2-pentadiene** (*tert*-Butylallene)	80-3			0 7184						
78	**1,3-Cyclohexadiene**	80 31[757]	-104 8	1 4740	0 8413	*di-* *tetra-* 2 forms		68, isomerizes → m 108 1, *trans*-2,*cis*-3, *trans*-4, 92, 1,*cis*-2, *trans*-3, *trans*-4, 156			Maleic anh adduct, 145-6, heptane, Benzoquinone adduct, 196 7, lgr
79	**4,4-Dimethyl-*cis*-2-pentene**	80 42	-135 46	1 4024	0 6996	*di-*	92 8 3 0[14]		1 5080	1 5538	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P °C	M P °C	n_D^{20}	D_4^{20}	
80	**3,4-Dimethyl-1-pentene**	81		1 3995	0 701						
81	**Cyclohexene**	82 97	−103 51	1 44654	0 81096	*dl*-	101 3[13]		1 5445[19]	1 7759[19]	Mercaptosuccinic acid adduct, 150 5 1 5, $KMnO_4$ oxid → adipic ac , 154, 2,4-Dinitrophenylsulfenyl chloride, 117 8 HBr → cyclohexyl bromide, b p 165
82	**2,4-Dimethyl-2-pentene**	83-4	−127 7	1 40165[22]	0 6958[22]	*dl*-	88[17]		1 50920[22 5]	1 5431[22 5]	
83	**3-Methyl-1-hexene**	84 0		1 397	0 695	*dl*-	84 0- 2[6]		1 5028	1 5248	
84	**2,3-Dimethyl-1-pentene**	84 26	−134 8	1 4033	0 7051	*dl*-	72 5- 3 0[3]		1 5028	1 5245	
85	**3-Ethyl-1-pentene**	85 13	−127 4	1 3980	0 6962	*dl*-	93 5[15]		1 5006	1 5251	
86	**5-Methyl-1-hexene**	85 31		1 3966	0 6920	*dl*-	142 6 3 6[101]		1 4970	1 5072	
87	**5-Methyl-*trans*-2-hexene**	86 0		1 400	0 700	*dl*-	87 8[10]		1 4960	1 5027	
88	**2-Methyl-3-hexene**	86 0		1 399	0 694	*dl*-	96[19]		1 5060	1 5310	
89	**2,4-Dimethyl-2,3-pentadiene** (Tetramethylallene)	86 5		1 40039	0 7006						
90	**4-Methyl-1-hexene**	86 73	−141 45	1 4000	0 6985	*dl*-	94 7- 5 7[11]		1 4980	1 5027	
91	**3,4-Dimethyl-2-pentene**	87 0		1 407	0 713	*dl*-	65 5 6 0		1 5104	1 5400	
92	**4-Methyl-*cis*-2-hexene**	87 37		1 4024	0 6996	*dl*-	91 2[11]		1 5045	1 5382	
93	**4-Methyl-*trans*-2-hexene**	87 6	−126 5	1 4023	0 6975	*dl*-	91 2[11]		1 5045	1 5382	
94	**3,3-Dimethylcyclopentene**	88		1 423	0 771						
95	**2-Ethyl-3-methyl-1-butene**	89		1 410	0 715	*dl*-	72 5 3 5[3]		1 5062	1 5261	
96	**5-Methyl-*cis*-2-hexene**	91		1 400	0 700	*dl*-	89 90[11]		1 4990	1 5152	
97	**5-Methyl-1,4-hexadiene**	91-2 5		1 4390	0 7258	1,2-*dl*-	101 4[18]		1 5233[16]	1 566[16]	
98	**2-Methyl-1-hexene**	92 0	−102 84	1 4034	0 7030	*dl*-	100 5 1 5[23]		1 5000	1 5066	
99	**1,3-Dimethylcyclopentene**	92		1 428	0 766						
100	**2-Methyl-1,5-hexadiene**	92 5[769]		1 423/6[17 3]	0 7289[18 5]						Nitrosochloride, 75 6
101	**2,4-Dimethyl-1,3-pentadiene**	93	−114	1 4412	0 7368						
102	**1,4-Dimethylcyclopentene**	93 2		1 4283	0 779						
103	**3-Methyl-*trans*-3-hexene**	93 5		1 4107	0 7099						
104	**1-Heptene**	93 64	−119 03	1 39980	0 69698	*dl*-	106 2[13]		1 4990	1 5208	Mercaptosuccinic acid adduct 103 4- 9

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x Bromo	B P , °C	M P , °C	n_D^{20}	D_4^{20}	
105	3-Methyl-*trans*-2-hexene	94 0		1 410	0 7120	*di*-	65 0 5 1[2]		1 5040	1 5240	
106	2-Ethyl-1-pentene	94		1 405	0 708	*di*-	77 8[3]		1 4990	1 4929	
107	3-Methyl-*cis*-3-hexene	95 35		1 4123	0 7132						
108	2-Methyl-2-hexene	95 41	−130 35	1 4106	0 7082	*di*-	73 0 1[8]		1 4990	1 5116	
109	*trans*-3-Heptene	95 67	−136 63	1 4043	0 6981	*di*-	105 5 6 5[23]		1 5010	1 5153	
110	*cis*-3-Heptene	95 75		1 4059	0 7030	*di*-	105 5- 6 5[23]		1 5010	1 5153	
111	5-Methyl-1,2-hexadiene (Isobutylallene)	96		1 4282[19]	0 7225[19]						
112	3-Ethyl-2-pentene	96 01		1 4148	0 7204	*di*-	76 0- 4[3]		1 5090	1 5426	
113	2,3-Dimethyl-2-pentene	97 5	−118 3	1 4208	0 7277	*di*-	97 9[15]		1 517[22]	1 547[22]	
114	*trans*-2-Heptene	97 95	−109 48	1 4045	0 7012	*di*-	96 2[12]		1 5000	1 5129	
115	3-Ethylcyclopentene	98 1		1 4319	0 7830						
116	*cis*-2-Heptene	98 5		1 406	0 708	*di*-	96 2[12]		1 5000	1 5129	
117	5-Methyl-1,3-cyclohexadiene	100 5 1 5[762]		1 4662[22 5]	0 8252						
118	2,2-Dimethyl-*trans*-3-hexene	100 9		1 4063	0 7039	*di*-	96 5- 7 0[8]		1 5032	1 4856	
119	1,4-Heptadiene	101		1 4202	0 7106	*di*-			1 5734	2 091	
120	2,4,4-Trimethyl-1-pentene	101 44	−93 48	1 4086	0 7150						
121	3,3-Dimethyl-1,5-hexadiene	101 6		1 4160	0 7249						
122	3,4-Dimethyl-1,5-hexadiene	101 8		1 4211	0 7304						
123	2,5-Dimethyl-3-hexene	102		1 406	0 710	*di*-	109[19]		1 5058	1 5034	
124	5,5-Dimethyl-1-hexene	102 5		1 4049	0 709						
125	4-Methylcyclohexene	102 74	−115 5	1 4414	0 7947	*di*-	130[40]			1 650[15 15]	
126	3-Methylcyclohexene	104 0		1 4444	0 8010						
127	2-Isopropyl-3-methyl-1-butene	104		1 4085	0 722						
128	3,4,4-Trimethyl-1-pentene	104		1 412	0 719						
129	3,5-Dimethyl-1-hexene	104		1 404	0 708						
130	3,3-Dimethyl-1-hexene	104		1 4070	0 7140						
31	5,5-Dimethyl-*trans*-2-hexene	104 1		1 4055	0 7066						
32	2,4,4-Trimethyl-2-pentene	104 91	−106 33	1 4160	0 7218						
33	3,3,4-Trimethyl-1-pentene	105		1 4144	0 729						
34	2,2-Dimethyl-*cis*-3-hexene	105 4	−137 4	1 4099	0 7128						
35	1,2-Heptadiene (*n*-Butylallene)	105 5 6 0		1 432[18]	0 7306[18]	2,3-*di*-	108- 10[12],		1 5200[18]	1 5595[18]	
						tetra-	140[3]		1 5718	2 0675	
36	1,2-Dimethylcyclopentene	105 8	−90 4	1 4448	0 7976						
37	4-Ethylcyclopentene	106		1 440	0 798						
38	4,4-Dimethyl-2-hexene	106		1 413	0 722	*di*-	92 3[4]		1 5113	1 5148	
39	1-Ethylcyclopentene	106 3	−118 4	1 4410	0 7982						
40	5,5-Dimethyl-*cis*-2-hexene	106 9		1 4113	0 7169						

)erivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P °C	M P °C	n_D^{20}	D_4^{20}	
141	**2-Methyl-2,4-hexadiene**	107		1 4266[24]	0 7439						
142	**2-Methyl-1,3-cyclohexadiene**	107 8		1 4662[18]	0 8272[18/18]						
143	**3-Methyl-2,4-hexadiene**	107 8		1 46146[15]	0 7625[15]						
144	**4,4-Dimethyl-1-hexene**	107 2		1 4102	0 7198	*dl-*	224 5		1 5003	1 4689	
145	**3-Ethyl-4-methyl-1-pentene**	107 5		1 4097	0 7200						
146	**2,4-Heptadiene**	107 5 8 0		1 4578	0 7384						
147	**2,4-Dimethyl-*trans*-3-hexene**	107 6		1 4126	0 7145						
148	**Quadricyclene** (Quadricyclo [2,2,1,$0^{2,6}$, $0^{3,5}$] heptane)	108[740] sl d		1 4804							
149	**2,3,4-Trimethyl-1-pentene**	108		1 415	0 729						
150	**4-Methyl-1,3-hexadiene**	108 10		1 4523	0 7558						
151	**2,3,3-Trimethyl-1-pentene**	108 3	−69	1 4174	0 7352						
152	**4,5-Dimethyl-1-hexene**	109		1 414	0 728						
153	**1,5,5-Trimethylcyclopentene** (Isolaurolene)	109[754]		1 4324	0 7824						Reduces Tollen's reagent on warming
154	**2,4-Dimethyl-*cis*-3-hexene**	109		1 4140	0 7178						
155	**3,3-Dimethyl-2-ethyl-1-butene**	110		1 4159	0 728						
156	**3-Ethyl-2-methyl-1-pentene**	110		1 415	0 730						
157	**4,5-Dimethyl-2-hexene**	110		1 413	0 725						
158	**1-Methylcyclohexene**	110 0	−121	1 4503	0 8102	*dl-*	100 2[12]				2,4-Dinitrophenylsulfenyl chloride, 139 40
159	**2-Ethyl-4-methyl-1-pentene**	110 3		1 4105	0 7195						
160	**3-Ethyl-1-hexene**	110 3		1 407	0 715						
161	**2,3-Dimethyl-1-hexene**	110 5		1 4113	0 7214						
162	**2,4-Dimethyl-2-hexene**	110 6		1 4118	0 7213						
163	**3-Methyl-1-heptene**	111		1 406	0 711						
164	**2,4-Dimethyl-1-hexene**	111 2		1 4110	0 720						
165	**2,5-Dimethyl-1-hexene**	111 6		1 4105	0 7172						
166	**3-Ethyl-3-methyl-1-pentene**	112		1 418	0 7305						
167	**3,4-Dimethyl-1-hexene**	112		1 413	0 724						
168	**3,4,4-Trimethyl-2-pentene**	112		1 4232	0 7395						
169	**3,5-Dimethyl-2-hexene**	112		1 416	0 725						
170	**2-Methyl-3-heptene**	112		1 402	0 706						
171	**5-Methyl-3-heptene**	112		1 410	0 713						
172	**2,5-Dimethyl-2-hexene**	112 2		1 4140	0 720	*dl-*	88[13]		1 4740	1 3980	
173	**3-Methyl-1,5-heptadiene**	112 5		1 4230[22 5]							
174	**2-Ethyl-3-methyl-1-pentene**	112 5		1 4142	0 729						

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TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P , °C	M P °C	n_D^{20}	D_4^{20}	
175	**4-Methyl-1-heptene**	112 8		1 410	0 717						
176	**6-Methyl-3-heptene**	113^{734}		1 4114	0 7256	*di-*		97			
177	**4-Ethyl-1-hexene**	113		1 412	0 726						
178	**4-Ethyl-2-hexene**	113		1 412	0 725						
179	**2-Isopropyl-1-pentene**	113		1 414	0 725						
180	**5-Methyl-1-heptene**	113 3		1 4094	0 7164						
181	**4-Methyl-2-heptene**	113 5 4 1		1 4096	0 7154						
182	**2,3-Dimethyl-3-hexene**	114		1 416	0 728						
183	**4-Methyl-2-octene**	114		$1\ 4100^{25}$	$0\ 7188^{25}$						
184	**2,4-Dimethyl-2,4-hexadiene**	114–5		$1\ 45457^{16\ 5}$	$0\ 7635^{16\ 5}$						
185	**6-Methyl-2,4-heptadiene**	114 6		$1\ 4397^{25}$	$0\ 7041^{25}$						
186	**3-Ethyl-4-methyl-*trans*-2-pentene**	114 3		1 4210	0 7350						
187	**Cycloheptene** (Suberene)	114 38	–56	1 4580	0 8254	*di-*	unstable				Nitrosochloride, 118 Oxid → pimelic ac , 105
188	**1-Methyl-1,4-cyclohexadiene**	114 5–4 8	< –70	1 4703	0 848	*tetra-*		171			
189	**3-Ethyl-4-methyl-*cis*-2-pentene**	115		1 424	0 739						
191	**1,3,5-Cycloheptatriene** (Tropilidene)	115 5	–79 49	1 5243							Maleic anh adduct, 104 2–5 0, CCl_4
192	**3,4-Dimethyl-2-hexene**	116		1 418	0 737						
193	**3-Ethyl-3-hexene**	116		1 418	0 729						
194	**6-Methyl-1,3-heptadiene**	116 8			$0\ 741^{22}$						
195	**2,5-Dimethyl-1,3-hexadiene**	116 8	> –80	1 45024	0 7412						
196	**2,3,4-Trimethyl-2-pentene**	116 3	–113 3	1 4275	0 7434						
197	**4,4-Dimethylcyclohexene**	116 98	–80 5	1 4420	0 7996						
198	**6-Methyl-2-heptene**	117		1 412	0 718						
199	**2-*n*-Propyl-1-pentene**	117 7		1 4136	0 7240						
200	**5-Methyl-2-heptene**	118		1 414	0 723						
201	**3,3-Dimethylcyclohexene**	119		1 445	0 804						
202	**2-Methyl-1-heptene**	119 22	–87 38	1 41195	0 72025						
203	**2,5-Dimethyl-1,5-hexadiene**	119 23	solid at –80, liq at –23	1 45054	0 7637						
204	**2-Ethyl-1-hexene**	120		1 4157	0 7270						Mercaptosuccinic acid adduct, 101 9–2 7
205	***d l*-1,2,3-Trimethylcyclopentene** (Laurolene)	$120\ 1^{752}$		1 4421	0 7950						
206	**4-Methyl-3-heptene**	120 4		$1\ 41712^{25}$	$0\ 7411^{25}$						
207	**3-Ethyl-2-hexene**	121		1 424	0 737						
208	**3-Methyl-3-heptene**	121		1 418	0 728						
209	**1-Octene**	121 28	–101 76	1 40870	0 71492	*di-*	240 2, $118\ 5^{15}$		1 4970	1 4580	Mercaptosuccinic acid adduct, 96 1–6

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x Bromo	B P C	M P C	n_D^{20}	D_4^{20}	
210	*trans*-4-Octene	121 4[739]	f p −94	1 41157	0 71467	*dl* (*meso*)	103[8]		1 4967[24]	1 4525	
211	1,3-Cycloheptadiene (Hydrotropilidene)	121 52	−110 42		0 8929[0]						H_2 → Cyclo heptane b p 118 20
212	3-Methyl-2-heptene	121 6		1 4183	0 7296						
213	*cis*-4-Octene	121 7[739]	f p −118	1 41361	0 72048	*dl* (*d l*)	84 0 8 4[4 3]		1 4981	1 4569	
214	2,3-Dimethyl-2-hexene	121 8	−115 1	1 4268	0 7408						
215	3,4-Dimethyl-*trans*-3-hexene	122		1 430	0 747	*dl*	85 7[5]		1 5060	1 387	
216	6-Methyl-1-heptene	122 4 113 5		1 4070	0 7125						
217	*cis*-3-Octene	122 3[741]	f p −126	1 41246	0 71888						
218	*trans*-3-Octene	122 4[741]	f p −110 4	1 41241	0 71630						
219	2-Methyl-2-heptene	123 5		1 4138	0 7241						
220	*trans*-2-Octene	125 0	−87 7	1 4132	0 7199						Mercaptosuccinic acid adduct 142 9 3 5
221	*cis*-2-Octene	125 64	−100 2	1 4150	0 7243						
222	2-Methyl-1,3-heptadiene	127 8 [4]		1 4432	0 7432						
223	1,4-Dimethylcyclohexene	128		1 446	0 802						Nitrosochloride 83 4
224	1,5-Dimethylcyclohexene	128		1 448	0 8051						Nitrosochloride 118 9
225	2,6-Dimethyl 2-heptene	128 9		1 412	0 722						
226	4-Vinylcyclohexene	129 5 30 5 36[23]		1 4623	0 8320	α β *dl*		69 5 70 eth			
227	4-Methyl-2,4-heptadiene	131 2		1 4621	0 7551						
228	3,4-Dimethyl-2,4-hexadiene	132 4 71 3		1 4410	0 7832						
229	3-Methyl-2,4-heptadiene	132 5		1 4649	0 7667						HBr → Dihydro bromide b p 109 11 [6]
230	Bicyclo[4,2,0]oct-7-ene	132 5		1 4761		*dl*	74[0]				
231	4-Ethylcyclohexene	133		1 449	0 810						
232	1,6-Dimethylcyclohexene	133		1 454	0 815						
233	3,5-Dimethyl-2,4-heptadiene	133 44 [4]		1 4487	0 7728						
234	2,4-Octadiene	133 5 4 0		1 4542[2]	0 7427[2]						
235	2,5-Dimethyl-2,4-hexadiene	133 6 28[1]	14 6 8	1 4796[1,3]	0 7646 [K]	*tetra*		101			Oxid in air → polymeric peroxide 59
236	3-Ethylcyclohexene	134		1 451	0 814						
237	1,2,3,3-Tetramethylcyclopentene (Campholene)	134 5		1 44406	0 8035						
238	1-Ethylcyclohexene	136		1 4575	0 823						
239	1,2-Dimethylcyclohexene	137		1 4588	0 8250	*dl*		142 3 acet			Nitrosochloride 58 60
240	1,3-Dimethylcyclohexene	137		1 445	0 802						
241	Bicyclo[4,2,0]oct-2-ene	137 9		1 4810[30]	0 8948						

*Derivative data given in order m p crystal color solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x Bromo	B P °C	M P °C	n_D^{20}	D_4^{20}	
243	**1-Methylcycloheptene**	137 5 8 5		1 4581	0 8243[22]						Nitrosochloride, 106, Nitrosate, 97 8
244	**2-Methyl-4-octene**	138[713]		1 4181	0 7392						
245	**δ-Fenchene** (1,5 5-Trimethylbicyclo[2,2,1] hept-2-ene)	139 40		1 44862	0 8433						Nitrosochloride, 131
246	**1,5,5-Trimethylcyclohexene** (α-Cyclogeraniolene)	139-41 [31]		1 44612[21]	0 7981[21]						Nitrosochloride, 100 20, aq me , al Nitrosate, 102 4
247	**2,6-Dimethyl-2,4-heptadiene**	139 43[7 2]		1 4587[44]	0 74820						
248	**1,4,4-Trimethylcyclohexene** (Pulenene)	139 5-40 5		1 444[25 2]	0 8032[18 5]	*di-*	120 0 5[10]		1 5247[11]	1 5324[11]	Nitrosochloride, 118 22, et ac
249	**1,5,6-Trimethylcyclohexene**	140		1 4572	0 831[25]						
250	**2,3-Dimethyl-2-norbornene** (Santene 2,3-Dimethylbicyclo [2,2,1]-hept-2-ene)	140-1, 35[1]		1 46699	0 8640						Dichloride 88 9, Nitrosate, 216d , Nitrosochloride, 109 10 Nitrosite, 3 forms a) 122 4, bl b) 127-8, grn , c) 104, col
251	**2,6-Dimethyl-1,3-heptadiene** (Isogeraniolene)	140-2, 31		1 4606[22]	0 7923[22]						
252	**Cyclooctatetraene**	140 56 142 3, 42 2 5[1]	−4 68, −7	1 5290	0 9206						Maleic anh adduct, 167 8 Benzoquinone adduct, 141, al Acrylic ac adduct 112 3, lgr $AgNO_3$ adduct, 173 4
253	**7-Methyl-3-octene**	141[746]		1 4168	0 7278						
254	**2,6-Dimethyl-1,5-heptadiene** (Geraniolene)	141-2, 165 70	−70	1 44361[22]	0 7626[22]						
255	**1,8-Nonadiene** *	141-4		1 4302	0 7511						
256	**1,3,5-Trimethylcyclohexene** (Tetrahydromesitylene)	142 5-3 5		1 449[13 5]	0 8025[14 3]						Nitrosochloride, 134
257	**3-Methyl-2-octene**	143-5[734]		1 4247	0 7409[25]						
258	**Cyclooctene**	143 8-4 5[773]		1 4693							Br_2 → Bromocyclooctene, b p 7-8[23], n_D^{20} 1 5182, Dichloride, b p 130 4-0 6[25], m p −5, n_D^{20} 1 5061, D_4^{20} 1 1620
259	**3,6-Dimethyl-2,4-heptadiene**	144-6		1 46335[14]	0 7853[0]						
260	**4-Nonene**	144-6, 44 6[12]		1 4212[18]	0 732[18]	*di-*	119 20[12]		1 4988[17]	1 410[17]	
261	**1,4,5-Trimethylcyclohexene**	144-6		1 4482	0 805						

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TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P , °C	M P , °C	n_D^{20}	D_4^{20}	
262	**1-Vinylcyclohexene**	145, 63 5[53]		1 4950[19]							50% H_2SO_4 → dimer, b p 118-9[5]
263	*cis*-**1,4-Cyclooctadiene**	145 1[758]	−53		0 8754	*tetra-*		139			
264	**1,3,5-Cyclooctatriene**	145 6, 76[90]		1 5035[25]	0 8971[25]						Maleic anh adduct, 144-5, $AgNO_3$ adduct, 125-6, al
265	**4,4-Dimethyl-1,7-octadiene**	145 8		1 4330	0 7647						
266	**ξ-Fenchene** (2,7,7-Trimethylbicyclo[2,2,1] hept-2-ene)	146 2 6 8[752]		1 4865	0 8626						$[\alpha]_D^{20}$ −24 1
267	**1,6,6-Trimethylcyclohexene**	146 2-7 2[767], 144 6		1 456[20 4]	0 8217[20 3]						Nitrosochloride, 133 4, et ac
268	**1-Nonene**	146 87	−81 37	1 41572		*di-*	141 5[20]		1 4942	1 3980	
269	**3-Nonene**	147 4[750]		1 4173	0 7294						
270	**1,5-Cyclooctadiene**	148 9		1 4905	0 8818[24]						N-Bromosuccinimide → bromocyclooctadiene, b p 64[1 9], n_D^{25} 1 5410, D_4^{25} 1 3420
271	**4-Methyl-3,5-octadiene**	148 51		1 46285[25]	0 7640[25]						
272	**7-Methyl-2,4-octadiene**	149		1 4543[18]	0 7521[18]	*tetra-*	184[18]				
273	**1-Ethyl-4-methylcyclohexene**	149, 153 4		1 453[16]	0 8169[16]						Nitrosochloride, 2 forms a) 103-4, pr , eth , b) 98 9, cr , eth
274	**1-Ethyl-3-methylcyclohexene**	149 51		1 454	0 8296						
275	**2-Nonene**	149 4 9 9		1 420[21]	0 738[21]						
276	**1,2,3-Trimethylcyclohexene**	149 6 150[749]		1 463[12]	0 8347[12]						
277	**1-Ethyl-5-methylcyclohexene**	150		1 4527[25]	0 812[25]						
278	**β-Fenchene** (2,2 Dimethyl-5-methylenebicyclo[2,2,1] heptane)	150 5 3 5		1 46511	0 8599	*di-*		81-2			$[\alpha]_D^{25}$ +62 5, Nitrosochloride, 120
279	**2,6-Dimethyl-2,5-heptadiene**	150 6 1 0		1 4490							
280	**2,7-Nonadiene**	150 6	−72 5	1 4358	0 7499						
281	**Allylcyclohexane** (3-Cyclohexylpropene)	151		1 4536[13]	0 8196[13]	*di-*	143 4[16]			1 537[0]	
282	**1-Ethylidene-4-methylcyclohexane**	152-3		1 4571[21]	0 81[21]						Nitrosochloride, 2 forms a) 117-8, least soluble, b) 113-4, more soluble
283	**4,5-Dimethyl-2,6-octadiene**	152 9-3 8		1 4375[25]	0 7611[25]						
284	**1-Ethylidene-3-methylcyclohexane**	153		1 458[4]	0 8135[19/19]						Nitrosochloride, 114, acet
285	**3,6-Dimethyl-2,6-octadiene**	153-5		1 44453	0 7767						
286	**2,6-Dimethyl-2,7-octadiene**	155 6[720]		1 4385[18]	0 7605[18]						

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TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x Bromo	B P , °C	M P , °C	n_D^{20}	D_4^{20}	
287	**α-Pinene**	156 0-6 3	-50	1 4560	0 8600	*di-*		169 70, al			Nitrosochloride, 109, Hydrobromide, 89, Nitrosobromide, 91 2d , Acid $KMnO_4$ → pinonic ac , 103-5
288	**1-Ethylidene-2-methylcyclohexane**	158		1 47	0 823[0]						
289	**2,4-Dimethyl-2,4-octadiene**	161 3[746]		1 4558[9 8]	0 7802[9 8]						
290	**1,4,4-Trimethylcycloheptene** (Eucarvene)	161-5[720]		1 4561	0 8185						
291	**β-Pinene** (Nopinene, Pseudopinene)	163-4		1 4782	0 8694						$[\alpha]_D$ -22
292	**2,7-Dimethyl-2,6-octadiene**	163 5 4 5		1 44814	0 7849	*tetra-*		124-7			
293	**3,7-Dimethyl-2,4-octadiene**	164-7, 58[12]		1 456	0 7933						
294	***l*-4-Carene** (3,7,7-Trimethylbicyclo[2,2,1]hept-2-ene)	165 5 7 0[707]		1 474[30]	0 8552[30 30]						$[\alpha]_D^{30}$ +62 2
295	**Myrcene** (2-Methyl-6-methylene-2,7-octadiene)	166		1 4722	0 7982						Maleic anh adduct, 33-4, 1,4-Naphthoquinone adduct, 81
296	**2,6-Dimethyl-2,6-octadiene**	168, 56[14]		1 45245[15]	0 775[21]						Methiodide, 130d
297	***l*-3-Carene** (3,7,7-Trimethylbicyclo[2,2,1]-hept-3-ene)	168 9[705], 123 4[200]		1 469[30]	0 8586[30 30]						$[\alpha]_D^{30}$ +7 69, Nitrosochloride, 100-1
298	**3,8-*o*-Menthadiene** (*cis*-3-Isopropenyl-4-methylcyclohexene)	169-70		1 4749	0 8507						
299	**5-Decene**	170[750]	-112 to -111	1 4260	0 7474	*di-*	119[9]		1 4912	1 3484	
300	***p*-8-Menthene** (1-Isopropenyl-4-methylcyclohexane)	170		1 4523	0 8142						
301	***d-m*-8-Menthene** (1-Isopropenyl-3-methylcyclohexane)	170		1 4546	0 8179						$[\alpha]_D$ +9 73
302	***l-m*-8-Menthene** (1-Isopropenyl-3-methylcyclohexane)	170-1		1 4574	0 8189						$[\alpha]_D$ -8 06
303	**6,8-*o*-Menthadiene** (3-Isopropenyl-2-methylcyclohexene)	170 1		1 4758	0 8481						
304	**5,8-*o*-Menthadiene** (4-Isopropenyl-3-methylcyclohexene)	170-1		1 4778	0 8490[17 17]						
305	**1-Decene**	170 57	-66 31	1 42146	0 74081	*di-*	145 160[18]		1 4891[24]	1 324[28]	Mercaptosuccinic acid adduct, 93 5- 8
306	**4-Decene**	170 6		1 4243	0 7404						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo-	B P , °C	M P , °C	n_D^{20}	D_4^{20}	
307	***p*-Menthene** (1-Isopropylidene-4-methylcyclohexane)	172-4		1 4568	0 819[21]						Nitrosochloride, 101-3
308	**1-Isopropenyl-1,4-cyclohexadiene**	172-6		1 5216	0 9068	*tetra-*		113			
309	***o*-Menthene** (1-Isopropylidene-2-methylcyclohexane)	173, 160-2		1 467	0 8345						
310	***m*-Menthene** (1-Isopropylidene-3-methylcyclohexane)	173-5		1 4670	0 8214						
311	**α-Terpinene** (1-Isopropyl-4-methyl-1,3-cyclohexadiene)	173 5 4 8[755]		1 477	0 8375						Dihydrochloride, 53-4, me al , Dihydrobromide, 58 9, me al , Dihydroiodide, 76, me al , Nitrosite, 155, Maleic anh adduct, 62, 66-7
312	**2,4-*p*-Menthadiene**(2-Isopropyl-5-methyl-1,3-cyclohexadiene)	174 6		1 4845[27]	0 8441[27/27]						
313	***l*-5-Isopropyl-2-methyl-1,3-cyclohexadiene**	174-7		1 4732	0 8425						$[\alpha]_D^{20}$ −112 76, Nitrosite, α 120-1, β 105 6
314	**1,5-*p*-Menthadiene** (5-Isopropyl-2-methyl-1,3-cyclohexadiene)	175 6		1 4777	0 8463[25]						$[\alpha]_D$ +49 1, Nitrosite, α 113-4, β 105 Maleic anh adduct, 126-7, pet eth
315	***d*-Silvestrene**	175 8		1 4760	0 8479	*tetra-*		135			Dihydrochloride, 72, Nitrosochloride, 106-7
316	***d*-Limonene**	176 6 4		1 4743	0 8411	*tetra-*		104			Nitrosochloride, 100-4, 2,4-Dinitrophenylsulfenyl chloride, 195-6
317	**Isocarvestrene** (5-Isopropenyl-1-methylcyclohexene)	176 7[765]		1 4804	0 8496	*tetra-*		137-8, me al -chl			Dihydrochloride, 71 5, me al
318	***l*-3-Isopropenyl-1-methylcyclohexene**	176-8	.....	1 4761[18]	0 848[19]						$[\alpha]_D^{18}$ −68 2, Dihydrochloride, 72
319	**Dipentene** (*d l*-Limonene)	177 6-8 0		1 4727[20]	0 8402[20]	*tetra-*		125, eth			Dihydrochloride, 50-1, al
320	**3,8-*m*-Menthadiene** (1-Isopropenyl-5-methylcyclohexene)	179[730]		1 4972							$[\alpha]_D$ +17 5
321	**Menogerene** (5-Isopropylidene-2-methyl-1,3-cyclohexadiene)	180 1[769]		1 5005	0 8672	*di-*		115			
322	**γ-Terpinene** (1-Isopropyl-4-methyl-1,4-cyclohexadiene)	183		1 4765[14 5]	0 849	*tetra-*		129-30, pet eth			$[\alpha]_D^{25}$ +36, Nitrosochloride, 111, Nitrosate, 116d , ac a -me al
323	***d l*-2,8-*m*-Menthadiene** (1-Isopropenyl-3-methylcyclohexene)	184 7		1 503	0 864[20/20]						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x-Bromo	B P °C	M P °C	n_D^{20}	D_4^{20}	
324	**Menogene** (3-Iso-propylidene-6-methyl cyclohexene	184 $6^{764.5}$		1 5026	0 8624						Nitrosite, 155, me al or chl , Maleic anh adduct, 205 8
325	**Terpinolene** (4-Iso-propylidene-1 methylcyclohexene)	186		1 4883	$0\ 8633^{15}_{15}$	*di-tetra-* 2 forms		69 70 a) 119, ac a , b) 122			Maleic anh adduct, 182
326	**2-Undecene** (2-Hendecene)	192 3, 78 5^{14}		1 43325	$0\ 7735^{15}_{15}$	*di-*	145 6^{9}				
327	**5-Undecene** (5-Hendecene)	192 2		1 4289	0 7511						
328	**1-Undecene** (1-Undecene)	192 67	−49 19	1 42609	0 75032	*di-*	186^{23}		1 4916	1 3122	
329	*cis*-**Cyclodecene**	194 5^{740}		1 4854	0 8770	*di-*		121			O_3 → Sebacic acid, 134 5
330	**1-Dodecene**	213 36 88 7^{10}	−35 23	1 43002	0 75836	*di-*		−15			
331	**1-Tridecene**	232 78 104 5^{10}	−23 07	1 4336	0 7653						
332	**1-Tetradecene**	251 1, 119 0^{10}	−12 85	1 43631	0 7713	*di-*		0			Mercaptosuccinic acid adduct, 104 0 8
333	**Cedrene**	262–3, 124 6^{12}		1 5001^{19}	$0\ 9359^{15}_{15}$						
334	**1-Pentadecene**	268 17, 133 7^{10}	−3 73	1 4389	0 77641	*di-*	204–5^{17}		1 4897	1 2235	
335	**1-Hexadecene**	284 4 103 9^{1}	4 12	1 44120	0 78112	*di-*	225 7^{15}	13 5, al			1% Hot $KMnO_4$ → *n* pentadecylic ac , 52 3, Mercapto-succinic acid adduct, 105 0 8
336	**1-Heptadecene**	299 7, 116^{1}	11 2	1 4432	0 7852						
337	**2-Methyl-2-hepta-decene**	314, 277^{100}	−2 5		0 7953	*di-*	267–8^{28}				
338	**1-Octadecene**	314 2, 128^{1}	17 6	1 4449	0 7888	*di-*		24, al			

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

a) Liquids 2) (B.p. at reduced pressure only. Listed alphabetically)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Miscellaneous
1	**Bicyclo[12,2,2]octadeca-14,16,18-triene**	163 5 4 5[5 5]		1 5204[25]		Maleic anh adduct, 143 4
2	**Bicyclo[4,2,0]oct-3-ene**	81[140]		1 4832		
3	**Butylcyclooctatetraene**	98[20]		1 5083[25]	0 8876[25]	
4	*trans*-**Cyclodecene**	68-70[10]		1 4822	0 8672	$O_3 \rightarrow$ Sebacic acid, 134 5
5	**1,5,9,13-Cyclohexadecatetraene**	93 8[0 8]		1 5472		
6	*trans*-**Cyclononene**	73 4[30]		1 4799	0 8615	Phenylazide adduct, 97 8 8 2
7	**1,3-Cyclooctadecadiene**	115[3]		1 4899	0 8814	
8	**1,3-Cyclooctadiene**	48[25]	−57 to −55	1 4940[25]	0 8699[25]	
9	**1,3,6-Cyclooctatriene**	68[60]	−62 to −56		0 8940[25]	
10	**1,3-Cyclotetradecadiene**	106-8[3]		1 4982	0 8723[25]	Nitrosochloride, 109-10, Nitrosate, 210d
11	**1,2-Dimethylcyclooctatetraene**	107[96]		1 5219[25]	0 8950[25]	Maleic anh adduct, 184 5-5 5, bz -lgr , $AgNO_3$ adduct, 142 5 4 5, al
12	**2,6-Dimethyl-2,5-octadiene**	59 0- 5[12]		1 4500	0 733	
13	**Ethylcyclooctatetraene**	81[37]		1 5187[25]	0 8996[25]	Maleic anh adduct, 97 8 5, bz -cyclohexane, $AgNO_3$ adduct, 124-5 5, al
14	**5-Methylcycloheptene**	69 70[38]		1 42016[31]	0 76061[31]	
15	**Methylcyclooctatetraene**	84 5[67]		1 5249[25]	0 8978[25]	
16	**7-Pentadecene**	114[3 2]		1 4420	0 7765	
17	**Propylcyclooctatetraene**	73[9]		1 5131[25]	0 8870[25]	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES, DIENES AND POLYENES

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point, °C	n_D^{20}	D_4^{20}	Bromine addition product					Miscellaneous
						x Bromo	B p , °C	M p °C	n_D^{20}	D_4^{20}	
1	**1-Nonadecene**	23 4	328 0, 138 8[1]	1 4445	0 7886						
2	**Eicosene**	28 6	341 2	$1\ 4439^{30}$	$0\ 7882^{30}$						
3	**Bicyclo[4,7]pentadiene** (*endo*-4,7-Methylene-4,7,8,9-tetrahydroindene)	32	170	$1\ 5070^{25}$	$0\ 9766^{33}$						Phenylazide adduct, 128
4	**1-Heneicosene**	33 3	355	$1\ 4494^{S}$	$0\ 7977^{S}$						
5	**1-Docosene**	37 8		$1\ 4505^{S}$	$0\ 8002^{S}$						
6	**1-Tricosene**	41 6	379	$1\ 4516^{S}$	$0\ 8023^{S}$						
7	**1-Tetracosene**	45 3	390	$1\ 4527^{S}$	$0\ 8045^{S}$						
8	**1-Pentacosene**	48 7	401	$1\ 4536^{S}$	$0\ 8063^{S}$						
9	*cis cis cis* **1,4,7-Cyclononatriene**	49 5-50									$AgNO_3$ adduct, 243d
10	*d,l*-**Camphene** (2,2-Dimethyl-3-methylenebicyclo[2,2,1]heptene)	50	159 60			*di*-	91-2	153 5^{15}			
11	*l*-**Camphene**	51 3	159-60								2,4-Dinitrophenylsulfenyl chloride, 121 2, Hydrochloride, 125-7
12	**1-Heptacosene**	54 7	421	$1\ 4552^{S}$	$0\ 8097^{S}$						
13	**1-Triacontene**	62 4	448	$1\ 4573^{S}$	$0\ 8141^{S}$						
14	**1-Hentriacontene**	64 6	457	$1\ 4580^{S}$	$0\ 8153^{S}$						
15	**1-Dotriacontene**	66 7	465	$1\ 4585^{S}$	$0\ 8165^{S}$						
16	**1-Tritriacontene**	68 7	473	$1\ 4591^{S}$	$0\ 8176^{S}$						
17	**1-Tetratriacontene**	70 5	481	$1\ 4596^{S}$	$0\ 8186^{S}$						
18	**1-Pentatriacontene**	72 3	489	$1\ 4601^{S}$	$0\ 8196^{S}$						
19	**1-Hexatriacontene**	73 9	496	$1\ 4605^{S}$	$0\ 8205^{S}$						
20	**1-Heptatriacontene**	75 5	503	$1\ 4610^{S}$	$0\ 8214^{S}$						
21	**1-Octatriacontene**	77	510	$1\ 4614^{S}$	$0\ 8223^{S}$						
22	**1-Nonatriacontene**	78 4	517	$1\ 4618^{S}$	$0\ 8231^{S}$						
23	**1-Tetracontene**	79 8	523	$1\ 4622^{S}$	$0\ 8238^{S}$						
24	**Bicyclo(2,2,2)-oct-2-ene**	111 2	128 34			2,3-*trans*-*di*-		55 0 5 5			

*Derivative data given in order m p , crystal color, solvent from which crystallized

S = Supercooled liquid at 20°

EXPLANATIONS AND REFERENCES TO TABLE III

Hg salt (Mercuric acetylide) *

$$2\,RC{\equiv}CH + K_2HgI_4 + 2\,KOH \rightarrow \underset{\text{Mercuric salt}}{(RC{\equiv}C)_2Hg} + 4\,KI + 2\,H_2O$$

From the terminal alkyne and K_2HgI_4 (prepared from mercuric chloride, potassium iodide and potassium hydroxide)

For directions and examples see Linstead, p 52, J R Johnson and W L McEwen, *J Amer Chem Soc*, **48**, 469 (1926)

Hydration to form carbonyl compound

$$\text{Terminal acetylenes}\quad RC{\equiv}CH + H_2O \xrightarrow[HgSO_4]{H_2SO_4} \underset{\text{Methyl ketone}}{RCOCH_3}$$

$$\text{Other acetylenes}\quad RC{\equiv}CR' + H_2O \xrightarrow[HgSO_4]{H_2SO_4} \underset{\text{Mixture of ketones}}{RCOCH_2R' + RCH_2COR'}$$

From the alkyne in methanol and a catalyst composed of boron trifluoride etherate, red mercuric oxide and trichloroacetic acid

For directions and examples see J G Sharefkin and E M Boghosian, *Anal Chem*, **33**, 640 (1961)

From the alkyne, mercuric sulfate and sulfuric acid in 70% methanol, in 70% acetone or in 60% acetic acid

See Cheronis, p 576, H Erdmann and F Kother, *Z Anorg Chem*, **18**, 48 (1898), R J Thomas, K N Campbell and G F Hennion, *J Amer Chem Soc*, **60**, 718 (1938)

From the alkyne, mercuric oxide and sulfuric acid in alcohol

See J R Johnson, A M Schwartz and T L Jacobs, *J Amer Chem Soc*, **60**, 1882 (1938)

NOTE For directions and examples for the preparation of the semicarbazones and the 2,4-dinitrophenylhydrazones of the formed carbonyl compounds see explanations and references to Table IX and X, p 141, 142, 143

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)

a) Liquids (Listed in order of increasing b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Hydration product ($RC{\equiv}CR' \rightarrow RCOCH_2R$) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p , °C	2,4-Dinitrophenylhydrazone of ketone	Semicarbazone of ketone		
1	**Ethyne** (Acetylene)	−84 0 (sat press)	−80 8, subl		0 6179[−84]	(Acetaldehyde)	(20 2)	(168)	(162-3)		
2	**Propyne** (Methyl acetylene)	−23 22	−102 7		0 6174[−23]	Acetone	56	128	190	204	
3	**1-Butyne** (Ethyl acetylene)	8 09, 8 3	−125 72	1 3962	0 6682[8]	2-Butanone	82	116-7	135 6	162 3, al	
4	**1,3-Butadiyne** (Diacetylene)	10 3	−35 to −36	1 4120	0 7249					161 5 2 0	KOBr → 1,4-Dibromo deriv , 49 50, bz
5	**3-Methyl-1-butyne** (Isopropyl acetylene)	26 35, 28	−89 7	1 3723	0 666						Tetrabromo deriv , b p 275
6	**2-Butyne** (Dimethyl acetylene)	27 2 6	−32 26	1 3921	0 6901	2-Butanone	82	116 7	135 6		Tetrabromo deriv , 243, eth , 2,4-Dinitrophenylsulfenyl chloride, 65 6
7	**3-Methyl-3-buten-1-yne** (Isopropenyl acetylene)	33		1 4158	0 6801[11]						3,4-Dibromo deriv , b p 50 0-1 5[10]
8	**3,3-Dimethyl-1-butyne** (*tert*-Butyl acetylene)	38 9	−81 20	1 37725[15]	0 6737[15]					92 5-3 0	Cu salt, 140, red
9	**1-Pentyne** (Propyl acetylene)	40 18	−105 7	1 3852	0 6901	2 Pentanone	102 3	145	112, 106	118 4	Tetrabromo deriv , b p 275
10	**1-Penten-4-yne** (Allyl acetylene)	42-3		1 4125[16]	0 738[16]	Allyl methyl ketone	111 2	160			1,2-Dibromo deriv , b p 79 5 80 5[10], 4,4,5,5-Tetrabromo deriv , b p 132 6[10]
11	*cis*-**3-Penten-1-yne** (*cis*-Propenyl acetylene)	44 6		1 4330						48	
12	*trans*-**3-penten-1-yne** (*trans* Propenyl acetylene)	52 2		1 4377	0 7270					155-7	1,2-Dibromo deriv , b p , 60-2[10], 3,4-Dibromo deriv , 66-76[10]
13	**2-Pentyne** (Ethyl methyl acetylene)	56 07	−109 3	1 4039	0 7107	2-Pentanone + 3-Pentanone	102 3 102	145 156	112, 106 138-9		$KMnO_4$ → formic ac + propionic ac
14	**1-Penten-3-yne** (Methyl vinyl acetylene)	59 2 60 1		1 4496	0 7401						
15	**4-Methyl-1-pentyne** (Isobutyl acetylene)	61 1 2, 99	−105 1	1 3936$_\alpha^{15}$	0 7092[15]					100 0- 5	
16	**3-Methyl-1-pentyne** (*sec*-Butyl acetylene)	65 70[770], 57 7		1 3916	0 7037					74-5	
17	**1-Hexyne** (Butyl acetylene)	71 33	−131 9	1 3989	0 7155	2-Hexanone	128	106 7	125	96 2 4	
18	**4-Methyl-2-pentyne** (Isopropyl methyl acetylene)	72 0 5	−110 37	1 4078[19]	0 716[19]						
19	**4,4-Dimethyl-1-pentyne**	73 5		1 4028	0 7154					125 6 5	
20	**1,3-Pentadiyne**	75 0- 5, 55-6	−45 to −35	1 4431[21]	0 7375[21]						
21	**1,4-Hexadiyne**	78-83			0 825$_4^0$						
22	**3-Hexyne** (Diethyl acetylene)	81 5[744]	−51	1 4112[25]	0 7263[25]	3-Hexanone	125	130	112		2,4-Dinitrophenylsulfenyl chloride, 65 6

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)
a) Liquids (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^t	D_4^t	Hydration product (RC≡CR → $RCOCH_2R$) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p °C	2 4 Di nitro phenyl hydrazone of ketone	Semicar bazone of ketone		
23	**4,4-Dimethyl-2-pentyne** (*tert* Butyl methyl acetylene)	82 9 3 0		1 4071	0 7176						
24	**2-Hexyne** (Methyl propyl acetylene)	83 7 4 0	−92	1 4135	0 7317	2 Hexanone	128	106 7	125		
						+ 3 Hexanone	125	130	112		
25	**1-Hexen-3-yne** (Ethyl vinyl acetylene)	85[758]		1 4522	0 7492						1 2 Dibromo deriv b p 87 0 5[10] 3 3 4 4 Tetra bromo deriv b p 140 50[10]
26	**1,5-Hexadien-3-yne** (Divinyl acetylene)	85 0	−87 83	1 5045	0 7857						
27	**1-Hexen-4-yne**	87 [53]		1 446[14]	0 767[14]						1 2 Dibromo deriv b p 93 0 5[1] 1 2 4 5 Tetra bromo deriv b p 154 5 5 0[10]
28	**3-Ethyl-1-pentyne**	87 0 8 5		1 4102	0 7246						
29	**1,5-Hexadiyne** (Dipro pargyl)	87 5 8 5[58] 20[46]	−4 266	1 4381[23]	0 79943						
30	**2-Hexen-4-yne**	88 9		1 4918	0 7710	Allyl ethyl ketone	74 5 6 5[90]	95 106			
31	**2-Methyl-3-hexyne**	95 2	−116 7	1 4114	0 7263						
32	**4-Methyl-2-hexyne**	95 94	f p −107 63	1 4170	0 73855						
33	**3-Ethyl-3-penten-1-yne**	96 5		1 4338[25]	0 7886[25]						
34	**5-Methyl-3-heptyne**	98 100 [45]		1 4102	0 7360						
35	**1-Heptyne** (*n* Pentyl acetylene)	99 74	−80 9	1 4087	0 7328	2 Heptanone	151 2	89	123 127	61 me al	
36	**5-Methyl-2-hexyne**	102 46	−92 91	1 41762	0 73776						
37	**8-Methyl-4-nonyne**	104 5		1 4311	0 7681						
38	**3-Heptyne** (Ethyl propyl acetylene)	105 6		1 415	0 7337	4 Heptanone	144	75	132		
39	**2-Heptyne** (*n* Butyl methyl acetylene)	111 5 2 5		1 4230	0 748	2 Heptanone	151 2	89	123 127		
						+ 3 Heptanone	148		101		
40	**2,2,5,5-Tetramethyl-3-hexyne** (Di *tert*-butyl acetylene)	111 9[746]	19 4	1 4055	0 7120						
41	**1,6-Heptadiyne**	112 30[26]	−85	1 451[1]	0 8164[17]						
42	**1-Octyne** (*n* Hexyl acetylene)	126 2	−79 3	1 4159	0 7461	2 Octanone	173	64 5 58	124 5	80 4 7 me al	
43	**4-Octyne** (Dipropyl acetylene)	130 4 6[745]		1 4226	0 7484						
44	**3-Octyne** (Butyl ethyl acetylene)	131 0- 5		1 4261	0 748						
45	**2-Octyne** (Hexyl methyl acetylene)	138 0 4		1 4285	0 761	2-Octanone	173	64 5 58	124 5		
						+ 3-Octanone	169 70[738]	64 5	117 0 5		
46	**4-Nonyne** (*n* Butyl propyl acetylene)	150 4[752]		1 4296[25]	0 757[25]	4-Nonanone	187 8	57 8	73 4		
						+ 5-Nonanone	188 4		90		

*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)

a) Liquids (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Hydration product ($RC{\equiv}CR' \rightarrow RCOCH_2R'$) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p , °C	2,4-Dinitrophenylhydrazone of ketone	Semicarbazone of ketone		
47	**1-Nonyne** (Heptyl acetylene	150 8	−50	1 4217	0 7568	2-Nonanone	195 3	55-6	118 20	67 8-8 5, me al	
48	**3-Nonyne** (Methyl pentyl acetylene)	153 5[745], 92[97]		1 4299	0 7616	3-Nonanone + 4-Nonanone	187[751] 187-8	55 6 57-8	111-2 73 4		
49	**Cyclooctyne**	157 5-8 0[740]		1 4850	0 868						
50	**2-Nonyne** (Methyl hexyl acetylene)	161		1 4331	0 769	3-Nonanone + 2-Nonanone	187[751] 195 3	55-6 55 6	111 2 118 20		
51	**1,8-Nonadiyne**	162, 55 0-5[13]	−27 28	1 4490	0 8158						
52	**1-Decyne** (*n*-Octyl acetylene)	174 0	−44	1 4265	0 7655	2-Decanone	215 5	124	63, 81	80 0- 7	
53	**3-Decyne** (Ethyl hexyl acetylene)	175-6		1 433[21]	0 7765[21]	3-Decanone + 4-Decanone	211 206 7		100 1 51 2		
54	**5-Decyne** (Dibutyl acetylene)	177, 100[80]	−73	1 4332	0 7688	5-Decanone		60 1 5	57 5-8 0		$NaNH_2$ at 210° → 1-Decyne, b p 174
55	**Cyclononyne**	177 8[740]	−36 4	1 4890	0 8972	Cyclononanone	m p 34	146	184 5		
56	**2,7-Nonadiyne**	180	4 30	1 4674	0 8332						
57	**1-Undecyne** (1-Hendecyne, Nonyl acetylene)	195, 96 43[30]	−25	1 4306	0 7728	2-Undecanone	228	63	122 0- 5	79	
58	**Cyclodecyne**	203 4[740] 78 5[12]		1 4950	0 8975	Cyclodecanone	100 2[12]		203-5		Ozonolysis → sebacic acid, 134 5
59	**6-Dodecyne** (Dipentyl acetylene)	209[745], 90[8]		1 4380[25]	0 7816[25]						$NaNH_2$ → 1-Dodecyne, b p 215
60	**1-Dodecyne** (Decyl acetylene)	215 89 09[10]	19	1 4340	0 7788					84 2 8	
61	**1-Tridecyne** (*n*-Undecyl acetylene)	234, 102 95[10]	−5	1 4371	0 7842						
62	**1-Tetradecyne** (Dodecyl acetylene)	252, 118 31[10]	0	1 4396	0 7888						
63	**1-Pentadecyne** (Tridecyl acetylene)	268 129 79[10]	10	1 4419	0 7928						
64	**1-Hexadecyne** (Tetradecyl acetylene)	284 103 3[1]	15	1 4440	0 7965						

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)

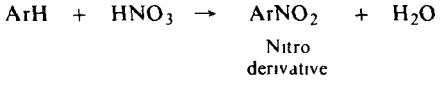
b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point C	n_D^{20}	D_4^{20}	Miscellaneous
1	**1-Heptadecyne**	22	299	1 4437[25]	0 7961[25]	
2	**2,6-Octadiyne**	27	62[19]	1 453[21]	0 828[40]	
3	**1-Octadecyne**	27	313 180	1 4474	0 8025	
4	**2-Octadecyne**	30	184[15]		0 8016	
5	**1-Nonadecyne**	33	327 144[1 5]	1 4488[S]	0 8050[S]	Hg salt, 96 7 *n*-BuOH
6	**1-Eicosyne**	35	340 153[1]	1 4501[S]	0 8073[S]	
7	**2-Heneicosyne**	35 6	180[2]	1 4499[40]		
8	**1-Heneicosyne**	41		1 4513[S]	0 8094[S]	
9	**1-Docosyne**	45	363	1 4524[S]	0 8114[S]	
10	**1-Tricosyne**	49	374	1 4534[S]	0 8131[S]	
11	**1-Tetracosyne**	52	385	1 4544[S]	0 8148[S]	
12	**1-Pentacosyne**	55	395	1 4552[S]	0 8163[S]	
13	**1-Hexacosyne**	57	405	1 456[S]	0 8177[S]	
14	**1-Heptacosyne**	60	415	1 4568[S]	0 8190[S]	
15	**1-Octacosyne**	62	426	1 4575[S]	0 8202[S]	
16	**1-Nonacosyne**	65	432	1 4581[S]	0 8213[S]	
17	**1-Triacontyne**	67	441	1 4587[S]	0 8224[S]	
18	**1-Hentriacontyne**	69	449	1 4593[S]	0 8234[S]	
19	**1-Dotriacontyne**	71	457	1 4598[S]	0 8243[S]	
20	**1-Tritriacontyne**	73	464	1 4603[S]	0 825[S]	
21	**1-Tetratriacontyne**	74	472	1 4608[S]	0 8260[S]	
22	**1-Pentatriacontyne**	76	479	1 4612[S]	0 8268[S]	
23	**1-Hexatriacontyne**	77	486	1 4617[S]	0 8275[S]	
24	**1-Heptatriacontyne**	79	493	1 4621[S]	0 8282[S]	
25	**1-Octatriacontyne**	80	499	1 4625[S]	0 8289[S]	
26	**1-Nonatriacontyne**	82	505	1 4628[S]	0 8295[S]	
27	**1-Tetracontyne**	83	512	1 4632[S]	0 8301[S]	

Derivative data given in order m p crystal color solvent from which crystallized
S = supercooled liquid at 20°

EXPLANATIONS AND REFERENCES TO TABLE IV

Nitro derivative *



From the aromatic hydrocarbon with concentrated nitric and sulfuric acids

For directions and examples see Cheronis, p 578 80, Linstead, p 48, 49, Shriner, p 249, Vogel, p 520, Wild, p 24

From the aromatic hydrocarbon with fuming and concentrated nitric acids

See Shriner, p 249, Wild, p 24

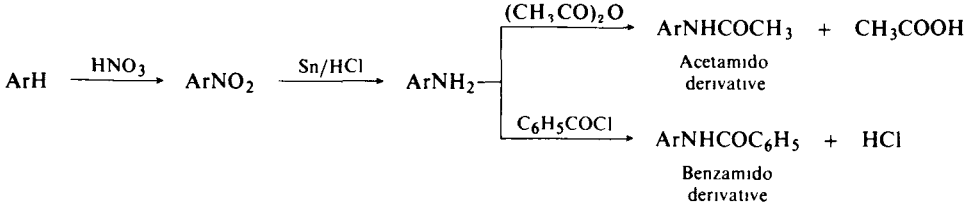
From the aromatic hydrocarbon with fuming nitric acid in acetic acid

See Vogel, p 520

From the aromatic hydrocarbon with nitric and sulfuric acids in chloroform

See Vogel, p 580

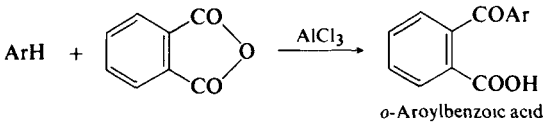
Acetamido and Benzamido derivatives *



Nitration of the aromatic hydrocarbon is followed by reduction with tin and hydrochloric acid The resulting amine is acetylated with acetic anhydride or benzoylated with benzoyl chloride

For directions and examples see Cheronis, p 581, V L Ipatieff and L A Schmerling, *J Amer Chem Soc*, **59,** 1056 (1937), **60,** 1476 (1938), **65,** 2470 (1943)

o-Aroylbenzoic acid (product with phthalic anhydride)



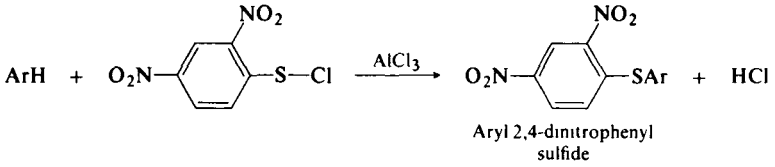
From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride in carbon disulfide

For directions and examples see Cheronis, p 548, Shriner, p 250, Vogel, p 519, Wild, p 28, H W Underwood and W L Walsh, *J Amer Chem Soc*, **57,** 940 (1935)

From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride without solvent

See G F Lewenz and K T Serijan, *J Amer Chem Soc*, **75,** 4087 (1953)

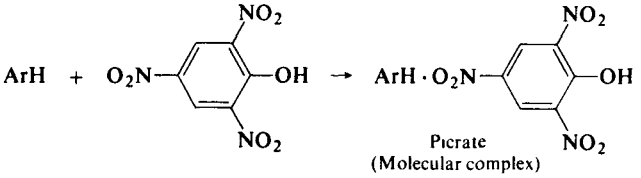
2,4-Dinitrobenzenesulfenyl chloride derivative (Aryl 2,4-dinitrophenyl sulfide)



From the aromatic hydrocarbon, 2,4-dinitrobenzenesulfenyl chloride and aluminum chloride in 1,2-dichloroethane

For directions and explanations see Cheronis, p 585, C M Buess and N Kharasch, *J Amer Chem Soc*, **72,** 3529 (1950)

Picrate



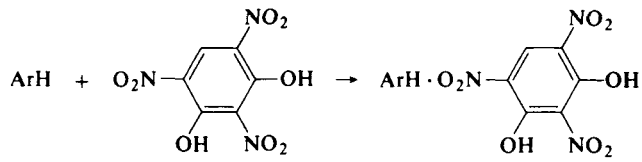
*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)

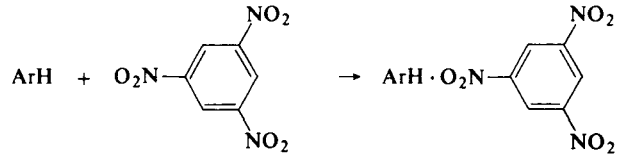
From the aromatic hydrocarbon and picric acid in alcohol
For directions and examples see Linstead, p 50 Vogel, p 518, Wild, pp 29 30
From excess of liquid aromatic hydrocarbon and picric acid without solvent
See Wild, pp 28 9 Baril and Hauber, *J Amer Chem Soc*, **53**, 1087 (1931)
From the aromatic hydrocarbon in methanol or in dry benzene
See Cheronis, pp 582 3

Styphnate



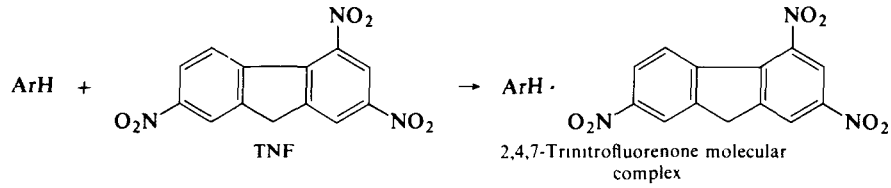
From the aromatic hydrocarbon and styphnic acid (2,4,6-trinitroresorcinol) in acetic acid
For directions and examples see Vogel, p 519, W J Hickinbottom, *Reactions of Organic Compounds*, 2nd ed , Longmans, Green and Co , London, 1948, p 76

1,3,5-Trinitrobenzene derivative



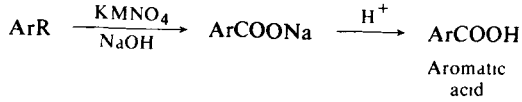
From the aromatic hydrocarbon and 1,3,5-trinitrobenzene in alcohol, acetic acid, or benzene
For directions and examples see Vogel, p 519

2 4,7-Trinitrofluorenone (TNF) derivative *



From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in methanol-benzene and ethanol-benzene mixtures
For directions and examples see Cheronis, pp 582 3, M Orchin, *J Amer Chem Soc*, **68**, 1727 (1946), M Orchin, L Reggel and E O Woolfolk, *J Amer Chem Soc*, **69**, 1225 (1947)
From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in glacial acetic acid
See M C Kloetzel and H E Mertel, *J Amer Chem Soc*, **72**, 4786 (1950), M D Soffer and R A Stewart, *J Amer Chem Soc*, **74**, 567 (1952)
From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone without solvent
See D E Laskowski and W C McCrone, *Anal Chem*, **30**, 542 (1958)

Acids from side-chain oxidation



*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)

From the alkyl-substituted aromatic hydrocarbon with potassium permanganate in sodium hydroxide or sodium carbonate solution

For directions and examples see Cheronis, p 585, 627, Linstead, p 50, Shriner, p 250, Vogel, p 520, Wild, p 26

From the alkyl-substituted aromatic hydrocarbon with sodium bichromate and sulfuric acid

See Cheronis, p 627, Shriner, p 250, Wild, p 26

Sulfonamide *

$$ArH + ClSO_3H \rightarrow \underset{\text{Sulfonyl chloride}}{ArSO_2Cl} \xrightarrow{NH_3} \underset{\text{Sulfonamide}}{ArSO_2NH_2}$$

From the aromatic hydrocarbon and chlorosulfonic acid in chloroform, followed by aqueous ammonia

For directions and examples see Linstead, p 49, Wild, p 27, E H Huntress and F H Carten, *J Amer Chem Soc*, **62**, 511 (1940), E H Huntress and J S Autenrieth, *J Amer Chem Soc*, **63**, 3446 (1941)

From the aromatic hydrocarbon with chlorosulfonic acid without solvent, followed by ammonolysis with dry ammonium carbonate

See Wild, p 27

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Picrate	1 3 5 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
1	**Benzene**	80 1	5 5	1 5011	0 87901	84		1,3-*di* 89, 1,3,5 *tri* 122		127	120	Sulfonamide, 156
2	**Toluene**	110 6	−95	1 49613	0 86694	88 2, pa yel		2,4-*di* 70	2,4-*di* 221	137	102 3	Oxid → benzoic acid, 121, Sulfonamide, 137
3	**Ethylbenzene**	136 2	−93 9	1 49594	0 86690	96 6, pa yel		2,4,6-*tri* 37	2,4-*di* 223	122, 128	97	Oxid → benzoic acid, 121, Sulfonamide, 109
4	**1,4-Xylene**	138 3	13 26	1 49581	0 86105	90		2,3,5-*tri* 139		132, 148	134-5	Oxid → terephthalic acid, >300, subl , Sulfonamide, 147
5	**1,3-Xylene**	139 1	−47 89	1 49722	0 86417	91		2,4,6-*tri* 183		126, 142		Oxid → isophthalic acid, 348, h w , Sulfonamide, 137
6	**1,2-Xylene**	144 4	−25 18	1 50545	0 88020	88		4,5-*di* 118		178		Oxid → phthalic acid, 206 8, Sulfonamide, 144
7	**Isopropylbenzene** (Cumene)	152 4	−96 04	1 49146	0 86179			2,4,6-*tri* 109	4-*mono* 106, 2,4-*di* 216	133		Oxid → benzoic acid, 121 Sulfonamide, 106
8	***n*-Propylbenzene**	159 2	−99 59	1 49202	0 86204	103		2,4-*di* b p 150[1]	4-*mono* 96, 2,4-*di* 208	125		Oxid → benzoic
9	**1-Ethyl-3-methylbenzene** (*m*-Ethyltoluene)	161 3	−96 55	1 49661	0 86455							Oxid → isophthalic acid, 348, h w
10	**1-Ethyl-4-methylbenzene** (*p*-Ethyltoluene)	162 1	−62 35	1 49500	0 86118							Oxid → terephthalic acid, >300, subl
11	**1,3,5-Trimethylbenzene** (Mesitylene)	164 7	−44 72	1 49937	0 86518	97		2,4-*di* 86, 2,4,6-*tri* 235		212		Oxid → trimesic acid, 380, Sulfonamide, 141
12	**1-Ethyl-2-methylbenzene** (*o*-Ethyltoluene)	165 2	−80 83	1 50456	0 88069							Oxid → phthalic acid, 206 8
13	***tert*-Butylbenzene**	169 1	−58 34	1 49266	0 86650			2,4-*di* 62, 2,4,6-*tri* 124	4-*mono* 170, 2,4-*di* 210		130 1	Oxid → benzoic acid, 121
14	**1,2,4-Trimethylbenzene** (Pseudocumene)	169 4	−43 91	1 50484	0 87582	97		3,5,6-*tri* 185				Oxid → trimellitic acid, 225 35 d
15	**Isobutylbenzene**	172 8	−51 53	1 48646	0 85321				4-*mono* 127 0 7 5		99 100	Oxid → benzoic acid, 121
16	***sec*-Butylbenzene**	173 3	−75 57	1 49020	0 86207			2,4-*di* b p 161 2[5]	4-*mono* 126, 2,6-*di* 192		88-9	Oxid → benzoic
17	**3-Isopropyl-1-methylbenzene** (3-Isopropyltoluene, *m*-Cymene)	175 1	−63 75	1 4930	0 8610							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	1,3,5 Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
18	**1,2,3-Trimethylbenzene** (Hemimellitene)	176 08	−25 41	1 51393	0 89438	90 5						Oxid → hemimellitic acid, 190 7 d
19	***trans*-Propenylbenzene**	176 5 7 5	−27 1 to −25 9	1 5463^{25}	0 902							
20	**Indane**	177	−51 4	1 5381	0 9645							
21	**4-Isopropyl-1-methylbenzene** (4-Isopropyltoluene, 4-Cymene)	177 1	−67 94	1 4909	0 8537			2,6-*di* 54, 2,3,6 *tri* 118		123 4		Sulfonamide, 115
22	**2-Isopropyl-1-methylbenzene** (2 Isopropyltoluene 2-Cymene)	178 35	−71 71	1 5006	0 8766							Br_2 → Tetrabromo, 59 5 60 5
23	**1,3-Diethylbenzene**	181 1		1 49552	0 86394			2,4,6-*tri* 62		114		
24	**1-Methyl-3-propylbenzene** (*m*-Propyltoluene)	181 8		1 4936	0 8610							
25	**Indene**	182 4	−2	1 5764	0 9915	98, yel						Acid → polymer
26	***n*-Butylbenzene**	183 27	−88 15	1 48979	0 86013				4-*mono* 105 2,4-*di* 214	97	72 3	
27	**1-Methyl-4-propylbenzene** (*p*-Propyltoluene)	183 3		1 4919	0 8584							
28	**1,2-Diethylbenzene**	183 4		1 50346	0 87996							
29	**1,4-Diethylbenzene**	183 8		1 49483	0 86196							
30	**1,3-Dimethyl-5-ethylbenzene**	183 8	−84 4	1 4981	0 8648			2,4,6-*tri* 117 0 7 6				Br_2 → Tribromo, 89
31	**1-Methyl-2-propylbenzene** (*o*-Propyltoluene)	184 8	−60 2	1 4998	0 8744							
32	**2,2-Dimethyl-1-phenylpropane** (Neopentylbenzene)	186		1 4880	0 858							
33	**1,4-Dimethyl-2-ethylbenzene**	186 9		1 5043	0 8772			3,5,6-*tri* 127 8, al	4-*mono* 142, 2,4-*di* 181			Sulfonamide, 107-8
34	**2-Methylindane**	187 0		1 5070	0 9034							
35	**3-Methyl-2-phenylbutane**	188		1 486	0 8701				4-*mono* 147 8, 2,4-*di* 193			4-Benzamido deriv , 141 2
36	**1-Methylindane**	188 90		1 5274	0 939							Heat with Pt at 310-350 → Naphthalene, 80 3
37	**1,3-Dimethyl-4-ethylbenzene**	188 4	−63 0	1 5038	0 8763			2,5,6-*tri* 127 5 9 0				Br_2 → 2,5,6-Tribromo, 94 5, 81 2
38	**3-*tert*-Butyl-1-methylbenzene** (3-*tert*-Butyltoluene)	189 3	−41 39	1 4944	0 8657							
39	**1,2-Dimethyl-4-ethylbenzene**	189 55	−67 1	1 5031	0 8745							Oxid → trimellitic acid, 225 35 d
40	**1,3-Dimethyl-2-ethylbenzene**	190		1 5107	0 8904							Oxid → hemimellitic acid, 190-7 d

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	1 3 5 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2 4 Dinitro phenyl sulfenyl chloride derivative	Miscellaneous
41	**3-Phenylpentane**	191		1 4877	0 8649				4-*mono* 145 6 2 4-*di* 199 200			4 Benzamido deriv , 154
42	**1-Ethyl-3-isopropylbenzene**	192		1 4955	0 859							
43	**2-Methyl-2-phenylbutane**	192 38		1 4934	0 8737				4 *mono* 142 2 4 *di* 181			4-Benzamido deriv 112 3
44	**4-*tert*-Butyl-1-methylbenzene** (4-*tert* Butyltoluene)	192 8	– 52 49	1 4918	0 8612			2 6 *di* 96				
45	**1-Ethyl-2-isopropylbenzene**	193		1 5080	0 888							
46	**2-Phenylpentane**	193		1 4876	0 8576				4-*mono* 107 2 4-*di* 181 2			4-Benzamido 127 8
47	**1,2-Dimethyl-3-ethylbenzene**	193 9	– 49 5	1 5117	0 8921							Oxid → hemimellitic acid 190 7 d
48	**3-*sec*-Butyl-1-methylbenzene** (3-*sec*-Butyltoluene)	194		1 490	0 858							
49	**3-Isobutyl-1-methylbenzene** (3-Isobutyltoluene)	194		1 4888	0 8536							
50	***d*-2-Methyl-1-phenylbutane**	194		1 4880	0 8617							
51	**1,3-Dimethyl-5-isopropylbenzene**	194 5 191		1 4955	0 8591							Oxid → trimesic acid, 380
52	**2-Phenyl-*cis*-2-butene**	194 5		$1\ 5402^{25}$	$0\ 9191^{2}$						81 2	
53	**4-Isobutyl-1-methylbenzene** (*p* Isobutyltoluene)	196		1 4874	0 8517							
54	**2-*sec*-Butyl-1-methylbenzene** (2-*sec* Butyltoluene)	196		1 497	0 873							
55	**2-Isobutyl-1-methylbenzene** (*o*-Isobutyltoluene)	196		1 4935	0 8649							
56	**1,4-Dimethyl-2-isopropylbenzene**	196 2		1 5010	0 8738							
57	**1-Ethyl-4-isopropylbenzene**	196 6		1 4923	0 8585							
58	***d,l*-2-Methyl-1-phenylbutane**	197		1 486	0 859				4-*mono* 115 6 2 4 *di* 193 4			4-Benzamido 126
59	**1,2,3,5-Tetramethylbenzene** (Isodurene)	197 9		1 5125	0 8899			4 6-*di* 181 157		213		
60	**3-Methyl-1-phenylbutane** (Isopentylbenzene)	198 9 196		1 4847	0 8558				4-*mono* 114 2,4-*di* 215 6			
61	**1,3-Dimethyl-2-isopropylbenzene**	199		1 509	0 890							
62	**1,3-Dimethyl-4-isopropylbenzene**	199 1 195		1 5018	0 869							
63	**3-Methylindene**	199 2 200 198 5		$1\ 55907^{27}$	0 9640	76 8, or - yel , al						
64	**4-*sec*-Butyl-1-methylbenzene** (*p*-*sec*-Butyltoluene)	200		1 4932	0 8650							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	1 3,5-Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2 4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
65	**2-*tert*-Butyl-1-methylbenzene** (2-*tert*-Butyltoluene)	200 5		1 5076	0 8897							
66	**3,5-Diethyl-1-methylbenzene** (3,5-Diethyltoluene)	200 7	−74 12	1 4969	0 8630			2,4,6-*tri* 106 6 5				
67	**2-Butyl-1-methylbenzene** (2-Butyltoluene)	201, 208		1 4958	0 8721							
68	**1-Ethyl-3-propylbenzene**	201		1 4930	0 8607							
69	**1,2-Dimethyl-4-isopropylbenzene**	201 8		1 4993	0 8699							
71	**1,2-Dimethyl-3-isopropylbenzene**	202 6		1 508	0 888							
72	**1-Ethyl-2-propylbenzene**	203		1 4992	0 8744							
73	**1,3-Di-isopropylbenzene**	203 2	−63 1	1 4883	0 85593			4,6-*di* 76 9 7 2, 2-ProH				
74	**1,2-Diethyl-4-methylbenzene**	203 6		1 5039	0 8762							
75	**1,2-Di-isopropylbenzene**	203 8		1 4960	0 8771							
76	**1,4-Dimethyl-2-propylbenzene**	204 3		1 4999	0 8717							
77	**1,2,3,4-Tetramethylbenzene** (Prehnitene)	205 0	−6 3	1 5201	0 9053	92-5		5,6-*di* 176				
78	**1-Ethyl-4-propylbenzene**	205		1 4921	0 8594							
79	**3-Butyl-1-methylbenzene** (*m*-Butyltoluene)	205		1 491	0 859							
80	**2,4-Diethyl-1-methylbenzene** (2,4-Diethyltoluene)	205		1 5027	0 8748							
81	***n*-Pentylbenzene**	205 4	−75	1 4878	0 8585				4-*mono* 101-2, 2,4-*di* 202			4-Benzamido, 128 9
82	**3-Methyl-3-phenylpentane**	206		1 4958	0 8755							
83	**1,3-Dimethyl-5-*tert*-butylbenzene**	206-6 5	−21 5	1 4958	0 8645			2,4,6-*tri* 107 (one form), 114 (another form)				
84	**1,3-Dimethyl-4-propylbenzene**	206 6		1 4998	0 8723							
85	**1,2-Diethyl-3-methylbenzene**	206 6		1 5105	0 8910							
86	**4-Butyl-1-methylbenzene** (4-Butyltoluene)	207		1 490	0 857							
87	**2,5-Diethyl-1-methylbenzene** (2,5-Diethyltoluene)	207 1		1 5034	0 8758							
88	**1,2,3,4-Tetrahydronaphthalene** (Tetralin)	207 6	−35 79	1 54135	0 9702			5,7-*di* 95		153 5		Cl_2 → 5,6,7,8-Tetrachloro, 172
89	**1,3-Diethyl-2-propylbenzene**	207 6		1 5063	0 8856							
90	**2,6-Diethyl-1-methylbenzene** (2,6-Diethyltoluene)	208 8		1 5106	0 8907							
91	**1,2-Dimethyl-4-propylbenzene**	208 9		1 5000	0 8715							
92	**1,3-Dimethyl-5-propylbenzene**	209		1 4933	0 8610							
93	**2-Methyl-3-phenylpentane**	209		1 4912	0 8678							
94	**4-*tert*-Butyl-1,3-dimethylbenzene**	210-4		$1\ 5030^{37}$	$0\ 9372^{30}$			2,5,6-*tri* 112, al				
95	**1,4-Di-isopropylbenzene**	210 4	−17 1	1 48983	0 85676							
96	**1,2-Dimethyl-3-propylbenzene**	210 7		1 5075	0 8864							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Picrate	1 3,5 Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
97	**1-*tert*-Butyl-4-ethylbenzene**	211		1 4950	0 8635			2,6-*dı* 94 5, al				
98	***d,l*-3-Phenylhexane**	211 208 3		1 4867	0 8596				2,4-*dı* 207 8			
99	**2-Ethyl-1,3,5-trimethylbenzene**	212 4	−12 2	1 5074	0 883			4,6-*dı* 111, al				
100	**3-Ethyl-4-isopropyl-1-methylbenzene**	213		1 5006	0 8722							
101	**5-Ethyl-1,2,4-trimethylbenzene**	213	−13 ٦	1 5075	0 833			3,6-*dı* 87 8, al				3,6-Dibromo, 60–1, acet
102	**6-Ethyl-1,2,4-trimethylbenzene**	213		1 5118	0 8897							
103	**2-Phenylhexane**	214		1 4882	0 8600				2,4-*dı* 178			
104	**2-Methyl-1-phenylpentane**	215		1 4847	0 8624							
105	**4-Isopropyl-1-propylbenzene**	215		1 4972	0 8614							
106	**1,3-Dipropylbenzene**	215 8		1 5155[14]	0 9137[1]							
107	**5-Ethyl-1,2,3-trimethylbenzene**	215 8		1 5101	0 8863							
108	**3-Ethyl-1,2,4-trimethylbenzene**	216 6		1 5133	0 895			5,6-*dı* 79 80, al				
109	**1,2,4-Triethylbenzene**	217 7		1 4982	0 8791							
110	**1,3,5-Triethylbenzene**	218 211 2		1 4965	0 8568[25]			2,4,6-*trı* 112 4 2 6		129		2,4,6-Tribromo, 105
111	**2-Methyl-1,2,3,4-tetrahydronaphthalene** (2 Methyltetralin)	218		1 5311	0 952							
112	**1-Methyl-1,2,3,4-tetrahydronaphthalene** (1-Methyltetralin)	219		1 5357	0 9580							
113	**4-Ethyl-1,2,3-trimethylbenzene**	220 4		1 5180	0 9019							
114	**1,4-Dipropylbenzene**	221		1 4914	0 8564							
115	**3-Methyl-1-phenylpentane**	221		1 4876	0 8605							
116	**2-Propyl-1,3,5-trimethylbenzene**	221		1 5033	0 8782							
117	**1,1-Dimethyl-1,2,3,4-tetrahydronaphthalene** (1,1-Dimethyltetralin)	221		1 5292	0 950			Ar-x, x-*dı* 64 5				
118	**3-*tert*-Butyl-1-isopropylbenzene**	222		1 4832	0 8512							
119	**1-Methyl-3-pentylbenzene** (3-Pentyltoluene)	223		1 4911	0 8593							
120	**4-*tert*-Butyl-1-isopropylbenzene**	224		1 4872	0 8665							
121	**2-Methyl-2-phenylhexane**	225		1 4943	0 8737							
122	**2,4-Di-isopropyl-1-methylbenzene** (2,4-Di-isopropyltoluene)	225		1 4990	0 8664							
123	**3-Methyl-3-phenylhexane**	226		1 4980	0 8776							
124	***n*-Hexylbenzene**	226 1	−61 2	1 4864	0 8575				2,4-*dı* 205 6			
125	**3-Phenylheptane**	227		1 4862	0 8607							
126	**2,6-Di-isopropyl-1-methylbenzene** (2,6-Di-isopropyltoluene)	228		1 5032	0 8768							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	1 3 5 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4 Dinitro phenyl sulfenyl chloride derivative	Miscellaneous
127	**5-Propyl-1,2,4-trimethylbenzene**	228		1 5095	0 887							
128	**6-Methyl-1,2,3,4-tetrahydronaphthalene** (6-Methyltetralin)	229		1 5357	0 9537							
129	**2,2-Dimethyl-1,2,3,4-tetrahydronaphthalene** (2 2 Dimethyltetralin)	230		1 5200	0 935							
130	**2-Phenylheptane**	231		1 4863	0 8610							
131	**5-Methyl-1,2,3,4-tetrahydronaphthalene** (5-Methyltetralin)	234 4		1 54395	0 9720							
132	**2-Ethyl-1,2,3,4-tetrahydronaphthalene** (2-Ethyltetralin)	235		1 523	0 938							
133	**Cyclohexylbenzene**	235-6	7 8	1 5329	0 9502							
134	**1-Ethyl-1,2,3,4-tetrahydronaphthalene** (1-Ethyltetralin)	236		1 5321	0 9535							
135	**2,5-Dimethyl-1,2,3,4-tetrahydronaphthalene** (2,5-Dimethyltetralin)	236		1 526	0 946							
136	**2,8-Dimethyl-1,2,3,4-tetrahydronaphthalene** (2,8-Dimethyltetralin)	236		1 526	0 941							
137	**2,7-Dimethyl-1,2,3,4-tetrahydronaphthalene** (2,7-Dimethyltetralin)	237 8		1 526	0 941							
138	**2,6-Dimethyl-1,2,3,4-tetrahydronaphthalene** (2,6-Dimethyltetralin)	238		1 526	0 941							Oxid → trimellitic acid 225 35 d
139	**1,4-Di-*sec*-butylbenzene**	239		1 4892	0 8590							
140	**1,5-Dimethyl-1,2,3,4-tetrahydronaphthalene** (1,5 Dimethyltetralin)	239		1 526	0 9410							
141	**3-Ethyl-3-phenylhexane**	239		1 4943	0 875							
142	**6-Ethyl-1,2,3,4-tetrahydronaphthalene** (6 Ethyltetralin)	241		1 5331	0 9568							
143	**2-Methyl-1-phenyl-1-butene**	241 2		1 528[18]								Nitrosit, 129 30
144	**5-Ethyl-1,2,3,4-tetrahydronaphthalene** (5-Ethyltetralin)	242		1 540	0 973							
145	***n*-Heptylbenzene**	244		1 4875	0 8595							
146	**1-Methylnaphthalene**	244 8	−30 57	1 6174	1 02025	142, or-red, al	153 5 4 5, al	4-*mono* 71, 4,5-*di* 143		68		Styphnate, 135, al
147	**5,6-Dimethyl-1,2,3,4-tetrahydronaphthalene** (5,6 Dimethyltetralin)	252		1 552	0 975							Oxid → melophanic acid, 238-42
148	**6,7-Dimethyl-1,2,3,4-tetrahydronaphthalene** (6,7-Dimethyltetralin)	252	10	1 5360	0 954			5,8 *di* 203				
149	**5,7-Dimethyl-1,2,3,4-tetrahydronaphthalene** (5,7 Dimethyltetralin)	253 1	−6	1 5405	0 9583							Heating with S at 320° → 1,3-Dimethylnaphthalene, b p 263

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	1 3 5 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitro phenyl sulfenyl chloride derivative	Miscellaneous
150	**5,8-Dimethyl-1,2,3,4-tetrahydronaphthalene** (5,8-Dimethyltetralin)	254		1 547	0 967							Heating with S at 230° → 1,4-Dimethylnaphthalene, b p 268
151	**2-Ethylnaphthalene**	257 9	−7 5	1 59761	0 9922	77 0 7 5, al	88 9, 2-PrOH					Styphnate, 88 90
152	**1-Ethylnaphthalene**	258 67	−13 88	1 6062	1 00816	98 5	111 5 12, al					Styphnate 111 3, al
153	**1,7-Dimethylnaphthalene**	263	−13	1 60831	1 0115	121	137					Styphnate, 143
154	**1,6-Dimethylnaphthalene**	263	−14	1 6072	1 003	114 5 or, al	139 yel					Styphnate, 122
155	**1,3-Dimethylnaphthalene**	263	−4 0	1 6078	1 0063	118	135, yel, al					Styphnate, 117 8, w -me al, 2,4,7-Trinitrofluorenone deriv, 142 5, or
156	***n*-Octylbenzene** (1-Phenyloctane)	264 5	−36	1 4845	0 8562			2 4-*di* 2				
157	**1-Allylnaphthalene**	265 7		1 6140	1 0228	69						
158	**1-Isopropylnaphthalene**	267 9	−16	1 5950	0 99565	85 6						Dimer 198 5 9 5 Tetrabromo, 141 2
159	**1,4-Dimethylnaphthalene**	268, 262–4	7 66	1 6127	1 0166	144, or, me al	165 6 yel, me al					Styphnate, 126–7 or me al
160	**1,1-Diphenylethane**	268–70		1 5761	1 0033							Oxid → benzophenone, 49
161	**2-Isopropylnaphthalene**	a) 268 2 b) 262		1 5772 1 5861	0 9795	93 5, 91 3						
162	**2-Propylnaphthalene**	273 5, 277 9		1 5872	0 9770	93 4, or al	99					
163	**1-Propylnaphthalene**	277, 272 5	−10	1 5952	0 9918	91 2	86 7, al					
164	**1,3,7-Trimethylnaphthalene**	280	13 5	1 5759	1 007	144, or, al						Styphnate 151 5 or me al
165	**1-Isopropyl-7-methylnaphthalene** (Apocadalene)	282		1 5884	0 9833	102, or, al						Styphnate, 166 (163–4), yel, al
166	***n*-Nonylbenzene** (1-Phenylnonane)	282	−24	1 4838	0 8558							4-Sulfonamide, 94 5–5 0 Maleic anhydride → 3-(4-Nonylbenzoyl) acrylic acid, 82 3
167	**2-Butylnaphthalene**	283–5, 292	−8 1	1 57774	0 9673	71 3, or-yel, al						
168	**2-*tert*-Butylnaphthalene**	285–90	−4	1 5768	0 9687	102 3						
169	**1-*tert*-Butylnaphthalene**	287 9		1 5726	0 9629	96, yel						
170	**1-Butylnaphthalene**	289 34	−19 76	1 5819	0 97673	104 5, or-yel						

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Picrate	1,3,5-Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
171	**4,5-Benzindane** (1,2-Cyclopentanonaphthalene)	294 5		1 6290	1 066	110	119 20					2,4,7-Trinitrofluorenone deriv , 133
172	***n*-Decylbenzene** (1-Phenyldecane)	300	−14 38	1 48319	0 85553							
173	**1-Pentylnaphthalene**	307	−22	1 5725	0 9656		75, yel					
174	**2-Pentylnaphthalene**	310	−21	1 5694	0 9561		74, yel					
175	***n*-Undecylbenzene** (*n*-Hendecylbenzene, 1-Phenylundecane)	316	−5	1 4828	0 8553							4-Sulfonamide, 95 7 6 2
176	**1-Hexylnaphthalene**	322	−17 7	1 5647	0 9566		69 74					
177	**2-Hexylnaphthalene**	324	−5 6	1 620	0 9479		67-8, yel					
178	***n*-Dodecylbenzene** (1-Phenyldodecane)	331	3	1 4824	0 8551							4-Sulfonamide, 97 5
179	**1-Heptylnaphthalene**	340		1 5582	0 9491							
180	**2-Heptylnaphthalene**	341	1	1 5556	0 9410							
181	**Tridecylbenzene** (1-Phenyltridecane)	346	10	1 4821	0 8550							
182	**1-Octylnaphthalene**	356	−2 0	1 5532	0 9427							
183	**2-Octylnaphthalene**	357	2 forms stable −0 5, metastable 13	1 5501	0 9356							
184	**1-Nonylnaphthalene**	372		1 5477	0 9371							
185	**2-Nonylnaphthalene**	372	12	1 5454	0 9298							
186	**1-Decylnaphthalene**	387		1 5435	0 9322							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS
b) Solids. (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	*sym*-Trinitrobenzene derivative	2,4,7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
1	**1,2,6-Trimethylnaphthalene**	14	146[10]	122-3, al	150-1, al						n_D^{20} 1 6010
2	**Diphenylmethane**	26 7	264 7, 261 2, 120[10]					2,4,2',4'-*tetra* 172			n_D^{20} 1 5770, D_{25}^{25} 1 0056, CrO_3 → Benzophenone, 49
3	**1,2,3-Trimethylnaphthalene**	27 8, al	125-30[12]	143, or, al	143 5, yel	154 6, al					n_D^{25} 1 5725
4	**1,6,7-Trimethylnaphthalene**	28, me al	285, 138[12]	125 6, or, me al	148-9, or, me al	142-3, yel, me al					
5	**2-Isopropylazulene**	31, bl-vlt				*di* 113 4					
6	**1,4-Dimethyl-7-isopropylazulene** (δ-Guaiazulene)	31 5, bl-vlt, al	167-8[12]	122 2 5, bl, al	105-6, bl, me al	151-1 5					D_4^{19} 0 9728 (supercooled) 2,4,6-Trinitrotoluene deriv, 89
7	**2,6-Dimethylphenanthrene**	33-4, me al		135 6, yel, al	148 50, yel, me al						
8	**1,2,5-Trimethylnaphthalene**	33 5, 31-2, al	147 8[11]	138 40, al	131, al	159-60, al					n_D^{20} 1 6110, D_{20}^{20} 1 0103, 2,4,6-Trinitrotoluene deriv, 90 0 5
9	**1-Propylphenanthrene**	34 5, me al		100-1, yel, me al							
10	**5-Isopropylazulene**	34 5				134, 122 3					
11	**2-Propylphenanthrene**	35-6, al	170[0.2]	91 2, al							
12	**2-Methylnaphthalene**	37-8, 34 4	240-2, 110-2[16]	116, al		123, yel	125 6, al	1-*mono* 81			CrO_3 → β-Naphthoic acid, 182
13	**1-Ethyl-5-methylnaphthalene**	40, al	133[10]	97, or, al							
14	**9-Isopropylphenanthrene**	41-2		109-10							
15	**6-Isopropylazulene**	43				124					
16	**2-Ethyl-6-methylnaphthalene**	44 5	145 50[11]	109, or	119, yel	116-7, yel					2,4,6-Trinitrotoluene deriv, 62, yel
17	**2-Isopropylphenanthrene**	44-5, al		108, yel, me al							
18	**6-Isopropyl-1-methylphenanthrene**	45-6		143, or							
19	**2-Ethylazulene**	45 5, 44-5, bl		110 1		107					
20	**2,5-Dimethylphenanthrene**	46 7, al	204-5[15]	127-9, yel, al	132-3, or, al						
21	**1,3,5-Trimethylnaphthalene**	47, me al	139 5[10]	141-2, me al	138, yel						
22	**3-Ethyl-6-methylphenanthrene**	47-8		156-6 5, or							
23	**2-Methylazulene**	47-8		130-1, bl, al		140-1, dk red, al					
24	**1,3,8-Trimethylnaphthalene**	48, me al		127 5, or, al	140 5, al						
25	**4-Methylphenanthrene**	49 50, 95% al		140-1, al	135, or, al						

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS
b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Picrate	Styphnate	*sym* Trinitrobenzene derivative	2 4 7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
26	**1,4-Dimethylphenanthrene**	50 1 (cor), me al		143 5, or -yel	135 5 6 5, or						
27	**Bibenzyl** (1,2-Diphenylethane)	53	284			102		4,4 -*di* 180, 2,2',4,4 -*tetra* 169		132 3	D_{30}^{30} 0 9782, CrO_3 → Benzoic acid, 121
28	**Methylenefluorene** (Biphenylenecethylene)	53		152 3							
29	**3,5-Dimethylphenanthrene**	53 4, me al		139, or , me al	124 5 or -yel						
30	**1,3-Dimethylazulene**	54		164 6		164 6, al					
31	**7-Methyl-3,4-benzphenanthrene**	54 0 4 5, al		134 0 4 5, red, al			178 5 8 8				
32	**Pentamethylbenzene**	54 3, 51	231 8	131		121		6-*mono* 154			
33	**1,2,4-Trimethylnaphthalene**	55-6 50, me al	146[12]	148 8 5, or me al	123 5, yel , me al	165 6 5, me al					
34	**3,3'-Dimethylstilbene** (*sym*-Di-*m*-tolylethylene)	55 6		97							
35	**1,4,5,7-Tetramethylnaphthalene**	56	162 5[11]	153			152 8 3 4				
36	**1,2,4,8-Tetramethylnaphthalene**	56 7	150[10]	145 5		167, red, me al					2 4,6-Trinitrotoluene deriv , 88 yel
37	**2,9-Dimethylphenanthrene**	56 7, al		138, yel , al							
38	**1,5-Dimethylphenanthrene**	57 8, me al		134 5, or , me al							
39	**2-Benzylnaphthalene**	58	350	93 4, yel , al			124 3 5 4				D^{0} 1 176
40	**1-Benzylnaphthalene**	58 9	350	103-4, yel							D^{1} 1 166
41	**1,2-Dimethylazulene**	58 9, bl , al		129 30, blk , al		166 7 br -blk , al					
42	**9-Propylphenanthrene**	59	265 70[22]	99, yel , al							
43	**1,7-Dimethyl-4-isopropylnaphthalene**	60, al -w		92, or -red, al	120, yel						
44	**3-Methylphenanthrene**	62-3	140 50[6]	137-8, yel , al							
45	**3,4-Dimethylphenanthrene**	62 3, me al		129-30, or -red, al	142 3, or -red, al						
46	**1-Ethylphenanthrene**	62 5, al		108-9, or , al	144, yel , al						
47	*sym*-**Diphenylacetylene** (Tolane)	62 5, al		111, yel		96, yel					
48	**9-Ethylphenanthrene**	62 5 3 0, 66, bz -pet eth	198 200	123-4, or -red, al							D_4^{78} 1 0603 n_D^{78} 1 6582

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS
b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Picrate	Styphnate	*sym*-Trinitro benzene derivative	2 4,7 Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4 Dinitro phenyl sulfenyl chloride derivative	Miscellaneous
49	**1,4,5-Trimethylnaphthalene**	63	145^{12}	144 5, red, al	129 30						
50	**4-Methylfluorene**	63, al									In H_2SO_4 sol → grn
51	**1,4,6,7-Tetramethylnaphthalene**	63 4, al		148 9			172 4 3 4				
52	**1,2,3-Trimethylphenanthrene**	63 8 4 8		187 8, or		200 7 1 5, yel, bz -al					
53	**1,8-Dimethylnaphthalene**	65 63	140^{18}	156 148	160						
54	**8-Methyl-3,4-benzphenanthrene**	65 6, al		107 8, red, al							
55	**2-Ethylphenanthrene**	67 8, me al 64 5		95 5 6 0, yel, al, 92 3			180 7 0 9				
56	**3,4-Benzphenanthrene**	68, al		120 8-8 5, red, al			170 8 1 1				
57	**1,3,7-Trimethylphenanthrene**	68 9 me al		163 4 al	160 1						
58	**4-Isopropyl-1-methylphenanthrene**	68 8 5 me al		113 6 4 or, al							
59	**4,8-Dimethylazulene**	69 70, bl, al		157-8, blk al		179 80 red-br, al					
60	**Biphenyl**	69 2 71	254 5 145^{22}					4 4'-*di* 237 229, 2,2',4,4'-*tetra* 150	225	142 3	n_4^{20} 1 475 D_4^{20} 0 866
61	**2-Methyl-3,4-benzphenanthrene**	70 4-1 0 al		141 8 3 2, red, bz -al		145 bz pet eth	158 8 5, or red, aq al				
62	**3-Methylpyrene**	71 2, al		211-2, br -red, bz							Conc H_2SO_4 sol → yel with grn fluorescence on heating → olive grn with vlt fluorescence
63	**1,4,7-Trimethylphenanthrene**	72 3		141 2, me al	129 30						
64	**1,4-Dimethylanthracene**	74, al		140							
66	**4,9-Dimethyl-1,2-benzanthracene**	75 me al		116, br, me al		124-5, red, me al					
67	**Benzalfluorene** (ω-Phenyldibenzfulvene)	76, al		115 6							Dibromide, 116 d
68	**1,3-Dimethylphenanthrene**	76 7, ac a		153 5, or, al	165 6						
69	**1-Methyl-3,4-benzphenanthrene**	77 8	$210^{0\ 4}$	112-3, red, al			171 8 2 2				
70	**3-Isopropyl-1-methylphenanthrene**	79	$180^{1\ 5}$	150	155						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS
b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	*sym* Trinitrobenzene derivative	2,4,7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
71	**1,2′-Binaphthyl**	79 80, 76		127 0–7 5 (cor), or			145 0 6 9				
72	**2,3-Dimethylphenanthrene**	79 80		146 7, or -red, al	147 8, or , al						
73	**1,2,4,5-Tetramethylbenzene** (Durene)	79 2, 80	196 8					3,6-*di* 205	263		
74	**1-Ethyl-2-methylphenanthrene**	80, me al		134 5, me al		152 5–3 0					
75	**1,5-Dimethylnaphthalene**	80 0 0 5, 85% al		140							
76	**6-Methyl-3,4-benzphenanthrene**	80–1, al	206–8[2]	118 0–8 5, red, me al			144 2–4 5				
77	**Naphthalene**	80 3	218	149		153	153 4	1-*mono* 61, 57	172	173 4	
78	**1,3,6,8-Tetramethylnaphthalene**	81	115–6[2]	151–2		175–6					
79	**1-Ethyl-7-methylphenanthrene** (Homopimanthrene)	81, al		115–6, yel , me al							Quinoxaline deriv , 154, ac a
80	**9-Methylanthracene**	81 5	196–7[12]	137 d , red-br							D_4^{99} 1 065, n_D^{99} 1 6959, Irradiation in acetone → dimer, 228 0–8 5 Photooxide, ca 80, exp
81	**1-Isopropyl-7-methylphenanthrene**	82 3	170[1]	119 20, or	148 9, yel	163 4, yel					
82	**6-Methylazulene**	83, bl-vlt		137, 125		141					
83	**1,3-Dimethylanthracene**	83		136							bl fluorescence
84	**2,2′-Dimethylstilbene** (*sym*-Di-*o*-tolylethylene)	83	176 80[10]	102							
85	**1-Methylanthracene**	85 6, me al	199 200	115 6 6 2, red, me al	176 4 7 0, red, me al		219 0–9 8, red, bz				D_4^{99} 1 0471 n_D^{99} 1 6802, Irradiation → dimer, 246
86	**1,7-Dimethylphenanthrene**	86		132, me al	159, me al						
87	**1,6-Diphenylnaphthalene**	86 7		106–8							
88	**1,6-Dimethylphenanthrene**	87–8, me al		134, yel , al							
89	**1,9-Dimethylphenanthrene**	88, al		163 5, or -yel , me al	181						
90	**9-Methylphenanthrene**	90 1, aq al		152 3, al							
91	**1,2,10-Trimethylanthracene**	90 6 1 4, yel		138 5 9 5, al		169 6–170 2, al					
92	**7-Ethyl-1-methylphenanthrene**	91 0 1 5, 84 5			141–2	135–6					
93	**Triphenylmethane**	92	358					4,4′,4″-*tri* 206			Br_2 → bromo deriv , 152
95	**5-Isopropylnaphthanthracene**	92, ac, a		157							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Picrate	Styphnate	*sym* Trinitrobenzene derivative	2,4,7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenylsulfenyl chloride derivative	Miscellaneous
96	**3,9-Dimethyl-1,2-benzanthracene**	93		137–8, red, al		145, red, bz-lgr					
97	**5,6-Benzindane** (2,3-Cyclopentenonaphthalene)	94		120–1							
98	**12-Isopropylnaphthanthracene**	94.5 ac a		157.8							
99	**Acenaphthene**	96.2, yel al	278	162, or-red, al		168, yel, al	175.6	5-*mono* 101	198	187.9 d	n_D^{99} 1.6066, D_4^{99} 1.0242 1,2-Dibromide, 121.3
100	**2,7-Dimethylnaphthalene**	96.7, al	262	136.0–6.5, yel, me al	158.0–9.5, yel, me al						
101	**7-Isopropyl-1-methylfluorene**	96.5–7.0, al						*di* ca 245			
102	**Azulene**	98.5–99	270 d, 115 35[10]	120 d		167					Heat at 270° → Naphthalene, 80.3 2,4,6-Trinitrotoluene deriv, 95.5–100
103	**Retene** (7-Isopropyl-1-methylphenanthrene)	100.5–101, al	390, 158 6.5[0.2]	124–5	141.2	139					D 1.035
104	**Phenanthrene**	101, al, 96.3	340, 332	144 132.8		158, 145	197			250.1	n_D 1.5973 D 1.182
105	**2,7-Dimethylphenanthrene**	101.2, me al		152.3, or, al							
106	**2,3,6-Trimethylnaphthalene**	102, 92.3	286, 146–8[14]	130, yel, me al	165, yel, me al						
107	**2-Phenylnaphthalene**	102–3					169.5 70.5				
108	**1,2,3,4-Tetrahydroanthracene**	103–5					182.4				
109	**2,3-Dimethylnaphthalene** (Guaiene)	104.0 4.5 (subl), al	265–6	123.4							D_4^{20} 1.008
110	**Ethylidenefluorene**	104, ac a		155.6							Dibromide, 93.5
111	**1,7-Dimethylfluorene** (Gibberene)	107.0 7.5		85–6, or-red		98, yel, al					In H_2SO_4 sol → bl
112	**1,1′-Dinaphthylmethane**	110, al	>360, 270[14]	142		141.5	216				
113	**Fluoranthrene**	110		185.6			216				
114	**2,6-Dimethylnaphthalene**	111	261–2	143			156				
115	**2,4-Dimethylphenanthrene**	111, al		138–9, 142, me al							
116	**Fluorene**	113.5, 116–7	293–5	87, 77		105	179	2-*mono* 156, 2,7-*di* 199	228		CrO_3 → Fluorenone, 84
117	**4,10-Dimethyl-1,2-benzanthracene**	114, pa yel, me al		162, blk							
118	**4H-Cyclopenta(def)phenanthrene** (Phenanthrindene)	116, al	353	166							Benzylidene deriv, 108
119	**1,3,8-Trimethylphenanthrene**	116		174–5		188	199				
120	**11-Methylnaphthanthracene**	117–8		159–60, dk red		170, or	238.2 8.6				

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS
b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	*sym*-Trinitrobenzene derivative	2,4,7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
121	**5-Methylchrysene**	117 2 7 8, bz - al		142 6 3 0, or - red, al		172 6 3 6, bz - al					
122	**1,2,5,6-Tetramethylnaphthalene**	118	150 60^{10}	156 7 red	166, bz	180 0 0 5, bz					
123	**Cyclohept(fg)acenaphthene** (Acepleiadene)	118 20 (subl), red, al		150 d							Maleic anh add comp , 248-50, bz
124	**1,2,7-Trimethylphenanthrene**	120 1, al		148 9	169 70						
125	**1',10-Dimethyl-1,2-dibenzanthracene**	122 3, al		147 8, red, al							In H_2SO_4, sol → red
126	**9,10-Dimethyl-1,2-benzanthracene**	122 3		112 3, blk , al *dt* 102 6, red, al							Highly carcinogenic
127	**Benz(bc)aceanthrylene**	122-3, al		141 5 2 0, dk red , al		162 5 3 0 or , al					
128	**1-Methylphenanthrene**	123, aq al		139, yel , al	152 3, yel						
129	**1,6,7-Trimethylphenanthrene**	123 4 al		165 6, or	111 2						
130	**1,1'-Diacenaphthene**	(a) 124, al , (b) 169, pet eth		*dt* 270, red							
131	***trans*-Stilbene**	124, al	305^{720}	94 5		115 20					
132	**3,4-Benzfluorene**	124 5, al		130 1, red, al			191 8				
133	**9-Isopropylnaphthanthracene**	125, al		152							
134	**6-Methylnaphthanthracene**	126 2 7 2, al		149 50, red-br , al			221 4 1 8 163-4, al				
135	**5,8-Dimethyl-1,2-benzanthracene**	131, bz - al		175, red, al							
136	**8-Isopropylnaphthanthracene**	132 3		118							
137	**1,4,5,8-Tetramethylnaphthalene**	132 3		154 6 5 4	143 4 4 2		158-9				
138	**12-Methylnaphthanthracene**	138, yel		115 6, red			234 5 5 0, 209 5 9 7, red, al				
139	**2-Methyl-1',2'-benzpyrene**	138 9, pa yel , me al , after fusing, 140 0 0 2		184 5, br , bz - lgr		211 5- 2 0, red, bz -lgr					
140	**1,5-Dimethylanthracene**	139 40, pa yel		166 7, scar , al							
141	**7-Methylnaphthanthracene**	140		174, dk red			236 1- 6 5				

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	*sym*-Trinitrobenzene derivative	2,4,7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
142	**3,6-Dimethylphenanthrene**	141, al		172 3, or -yel, me al							
143	**5-Methyl-3,4-benzphenanthrene**	141 4 1 9					130 6 1 4, red				
144	**1,4-Dimethylchrysene**	142		141, red, al							
145	**1,2-Dimethylphenanthrene**	142 3, al		148, or, al	153, yel, al						
146	**8,10-Dimethyl-1,2-benzanthracene**	146, bz -al		166, red, al							
147	**1,2,8-Trimethylphenanthrene**	146 7, al	210 20[15]	164 5, or, al		193 0 3 5 al					
148	**3-Methyl-1′,2′-benzpyrene**	146 7 8 1, yel, al -eth		179 5 80 0, br -red, bz -lgr		210 5 11 0, bz -lgr					
149	**9-Methyl-1′,2′-benzpyrene**	146 8 8 0, yel, hexane				218 5 9 5, red, bz -lgr					
150	**9-Phenylfluorene**	147 8, al						*di* ca 240 *tetra* ca 235 d			Bromide, *di* 181 2, *tri* 167 71
151	**2-Methylnaphthanthracene**	149 50, al		180			218 7 9 2				
152	**Pyrene**	149 50, pa yel	385	222, red, al 220, 227			242 3				
153	**9-Methylnaphthanthracene**	150 5 1 5, al		157 8			225 1 5 4				
154	**4-Methylchrysene**	151 0 1 5, bz-al		two forms 135 0 5 5, red, bz -lgr, 137 5 8 0, or, bz -lgr							
155	***trans-trans*-1,4-Diphenyl-1,3-butadiene** (*trans-trans*-Distyryl)	152 5	350	152 3							Maleic anh add comp, 198-200
156	**Cinnamalfluorene**	155, pa yel, ac a		*di* 178 9							Tetrabromide, ca 160 d
157	**5-Methylnaphthanthracene**	155 9 6 9, bz -pet eth		153			235 4 5 6				
158	**1,2-Benzanthracene**	159-60		133			160				
159	**8-Methylnaphthanthracene**	160 0-0 6		166			243 2 3 6				
160	**1,1′-Binaphthyl**	160 5	240 4[12]	145							
161	**Di-1-naphthastilbene** (*sym* -Di-1-naphthylethylene)	161, pa yel, al		*tri* 210							

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	*sym* Trinitrobenzene derivative	2 4 7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2 4 Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
162	**6-Methylchrysene**	161 0 1 4, et ac -al		170 0 0 6, or , bz -al		189 8 190 6, yel , bz -al					
163	**3-Methylnaphthanthracene**	163 0 3 9, al		146 0 6 8			239 0 9 6				
164	**2,6-Dimethyl-1,2-benzanthracene**	164, ac a		199 200							
165	**Cyclopentadienophenanthrene**	164 5		146 7		172 3					In H_2SO_4 sol → bl
166	**10,11-Benzfluoranthene**	165, 166,		194 5		220 0 0 5					
167	**Hexamethylbenzene**	165	264	170		174					
168	**3-Methylchrysene**	170 0 0 5, bz - pet-eth		164 0 4 5, grn , al							
169	**Cholanthrene**	170–1, 173 (subl), pa yel , bz -al		167 8, vlt -blk , bz			245 6				
170	**6-Methyl-1′,2′-benzpyrene**	171 0 1 5, yel , bz -lgr		181 5 2 5 br bz -lgr	209 10, red bz lgr						
171	**6,7-Dimethyl-1,2-benzanthracene**	174, et ac		170							
172	**1,2-Benzpyrene**	176 5 7 5, pa yel , bz - me al	310 2^{10}	197 8, vlt -blk							
173	**5,10-Dimethyl-1,2-benzanthracene**	177, bz - al		174, red-blk , bz							
174	**4,5-Benzpyrene**	178–9, bz		229 30, red, bz							
175	**9,10-Dimethylanthracene**	180 1, al		176–7 d							
176	**10-Methylnaphthanthracene**	183 0– 3 6, yel , al		159 0 9 4							2 4,6 Trinitrotoluene deriv , 224 8 5 0
177	**5,6-Dimethyl-1,2-benzanthracene**	187 8, al		191 3, red, al							
178	**2,2′-Binaphthyl**	188, 181	452	184			171				Lt bl fluorescence, $KMnO_4$ → Phthalic acid, 206 8
179	**1,2-Benzfluorene** (Chrysofluorene)	189–90, ac a , 183–4	413, 398 400	*di* 127 5, 124 6		144-5	213 5 5 5				
180	**1,8-Dimethylphenanthrene**	191–2, bz		151 2, yel			193 4				
181	**8-Methyl-1′,2′-benzpyrene**	192–3, yel , bz		205, dk br , bz		233 d , red, bz					
182	**Bifluorenylidene** (Dibiphenyleneethylene)	194 5 (cor), red		177 8				two *di*-forms 171, dk red, 170, or red			Dibromide, 312, red, bz
183	**1,2,7,8-Dibenzanthracene**	196, bz		212, brt red							Bl -grn fluorescence in sol

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

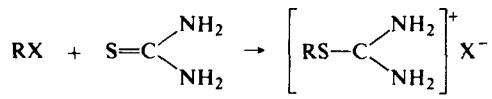
b) Solids. (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	*sym*-Trinitrobenzene derivative	2,4,7-Trinitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
184	**4-Methylnaphthanthracene**	197 4-8 0, al		139 40, lt red			228 2-8 8				
185	**1,2,3,4-Dibenzanthracene**	200 2, pa yel, ac a		207, red							In conc H_2SO_4 sol → pa vlt -red
186	**Di-2-fluorenylmethane**	201 2, al				-		*di* 256 7			$Na_2Cr_2O_7$ → Di-2-fluorenyl ketone, 297-8, yel, ac a
187	**2,3-Benzfluorene**	208 9					221 2-2 0				
188	**5-Methyl-1′,2′-benzpyrene**	215 7-6 2, yel, eth -al		207 8, vlt -blk, bz -lgr		230 1, red, bz -lgr					
189	**Anthracene**	216 2	340 (cor), 226 5[53]	138		164	194				D_4^{27} 1 25, Dibromide, 122, CrO_3 → Anthraquinone, 273
190	**11,12-Benzfluoranthene**	217	480	170 1		182	236 7				
191	**4-Methyl-1′,2′-benzpyrene**	217 5 8 0, yel		203 4, vlt -br, bz							
192	**2,8-Dimethylchrysene**	218, bz		171 2, bz	204, or, bz	195, yel, bz					
193	**2-Methylchrysene**	224 5 5 5, bz -al		143 6, yel, al							
194	**6,12-Dimethylchrysene**	237			207 d, bz	222					
195	**1,2-Benzphenanthrene** (Chrysene)	254, bz	448	273		186	248 9		214		Dibromide, 275
196	**Di-2-naphthastilbene** (*sym*-Di-2-naphthylethylene)	254 5, bz		215							
197	**1-Methylchrysene**	254 5 (cor), (vacuum), bz				174-6, yel, bz					
198	**2,3,6,7-Dibenzphenanthrene**	257, grn -yel		184, or -red							Bl fluorescence in sol, intense yel -grn in u v
199	**2,3,5,6-Dibenzphenanthrene**	261, grn -yel, ac a		*di* 213, or -red							Bl fluorescence in bz sol, grn fluorescence in u v
200	**1,2,5,6-Dibenzanthracene**	262, met, ac a		*di* 214, or							
201	**Perylene**	273 4					270-1				
202	**Picene** (1,2,7,8-Dibenzphenanthrene)	365 6, xyl	518 20				257 8				Dibromide, 295, 2,7-Dianthraquinone add comp, 299-300
203	**1,2,3,4,5,6,7,8-Tetrabenzanthracene**	428 9					318-9, red				
204	**Coronene** (Hexabenzobenzene)	438-40 (cor), yel, bz	525	>250 d, red, bz		>280 d, or, bz					

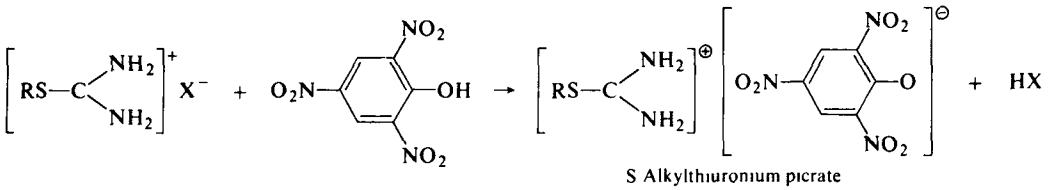
*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE V

*S-Alkylthiuronium picrate (S-Alkylisothiourea picrate)**



S-Alkylthiuronium salt



S Alkylthiuronium picrate

From the alkyl halide with thiourea in 95% ethanol, followed by addition of picric acid in ethanol

For directions and examples see Linstead, pp 82 3, Shriner, p 245, Vogel, pp 291 2, Wild, p 43, E L Brown and N Campbell, *J Chem Soc*, 1699 (1937), W J Levy and N Campbell, *J Chem Soc*, 1442 (1939)

From the alkyl halide with thiourea in ethylene glycol, followed by addition of picric acid in ethanol

See Cheronis, p 550, H M Crosby and J B Entrikin, *J Chem Ed*, **41**, 360 (1964)

1-Naphthylamide (α-Naphthalide) *

$$RX + Mg \rightarrow RMgX$$

$$RMgX + 1\text{-}C_{10}H_7N{=}C{=}O \rightarrow 1\text{-}C_{10}H_7N{=}\overset{\overset{R}{|}}{C}OMgX \xrightarrow{H_2O} \underset{\text{1-Naphthylamide}}{1\text{-}C_{10}H_7NHCOR} + Mg(OH)X$$

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with 1-naphthylisocyanate in ether

For directions and examples see Cheronis, pp 551, 553 Linstead, p 83 Shriner, p 244, Vogel, pp 290-1, Wild, pp 35 37 H Gilman and M Furry, *J Amer Chem Soc*, **50**, 1214 (1928), H W Underwood and J C Gale, *J Amer Chem Soc*, **56**, 2117 (1934)

Anilide *

$$RX + Mg \rightarrow RMgX$$

$$RMgX + C_6H_5N{=}C{=}O \rightarrow C_6H_5N{=}\overset{\overset{R}{|}}{C}OMgX \xrightarrow{H_2O} \underset{\text{Anilide}}{C_6H_5NHCOR} + Mg(OH)X$$

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with phenylisocyanate in ether

For directions and examples see Cheronis, pp 551, 554, Linstead, p 83, Shriner, p 244, Vogel, pp 290 1, Wild, pp 35-7, A M Schwartz and J R Johnson, *J Amer Chem Soc*, **53**, 1063 (1931), H W Underwood and J C Gale, *J Amer Chem Soc*, **56**, 2117 (1934)

Alkylmercuric halide *

$$RX + Mg \rightarrow RMgX$$

$$RMgX + HgX_2 \rightarrow \underset{\substack{\text{Alkyl}\\\text{mercuric}\\\text{halide}}}{RHgX} + MgX_2$$

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with the mercuric salt of the same halogen in ether

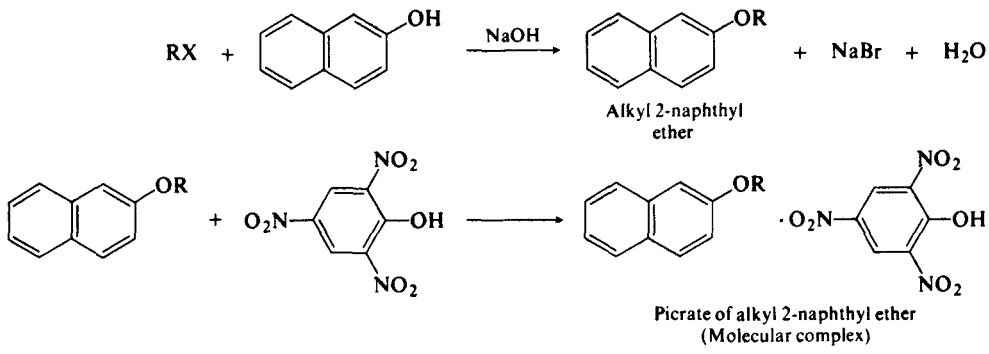
For directions and examples see Cheronis, pp 551, 554, Shriner, p 244, Vogel, p 291, Wild, p 38, C S Marvel, C Gauerke and E L Hill, *J Amer Chem Soc*, **47**, 3009 (1925), E L Hill, *J Amer Chem Soc*, **50**, 167 (1928), K H Slotta and K R Jacobi, *J prakt Chem*, **120**, 249 (1929)

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

*Picrate of alkyl 2-naphthyl ether (Molecular complex).**



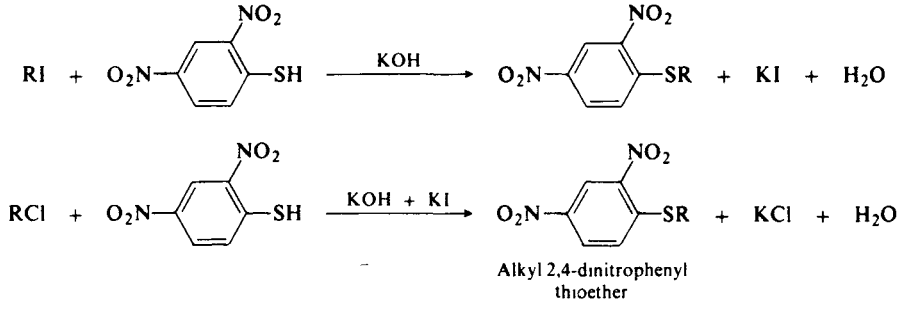
The alkyl 2-naphthyl ether is obtained from the alkyl halide with 2-naphthol in ethanolic sodium or potassium hydroxide.

For directions and examples see: Cheronis, p. 551; Linstead, p. 83; Shriner, p. 244; Vogel, p. 292; Wild, p. 44.

The picrate is obtained from the alkyl 2-naphthyl ether and picric acid in chloroform or ethanol.

See: Cheronis, p. 551; Linstead, p. 83; Vogel, p. 292; Wild, p. 44; O. L. Baril and G. A. Megrdichian, *J. Amer. Chem. Soc.*, **58**, 1415 (1936); V. H. Dermer and O. C. Dermer, *J. Org. Chem.*, **3**, 289 (1938).

Alkyl 2,4-dinitrophenyl thioether (Alkyl 2,4-dinitrophenyl sulfide).



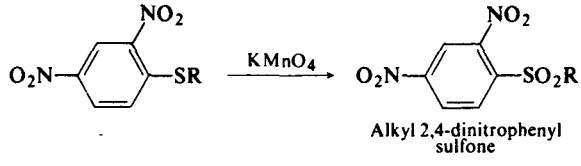
From the alkyl bromide or iodide with 2,4-dinitrothiophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous potassium hydroxide.

For directions and examples see: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, *J. Amer. Chem. Soc.*, **73**, 1968 (1951).

From the alkyl chloride with 2,4-dinitrothiophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) with potassium iodide and aqueous potassium hydroxide.

See: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, *J. Amer. Chem. Soc.*, **73**, 1968 (1951).

Alkyl 2,4-dinitrophenyl sulfone.



From the alkyl 2,4-dinitrophenyl thioether (prepared from the alkyl halide as above) in glacial acetic acid, with aqueous potassium permanganate.

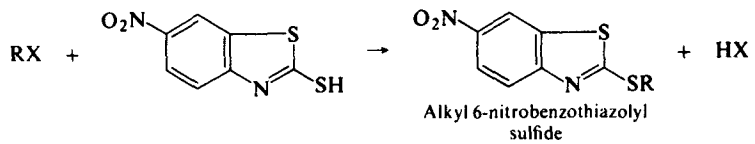
For directions and examples see: R. W. Bost, J. O. Turner and R. D. Norton, *J. Amer. Chem. Soc.*, **54**, 1985 (1932).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

6-Nitro-2-mercaptobenzothiazole derivative.

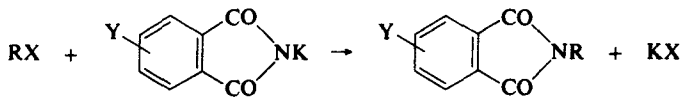


Alkyl 6-nitrobenzothiazolyl sulfide

From the alkyl halide (especially a dihalide) and 6-nitro-2-mercaptobenzothiazole in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous sodium hydroxide.

For directions and examples see: Cheronis, p. 557; H. B. Cutter and H. R. Golden, *J. Amer. Chem. Soc.*, **69**, 831 (1947); H. B. Cutter and A. Kreuchunas, *Anal. Chem.*, **25**, 198 (1953).

Substituted N-alkylphthalimides.



Substituted potassium phthalimide

Substituted N-alkylphthalimide

From the alkyl halide with the potassium salt of the substituted phthalimide.

For directions and examples see: Wild, p. 41.

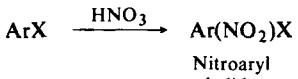
From the alkyl halide with the potassium salt of the substituted phthalimide or with the substituted phthalimide and potassium carbonate in dimethylformamide.

See: J. H. Billman and R. V. Cash, *J. Amer. Chem. Soc.*, **75**, 2499 (1953).

From the alkyl halide with the substituted phthalimide and potassium hydroxide in methanol-dioxane mixture.

See: C. H. Allen and R. V. V. Nicholls, *J. Amer. Chem. Soc.*, **56**, 1409 (1934).

*Nitro derivative.**



Nitroaryl halide

From the aromatic halide with fuming and concentrated nitric acids.

For directions and examples see: Wild, p. 450.

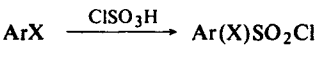
From the aromatic halide with 100% nitric acid.

See: Cheronis, pp. 559–561, 563.

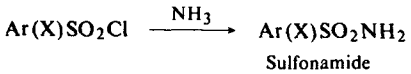
From the aromatic halide with nitric and sulfuric acids.

See: Cheronis, pp. 560, 563; Vogel, p. 543.

*Sulfonamide.**



Sulfonyl chloride



Sulfonamide

The sulfonyl chloride is prepared from the aromatic halide and chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with concentrated ammonia or dry ammonium carbonate.

For directions and examples see: Cheronis, pp. 564, 638, 639; E. H. Huntress and F. H. Carten, *J. Amer. Chem. Soc.*, **62**, 511 (1940).

NOTE: For additional information regarding directions and examples for the derivatization of aromatic halides (through the above reactions or additional ones, e.g., side-chain oxidation) see explanations and references to Table IV, pp. 32, 33, 34.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 1. Chlorides

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	S-Alkyl thiuronium picrate	1 Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	**Methyl chloride**	−24			224	160	114	167		128	185, 189	Methyl-2-naphthyl ether, 70
2	**Vinyl chloride**	−14			104							Polymerizes to solid on irradiation
3	**Ethyl chloride**	13		$0\ 917_0^0$	188	126	104	192	104	115	156, 160	
4	**Isopropyl chloride**	36 5	1 378	0 859	196,148		103		95			
5	**1-Chloropropene**	37					114					
6	**Allyl chloride**	44 5	1 416	0 940	155		114		99			3-Nitrophthalimide deriv , 100-1
7	***n*-Propyl chloride**	46 5	1 388	0 889	181, 176	121	92	147	81	84	126	
8	***tert*-Butyl chloride**	51	1 386	0 846	160-1	147	128	122-3				
9	**Chloroprene**	59	1 458	0 9583								Heating with maleic anh *and boiling the adduct in* water → 4-chloro-1,2,3,6-tetrahydrophthalic acid, 173-5
10	***sec*-Butyl chloride**	68	1 397	0 874	190, 166	129	108	30 5	86	66	120	
11	**Isobutyl chloride**	69	1 398	0 881	174	125	109		85	76	105	
12	**Methallyl chloride** (3-Chloro-2-methyl-1-propene)	72	1 4340	0 9475								Phthalimide deriv , 89-90
13	***n*-Butyl chloride**	78	1 402	0 886	180, 177	112	63	128	67	66	92	
14	**Neopentyl chloride**	85		0 879			130-1	117-8				
15	***tert*-Amyl chloride**	86	1 405	0 865		138	92					
16	**3-Chloro-1-pentene**	93-4	1 4254	0 8978								Phthalimide deriv , 78 9
17	**DL-3-Chloro-2-methyl-1-butene**	94	1 4304	0 9088								Br_2 → dibromo deriv , 197-8
18	**Trimethylvinyl chloride** (3-Chloro-2-methyl-2-butene)	94	1 4320	0 925 (0 905)								Br_2 in ether → dibromo deriv , 197
19	**DL-2-Chloropentane**	97	1 4079	0 8695		102 3	94 6					
20	**3-Pentyl chloride** (3-Chloropentane)	97	1 4082	0 8723		117-8	127, 122					
21	**Isoamyl chloride**	100	1 409	0 872	179, 173	111	108	86	94	80	124	
22	***n*-Amyl chloride** (*n*-Pentyl chloride)	106	1 412	0 882	154	112	96	110	67	80	83	
23	**1-Chloro-2-pentene**	109-10	$1\ 435^{21}$	$0\ 908_4^{21\ 5}$								Phthalimide deriv , 69-70
24	**2-Chloro-2-methylpentane**	110 3	1 4126	0 863		116-8	71-4					
25	**3-Chloro-2,2-dimethylbutane** (Pinacolyl chloride)	112	1 4181	0 8767				89-90				
26	**Cyclopentyl chloride**	114-5	1 4510	1 005				108				
27	**4-Chloro-2,2-dimethylbutane**	115	1 4160	0 8670			138-9	133				
28	**3-Chloro-3-methylpentane**	115-7	1 421	0 89			87-8					
29	**2-Chloro-2,3-dimethylbutane**	117-9		$0\ 8769^{22}$								Carbonation of Grignard and conversion of acid to amide, 125-7, Br_2 → 2,3-dibromo deriv , 166-8 (173-4)
30	**3-Hexyl chloride** (3-Chlorohexane)	123	1 4163	$0\ 870_{20}^{20}$								Grignard reagent + O_2 → 3-hexanol $\xrightarrow{CrO_3/H_2SO_4}$ 3-hexanone, 2,4-Dinitrophenylhydrazone, 147 8 Semicarbazone, 110 11

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 1. Chlorides

a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	S Alkyl thiuronium picrate	1 Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2 naphthyl ether	2 4 Dinitrophenyl thio ether	2 4 Dinitro phenyl sulfone	Miscellaneous
31	**2-Hexyl chloride** (2-Chlorohexane)	123 4	1 4142[21]	0 8694$_4^{21}$			91-2					
32	**1-Chloro-2-ethylbutane**	125-7	1 4230	0 8914			81 2 83-4					
33	**3-Chloro-2,2,3-trimethylbutane**	133										Carbonation of Grignard → acid, 80
34	***n*-Hexyl chloride**	133	1 420	0 878	157	106	69	125		74	97	
35	**Cyclohexyl chloride**	143	1 462	0 989		188	146					6-Nitro-2-mercaptobenzothiazole deriv 100-1 2 sulfone, 189
36	**5-Chloro-2,3-dimethylpentane**	152	1 4299	0 8825			80 1					
37	***n*-Heptyl chloride**	159	1 426	0 877	142	95	57	120		82	101	
38	**Benzyl chloride**	179	1 539	1 100	188	166	117	104	123	130	178, 182	Quaternary salt with dimethyl aniline, 110
39	***n*-Octyl chloride**	180, 184	1 431	0 875	134	91	57	115		78	98	
40	**β-Phenylethyl chloride**	190					97		84			
41	**4-Methylbenzyl chloride**	192	1 5380	1 0512								Phthalimide, 120 117 Carbonation of Grignard → 4-tolylacetic acid, 92
42	**α-Phenylethyl chloride**	195					133					
43	**3-Methylbenzyl chloride**	195-6	1 5327[25]	1 064$_{20}^{20}$								Phthalimide deriv , 117-8, Carbonation of Grignard → 3-tolylacetic acid, 61
44	**2-Methylbenzyl chloride**	197 9										Phthalimide deriv , 148-9, Heating with pyridine → alkyl pyridinium chloride 183
45	**β-Chlorostyrene**	197-9	1 571[25]	1 109								Br_2 in chl → dibromo deriv , 32, Oxid → benzoic acid, 122
46	***n*-Nonyl chloride**	202	1 434	0 870	131					86	92	
47	**2-Chlorobenzyl chloride**	213-4										5-Nitro deriv 66 Carbonation of Grignard → 2-chlorophenylacetic acid, 94-5
48	**4-Chlorobenzyl chloride**	214, 222					166					Oxid → 4-chlorobenzoic acid, 242
49	**3-Chlorobenzyl chloride**	216		1 2695$_4^{15}$								Oxid → 3-chlorobenzoic acid, 158, 155, Heating with 2,4-dichlorophenol in toluene → 2-(3-chlorobenzyl)-4,6-dichlorophenol, 59-60
50	***n*-Decyl chloride**	223	1 437	0 868	137							
51	**4-Isopropylbenzyl chloride**	226-9										Carbonation of Grignard → acid, 52
52	***n*-Undecyl chloride** (*n*-Hendecyl chloride)	241	1 440	0 868	139							
53	***n*-Dodecyl chloride** (Lauryl chloride)	243-4	1 4425	0 8673				114				Refluxed with pyridine → alkyl pyridinium chloride, 92
54	**Cetyl chloride** (Hexadecyl chloride)	286 d			155			102				3-Nitrophthalimide deriv , 101, Alkyl saccharin deriv , 98

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 1. Chlorides

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl-ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	**1,3-Bis(chloromethyl)benzene** (*m*-Xylylene dichloride)	32–4	250–5								Diphthalimide deriv , 237
2	**4-Bromobenzyl chloride**	36–8, 50	236	219							Oxid → 4-bromobenzoic acid, 251
3	**2,4,6-Trimethylbenzyl chloride**	37	130[22]								Hydrolysis → 2,4,6-trimethylbenzyl alcohol, 88–9, Phthalimide deriv , 209–10
4	**2,6-Dichlorobenzyl chloride**	39–40									Carbonation of Grignard → 2,6-dichlorophenylacetic acid, 157 8
5	**1-Chloro-2,2,3,3-tetramethylbutane**	52–3					170–1				Grignard treated with O_2 at −5 → carbinol, 149–50
6	**1,2-Bis(chloromethyl)benzene** (*o*-Xylylene dichloride)	54–5	239–41								Oxid → phthalic acid, 200–6
7	**4-Nitrobenzyl chloride**	71									Oxid → 4-nitrobenzoic acid, 241
8	**1,4-Bis(chloromethyl)benzene** (*p*-Xylylene dichloride)	98–100	240–5								Heating with benzyl alcohol + KOH → dibenzyl ether, 67, Boiling with $Pb(NO_3)_2$ → terephthaldehyde, 115
9	**Triphenylmethyl chloride** (Trityl chloride)	113									Boiling with H_2O → triphenyl carbinol, 162

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 2. Bromides

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	S-Alkyl thiuronium picrate	1 Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	**Methyl bromide**	3 5			224	160	114	172 160		128	185 189	
2	**Vinyl bromide**	16					104					
3	**Ethyl bromide**	38	1 425	1 460	188	126	104	193 198	104	115	156, 160	
4	**1-Bromopropene**	60	1 452	1 4133			114					
5	**Isopropyl bromide**	60	1 425	1 314	196,148		103	93	92	95	140	
6	**Allyl bromide**	71	1 46545	1 398	155		114		99	71		
7	***n*-Propyl bromide**	71	1 4341	1 353	181, 177	121	92	138	75	84	126	
8	***tert*-Butyl bromide**	72 3		1 211		147	128					
9	**Isobutyl bromide**	91	1 435	1 253	174 167	125	109	55	84	76	105	
10	***sec*-Butyl bromide**	91	1 437	1 256	190, 166	129	108	39	85	66	120	
11	***n*-Butyl bromide**	101	1 440	1 274	180, 177	112	63	136, 129	67	66	92	
12	***tert*-Amyl bromide**	108	1 442	$1\ 198\frac{18}{4}$		138	92					
13	**Neopentyl bromide**	109		1 225			126					
14	**DL-2-Pentyl bromide**	117, 113	1 442	1 212		102 3	93					
15	**3-Pentyl bromide**	118	1 443	1 211			124					
16	**Isoamyl bromide**	120-1	1 442	1 213	179, 173	111	108	80	94	80	124	
17	***n*-Amyl bromide** (*n*-Pentyl bromide)	129	1 445	1 219	154	112	96	127, 122	67	80	83	
18	**Cyclopentyl bromide**	137	1 489	1 387								
19	**2-Hexyl bromide** (2-Bromohexane)	146	$1\ 4832^{25}$	1 1658			91-2					
20	***n*-Hexyl bromide**	155 157	1 448	1 175	157	106	69	127 119		74	97	
21	**Cyclohexyl bromide**	165	1 495	1 336		188	146	153				
22	***n*-Heptyl bromide**	180 174	1 451	1 140	142	95	57	118		82	101	
23	**Benzyl bromide**	198		1 438	188	166	117	119	123	130	178, 182	
24	***n*-Octyl bromide**	201, 204	1 453	1 112	134	91	57	109		78	98	
25	**α-Phenylethyl bromide**	205					133					
26	**β-Phenylethyl bromide**	218	1 556	1 359			97	169	84			
27	***n*-Nonyl bromide**	220	1 454	1 090	131			109		86	92	
28	**β-Bromostyrene**	221				217	115	91				
29	***n*-Dodecyl bromide** (Lauryl bromide)	130^{6}	1 458	1 038				108				
30	***n*-Tetradecyl bromide**	179^{20}	1 460	1 017						94	104	m p 5

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 2. Bromides

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	***n*-Hexadecyl bromide** (Cetyl bromide)	14	201[9]	155, 137			101 2		95	105	n_D^{20} 1 462, D_4^{20} 1 001
2	**2-Bromobenzyl bromide**	31		222							CrO_3 → 2-bromobenzoic acid, 150
3	**3-Bromobenzyl bromide**	41		205							CrO_3 → 3-bromobenzoic acid, 155
4	**2-Nitrobenzyl bromide**	46–7									Oxid → 2-nitrobenzoic acid, 146–8
5	**4-Chlorobenzyl bromide**	51		194							CrO_3 → 4-chlorobenzoic acid, 242
6	**3-Nitrobenzyl bromide**	58–9									Oxid → 3-nitrobenzoic acid, 141
7	**4-Bromobenzyl bromide**	62		219							CrO_3 → 4-bromobenzoic acid, 251
8	**4-Nitrobenzyl bromide**	99									Oxid → 4-nitrobenzoic acid, 240

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 3. Iodides

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	**Methyl iodide**	43	1 532	2 282	224	160	114	152, 145	117	128	185, 189	
2	**Vinyl iodide**	56					104					
3	**Ethyl iodide**	72	1 514	1 940	188	126	104	186, 182	104	115	156, 160	
4	**Isopropyl iodide**	90	1 499	1 703	196, 148		103		92	95	140	
5	***n*-Propyl iodide**	102–3	1 505	1 743	181, 176	121	92	113	75	84	126	
6	**Allyl iodide**	103	1 578	1 777	155	121	114	112	99			
7	***tert*-Butyl iodide**	103, 98			188	147	128					
8	***sec*-Butyl iodide**	120	1 499	1 592	190, 166	129	108		85	66	120	
9	**Isobutyl iodide**	120	1 496	1 602	174, 167	125	109	72	84	76	105	
10	***tert*-Amyl iodide**	128		1 479		138	92					
11	***n*-Butyl iodide**	130	1 499	1 616	180, 177	112, 110	63	117	67	66	92	
12	**2-Pentyl iodide**	142	1 496	1 510			93					
13	**3-Pentyl iodide**	142	1 497	1 511			124					
14	**Isoamyl iodide**	148	1 493	1 503	179, 173	111	108	122	94	80	124	
15	***n*-Amyl iodide** (*n*-Pentyl iodide)	155	1 496	1 512	154	112	96	110	67	80	83	
16	**Cyclopentyl iodide**	166–7	1 5447	1 7096								
17	**Cyclohexyl iodide**	179, sl d		$1\ 626_{15}^{15}$		188	146					
18	***n*-Hexyl iodide**	179	1 493	1 437	157	106	69	110		74	97	
19	***n*-Heptyl iodide**	204	1 490	1 373	142	95	57	103		82	101	
20	***n*-Nonyl iodide**	220			131					86	92	
21	***n*-Octyl iodide**	225–6	1 489	1 330	134					78	98	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

A) Alkyl and cycloalkyl halides 3. Iodides

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	***n*-Hexadecyl iodide** (Cetyl iodide)	22		155, 137			82		95	105	
2	**Benzyl iodide**	24		188	166	117		123	130	178, 182	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

B) Dihalides and polyhalides (non-aromatic)

1. Fluorides (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	n_D^{20}	D_4^{20}	Miscellaneous
1	**Perfluorocyclopentane**	22		$1\ 648_4^{25}$	m p 10
2	**1,3-Difluoropropane**	41 2	$1\ 3190^{26}$	$1\ 0057_4^{25}$	
3	**Perfluorocyclohexane**	50			m p 49
4	**Perfluoro-*n*-hexane**	57	$1\ 2515^{22}$	$1\ 6995_4^{25}$	
5	**Perfluoro-2-methylpentane**	58	$1\ 2564^{22}$	1 7326	
6	**Perfluoro-*n*-heptane**	84	1 2770	$1\ 801_4^{25}$	
7	**Perfluoro-*n*-nonane**	127	$1\ 2865^{25}$	$1\ 860_4^{25}$	
8	**Perfluoro-*n*-decane**	150	$1\ 2890^{25}$	$1\ 873_4^{25}$	m p 36
9	**Perfluoro-*n*-undecane** (Perfluoro-*n*-hendecane)	161	$1\ 2960^{25}$	$1\ 919_4^{25}$	m p 57

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

B) Dihalides and polyhalides (non-aromatic)

2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	Miscellaneous
1	**Dichloromethane** (Methylene chloride)	41	1 4237	1 336	6-Nitro-2-mercaptobenzothiazole deriv , 232-3, Di-(2-naphthyl) ether, 133 S-Alkyl *bis*-(thiuronium picrate), 267
2	***trans*-1,2-Dichloroethylene**	48	1 452	1 2569	Br_2 → dibromo deriv , 190 5
3	**1,1-Dichloroethane**	57	1 4164	1 175	1,1-Di-(1-naphthyl)ether, 117
4	***cis*-1,2-Dichloroethylene**	60	$1\ 4428^{25}$	1 282	Br_2 → dibromo deriv , 190-5
5	**Chloroform**	61	1 446	1 489	Gives carbylamine test with primary amines
6	**2,2-Dichloropropane**	70	1 4117	1 093	
7	**1,1,1-Trichloroethane**	74	1 4380	1 349	
8	**Carbon tetrachloride**	77	1 4630	1 595	
9	**Ethylene dichloride** (1,2-Dichloroethane)	84	1 4443	1 256	1 2-Di-(2-naphthyl)ether 217
10	**1,1,2-Trichloroethylene**	87	1 4773	1 464	HgO + NaOEt + KCN in al shaken 1 hr at 40 60 → mercury *bis*-(trichloroethylenide), $Hg(—CCl=CCl_2)_2$, 83, eth
11	**1,2-Dichloropropane**	96	1 4388	1 155	1,2-Di-(2-naphthyl)ether, 152, 1,2-Diphenyl ether, 32
12	**1-Bromo-2-chloroethane**	106-7			6-Nitro-2-mercaptobenzothiazole deriv , 202 3 Di-(2-naphthyl)ether, 217
13	**1,1,2-Trichloroethane**	114	1 4707	1 443	
14	**1,1,2,2-Tetrachloroethylene** (Perchloroethylene)	121	1 5055	1 623	With paraformaldehyde + conc H_2SO_4 → α,α-di-chloro-β-hydroxypropionic acid 88 9
15	**1,2-Dichlorobutane**	123-4	1 440		6-Nitro-2-mercaptobenzothiazole deriv , 164-5
16	**1,3-Dichloropropane**	125	1 449	$1\ 189_4^{18}$ $1\ 177_4^{25}$	1,3-Di-(1 naphthyl)ether, 103-4 1 3-Di-(2-naphthyl) ether 148 9 1,3-Diphenyl ether 60
17	**1,3-Dichloro-2-methylpropane**	135 6	$1\ 4627^{19}$	$1\ 131_{20}^{20}$	
18	**1-Bromo-3-chloropropane**	143 4	1 4861	1 594	1,3-Di-(1-naphthyl) ether, 103-4 1,3-Di-(2-naphthyl) ether, 148-9 1,3-Diphenyl ether, 60
19	**1,1,2,2-Tetrachloroethane**	146	1 4942	1 600	
20	**1,2,3-Trichloropropane**	158	1 4585	1 417	
21	**Pentachloroethane**	161	1 504	1 681	
22	**Benzalchloride**	207, 214	1 5515	$1\ 295^{16}$	Oxid → benzoic acid, 122, Hydrolysis → benzaldehyde, 2,4-Dinitrophenylhydrazone 237, Semicarbazone, 222
23	**Benzotrichloride**	221		$1\ 374_{15}^{17}$	Hydrolysis → benzoic acid, 122
24	**2-Chlorobenzalchloride** (2-Chlorobenzylidene chloride)	228-9	$1\ 5670^{16}$	$1\ 399_{15}^{15}$	Oxid → 2-chlorobenzoic acid, 141 Hydrolysis → 2-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 213 209
25	**3-Chlorobenzalchoride** (3-Chlorobenzylidene chloride)	237-40			Oxid → 3-chlorobenzoic acid, 158 Hydrolysis → 3-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 256 248
26	**4-Chlorobenzalchloride** (4-Chlorobenzylidene chloride)	237			Oxid → 4-chlorobenzoic acid, 240, Hydrolysis → 4-chlorobenzaldehyde, 47 2,4-dinitrophenylhydrazone, , 265

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES
B) Dihalides and polyhalides (non-aromatic) 2. Chlorides
b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	**3,4-Dichlorobenzotrichloride**	26		Hydrolysis → 3,4-Dichlorobenzoic acid, 202
2	**DDT** (2,2-Bis-(4-chlorophenyl)-1,1,1-trichloroethane)	108	260	Heating with Cl_2 + trace PCl_3 in CCl_4 → 1,1,1,2-tetrachloro deriv, 91-2, Nitration → nitro deriv, 148, $AlCl_3$ + benzene → 1,1,2,2-tetraphenylethane, 211
3	**γ-Benzene hexachloride** (Gammexane, 666)	112		
4	**α-Benzene hexachloride**	157	288	Heat above m p → HCl + 1,2,4-trichlorobenzene, 17, b p 213, mononitro deriv, 56, dinitro, 103
5	**Hexachloroethane**	187 subl	185	
6	**β-Benzene hexachloride**	310		Unreactive to boiling pyridine, Unattacked by boiling HNO_3 or H_2SO_4

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

B) Dihalides and polyhalides (non-aromatic)

3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	Miscellaneous
1	**Dibromomethane** (Methylene bromide)	98-9	1 538	2 496	6-Nitro-2-mercaptobenzothiazole deriv , 232 3, S-Alkyl *bis*-(thiuronium picrate), 267
2	**1,1-Dibromoethane**	112	1 5128	2 055	6-Nitro-2-mercaptobenzothiazole deriv , 145 6 1,1-Di-(1 naphthyl) ether, 117
3	**1,2-Dibromoethane**	132	1 5379	2 179	m p 10, 6-Nitro-2-mercaptobenzothiazole deriv 201 2 1,2-Di-(2-naphthyl) ether 217
4	**DL-1,2-Dibromopropane**	141-2	1 5203	1 933	6-Nitro-2-mercaptobenzothiazole, 194 5, 1 2-Di-(2-naphthyl) ether, 152, 1,2-Diphenyl ether, 32
5	**1,2-Dibromo-2-methylpropane**	149	1 512	1 783	
6	**1,2-Dibromo-1-butene**	150		1 887	
7	**Bromoform**	150-1	1 598	2 890°	m p 8
8	**1,3-Dibromopropene**	156	$1\ 538^{25}$	2 097°	
9	**1,1-Dibromo-2-methylpropene**	156 7	1 530	$1\ 866_{20}^{0}$	
10	**2,3-Dibromobutane**	157	1 515	1 792	
11	**1,2-Dibromobutane**	166		1 820	6-Nitro-2-mercaptobenzothiazole deriv , 164 5
12	**1,3-Dibromopropane**	167 8	1 523	1 982	1,3-Di-(1-naphthyl) ether, 103-4 1 3 Di-(2-naphthyl) ether 148 9 1,3-Diphenyl ether, 60
13	**1,3-Dibromo-2-butene**	168-9	1 548	1 877	
14	**1,3-Dibromobutane**	174	1 507	1 820°	
15	**1,1,2-*Tribromoethane***	189	1 5933	2 6211	
16	**1,4-Dibromobutane**	197-8		1 847°	*p*-toluidine (3 moles) $\xrightarrow{\text{heat}}$ N-4 tolylpyrrolidine, 42 dil al
17	**1,2,3-Tribromopropane**	220	1 582	2 402	
18	**1,5-Dibromopentane**	221	$1\ 514^{15}$	$1\ 694_4^{25}$	6-Nitro-2-mercaptobenzothiazole deriv , 132 3 S-Alkyl *bis*-(thiuronium picrate) 247
19	**1,1,2,2-Tetrabromoethane**	243-4	1 638	2 967	
20	**1,8-Dibromooctane**	270-2	$1\ 501^{15}$	$1\ 468^{15}$	m p 15-6, S-Alkyl *bis*-(thiuronium picrate), 214
21	**1,9-Dibromononane**	285-8		$1\ 415^{15}$	m p −2 5, S-Alkyl *bis*-(thiuronium picrate), 193

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

B) Dihalides and polyhalides (non-aromatic)

3. Bromides b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point °C	Miscellaneous
1	**1,7-Dibromoheptane**	42	263	S-Alkyl *bis*-(thiuronium picrate), 208
2	**Carbon tetrabromide**	92	190	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

B) Dihalides and polyhalides (non-aromatic)

4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	n_D^{20}	D_4^{20}	Miscellaneous
1	**Di-iodomethane** (Methylene iodide)	181	1 7425	3 325	6-Nitro-2-mercaptobenzothiazole deriv , 232 3, Di-(2-naphthyl) ether, 133, S-Alkyl *bis*-(thiuronium picrate), 267
2	**1,3-Di-iodopropane**	224	1 6423	2 5755	1,3-Di-(1-naphthyl) ether, 103–4, 1,3-Di-(2-naphthyl) ether, 148–9, 1,3-Diphenyl ether, 60

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

B) Dihalides and polyhalides (non-aromatic)

4. Iodides b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	**1,2-Di-iodoethane**	81		6-Nitro-2-mercaptobenzothiazole deriv , 202 3, 1,2-Di-(2-naphthyl) ether, 217
2	**Iodoform**	119		Comp with quinoline, 65

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES
C) Aryl halides 1. Fluorides (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	**1,3-Difluorobenzene**	82		1 4404[18]	1 1473$_4^{25}$	74	1 3			
2	**Fluorobenzene**	87		1 466	1 024			125	4	
3	**1,4-Difluorobenzene**	88		1 4423[18]	1 1632$_4^{25}$					Boiling with NaOH → 4-fluorophenol, 48, b p 186–8, n_D^{56} 1 5010, D^{56} 1 1889
4	**1,2-Difluorobenzene**	92	−34	1 4451[18]	1 1496$_4^{25}$					
5	**2-Fluorotoluene**	114						105	5	Oxid → 2-fluorobenzoic acid, 127
6	**3-Fluorotoluene**	116						174	6	Oxid → 3-fluorobenzoic acid, 124
7	**4-Fluorotoluene**	117		1 496	0 998			141	2	Oxid → 4-fluorobenzoic acid, 182
8	**1-Fluoronaphthalene**	214		1 594	1 134					Picrate, 113
9	**2-Fluoronaphthalene**		60							Picrate, 101

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

C) Aryl halides 2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	**Chlorobenzene**	132		1 525	1 107	52	2,4	144	4	2,4-Dinitrobenzenesulfenyl chloride adduct, 123 4
2	**2-Chlorotoluene**	159		1 524	1 082	63	3,5	128	5	Oxid → 2-chlorobenzoic acid, 141
3	**3-Chlorotoluene**	162		1 521	1 072	91	4,6	185	6	Oxid → 3-chlorobenzoic acid, 158
4	**4-Chlorotoluene**	162	7	1 521	1 071	38	2	143	2	Oxid → 4-chlorobenzoic acid, 240
5	**1,3-Dichlorobenzene**	173		1 546	1 288	103	4,6	182	6	
6	**1-Chloro-2-ethylbenzene**	178, 180		1 5218	1 057					Oxid → 2-chlorobenzoic acid, 141
7	**1,2-Dichlorobenzene**	179		1 552	1 305	110	4,5	135, 140	4	
8	**1-Chloro-3-ethylbenzene**	184		1 5199	1 053					Oxid → 3-chlorobenzoic acid, 158
9	**1-Chloro-4-ethylbenzene**	184, 180–1		1 5175	1 045					Oxid → 4-chlorobenzoic acid, 240
10	**2-Chloro-1,4-dimethylbenzene**	184–5	2		$1\ 059_{20}^{20}$	77, 101	5, 5,6	155	5	Sulfonyl chloride, 50
11	**1-Chloro-2-vinylbenzene** (*o*-Chlorostyrene)	189		1 5649	1 100					Polymerizes on heating with benzoyl peroxide
12	**1-Chloro-2,3-dimethylbenzene**	190								Oxid → 3-chloro-2-methylbenzoic acid, 159
13	**1-Chloro-2-isopropylbenzene**	191		1 5168	1 0341					Oxid → 2-chlorobenzoic acid, 141
14	**1-Chloro-2,4-dimethylbenzene**	192, 187		$1\ 5230^{25}$	$1\ 0598_{20}^{20}$	42	6	195	6	Oxid $\xrightarrow{CrO_3/H_2SO_4}$ 4-chloro-3-methylbenzoic acid, 209 10, Oxid $\xrightarrow{\text{aq } KMnO_4}$ 4-chloroisophthalic acid, 294 5
15	**1-Chloro-4-vinylbenzene** (*p*-Chlorostyrene)	192		1 5660	1 0868					Polymerizes on heating with peroxide
16	**1-Chloro-3,4-dimethylbenzene**	194–5	−6		$1\ 069_{15}^{15}$	63	5	207	5	$Cl_2 \xrightarrow{Fe}$ 1,2-dichloro-4 5-dimethylbenzene, 76
17	**1-Chloro-4-isopropylbenzene** (*p*-Chlorocumene)	198		1 5117	1 0208			91		Oxid → 4-chlorobenzoic acid, 240
18	**2,6-Dichlorotoluene**	199		1 5510	1 2686	50, 121	3, 3,5			Chlorosulfonic acid in chl → 3-sulfonyl chloride 54 6, 60 Oxid → 2,6-dichlorobenzoic acid 139
19	**2,5-Dichlorotoluene**	199	4–5		$1\ 2535_{20}^{20}$	50 1, 100–1	4, 4,6			Oxid $\xrightarrow{\text{dil } HNO_3}$ 2,5-dichlorobenzoic acid, 154
20	**2,4-Dichlorotoluene**	200		1 549	1 249	104	3,5			Oxid → 2,4-dichlorobenzoic acid, 164
21	**3,5-Dichlorotoluene**	201				61 2, 99–100	2, 2,6	168 9	2	Oxid → 3,5-dichlorobenzoic acid, 188
22	**2-Chloro-1,3,5-trimethylbenzene**	204–6		$1\ 5212^{30}$	$1\ 0337^{30}$	178	4,6	165–6		Oxid $\xrightarrow{\text{aq } KMnO_4}$ 2-chlorobenzene tricarboxylic acid, 285 (anh), 278 (hyd)
23	**2,3-Dichlorotoluene**	207		1 5511		51, 71–2	4, 4,6			Oxid $\xrightarrow{\text{alk } KMnO_4}$ 2,3-dichlorobenzoic acid, 163
24	**3,4-Dichlorotoluene**	209		1 5471	1 2526	63, 91–2	6, 2,6			Oxid → 3,4-dichlorobenzoic acid, 206
25	**1,2,4-Trichlorobenzene**	213	17			56, 103	5, 3,5	>200		Sulfonyl chloride, 31–4
26	**2-Chloro-4-isopropyl-1-methylbenzene** (2-Chloro-*p*-cymene)	217		$1\ 5178^{17}$	$1\ 015_4^{17}$	109–10	5,6			Boiling with dil HNO_3 → 3-chloro-4-methylbenzoic acid, 196
27	**3-Chloro-4-isopropyl-1-methylbenzene** (3-Chloro-*p*-cymene)	217		$1\ 5179^{18}$	$1\ 018_4^{18}$	102–3, 106	2,6			
28	**1-Chloronaphthalene**	259		1 633	1 191	180	4,5			Picrate, 137
29	**3-Chlorobiphenyl**	284–5	16			202–3	4,4′			Oxid → 3-chlorobenzoic acid, 158, 155

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	**2-Chlorobenzotrichloride**	29	283					Hydrolysis → 2-chlorobenzoic acid, 142
2	**2,4,6-Trichlorotoluene**	33 4, 38		54 50 178 80	3, 3 5			Oxid → 2,4,6-trichlorobenzoic acid, 160-1
3	**2-Chlorobiphenyl**	34	273					Oxid → 2-chlorobenzoic acid, 141
4	**1,2-Dichloronaphthalene**	35	296	169	*di*			n_D^{18} 1 6337, D_4^{18} 1 3147 Oxid $\xrightarrow{CrO_3/ac\ a}$ 5,6-dichloro-1,4-naphthoquinone, 181
5	**2,3,4-Trichlorotoluene**	41	231[761]	60, 140-1	5 or 6, 5,6			Oxid → 2,3,4-trichlorobenzoic acid, 186-7
6	**1,2,3,4-Tetrachlorobenzene**	44-5	254	63 5, 151	5, 5,6			
7	**3,4,5-Trichlorotoluene**	44-5	245[768]	81 2, 163-4	2, 2,6			Oxid → 3,4,5-trichlorobenzoic acid, 203, $Cl_2 \xrightarrow{Al/Hg}$ 2,3,4,5-tetrachlorotoluene, 97-8
8	**2,3,5-Trichlorotoluene**	45-6	232	58 9, 149-50	4 or 6, 4,6			Oxid $\xrightarrow{dil\ HNO_3}$ 2,3,5-trichlorobenzoic acid, 162
9	**1,6-Dichloronaphthalene**	48		119	4	216	4	
10	**1,2,3,5-Tetrachlorobenzene**	50-1	246	40-1, 161-2	4, 4,6			
11	**1,2,3-Trichlorobenzene**	52 3	218-9	56, 92-3	4, 4,6	226-30	4	Sulfonyl chloride, 65
12	**1,4-Dichlorobenzene**	53	173	54	2	180 186	2	
13	**4,4'-Dichlorodiphenylmethane**	55	337	198-9	3,3'			Oxid $\xrightarrow{CrO_3/ac\ a}$ 4,4'-dichlorobenzophenone, 145
14	**2-Chloronaphthalene**	56, 61	265	175	1,8	126		Picrate, 81
15	**2,2'-Dichlorobiphenyl**	60		203-5	5,5'			
16	**1,3-Dichloronaphthalene**	61	291[775]	150 and 158	*di*			Oxid $\xrightarrow{dil\ HNO_3}$ phthalic acid, 200-6
17	**1,3,5-Trichlorobenzene**	63	208	68	2	210 2		Sulfonyl chloride, 35-40
18	**1,7-Dichloronaphthalene**	63-4	286	138-9		226	4	Sulfonyl chloride, 118
19	**1-Bromo-4-chlorobenzene**	67	197	72	2			
20	**1,4-Dichloronaphthalene**	68	286[740]	92	8	244	6	Oxid $\xrightarrow{CrO_3/ac\ a}$ 5,8-dichloro-1,4-naphthoquinone, 173 4 Boiling HNO_3 (D = 1 3) → 3 6-dichlorophthalic acid, 194 185
21	**2,5-Dichloro-1,4-dimethylbenzene** (2,5-Dichloro *p*-xylene)	68	224					Oxid → 2,5-dichloroterephthalic acid, 306
22	**4-Chlorobiphenyl**	77	293					Oxid → 4-chlorobenzoic acid, 240
23	**2,4,5-Trichlorotoluene**	82	230[715]	89-90, 226 7	3, 3,6			Oxid → 2,4,5-trichlorobenzoic acid, 168
24	**Pentachlorobenzene**	86, 84	276	143, 146	6			
25	**1,8-Dichloronaphthalene**	89				228	4	Sulfonyl chloride, 141
26	**1,5-Dichloronaphthalene**	107		142	8	204	3	Oxid $\xrightarrow{CrO_3/ac\ a}$ 3-chlorophthalic acid, 185 7 Picrate, 87
27	**2,7-Dichloronaphthalene**	114 5		141 2	*mono*	218	3	Oxid $\xrightarrow{dil\ HNO_3}$ 4-chlorophthalic acid, 157
28	**2,6-Dichloronaphthalene**	135-6	285			269	4	Sulfonyl chloride, 136, Cl_2 in chl → 1,2,6-trichloronaphthalene, 92 Oxid $\xrightarrow{CrO_3/ac\ a}$ 1 4-naphthoquinone deriv 148 9
29	**1,2,4,5-Tetrachlorobenzene**	140	245	99, 232	3, 3,6			Chlorosulfonic acid → hexachlorobenzene, 229
30	**4,4'-Dichlorobiphenyl**	149						Oxid → 4-chlorobenzoic acid, 240

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
31	**5,6,7,8-Tetrachlorotetralin**	174	180^{26}					Br_2 in CS_2 → 1,2-dibromo-5,6,7,8-tetrachloronaphthalene, 142
32	**1,2,3,4-Tetrachlorotetralin**	182, 187						Oxid $\xrightarrow{CrO_3/ac\ a}$ 2,4-dichloro-1-naphthol, 106–7 Boiling HNO_3 → phthalic acid, 200–6
33	**Octachloronaphthalene**	198, 200	442					Oxid $\xrightarrow{fuming\ HNO_3}$ hexachloro-1,4-naphthoquinone, 222 $SbCl_5$ in CCl_4 → cherry-red color
34	**9,10-Dichloroanthracene** (*meso*-Dichloroanthracene)	209–10, yel				279	2	Sulfonyl chloride, 221–5, Oxid → 9,10-anthraquinone, 286, Maleic anh adduct, 258 9
35	**Hexachlorobenzene**	229, subl, 226	309					Boiling with fuming HNO_3 + conc H_2SO_4 → tetrachloro-1,4-benzoquinone (chloroanil), 290

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

C) Aryl halides 3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	**Bromobenzene**	156		1 560	1 494	70–2	2,4	166 161	4	1-Naphthylamide, 161, 2,4-Dinitrobenzenesulfenyl chloride adduct 140–1
2	**2-Bromotoluene**	182			1 425	82	3,5	146	5	Oxid → 2-bromobenzoic acid, 150
3	**3-Bromotoluene**	184			1 410	103	4,6	168	6	Oxid → 3-bromobenzoic acid, 155
4	**1-Bromo-2-ethylbenzene**	199		1 5486	1 355					Oxid → 2-bromobenzoic acid, 150
5	**1-Bromo-4-ethylbenzene**	205		1 5448	1 342					Oxid → 4-bromobenzoic acid, 251
6	**1-Bromo-2-vinylbenzene** (*o*-Bromostyrene)	210		1 5927	1 4160					Polymerizes on heating with benzoyl peroxide
7	**1-Bromo-2-isopropylbenzene**	210		1 5408	1 3020					Oxid → 2-bromobenzoic acid, 150
8	**1-Bromo-4-vinylbenzene** (*p*-Bromostyrene)	212		1 5947	1 398					Polymerizes on heating with benzoyl peroxide, Oxid → 4-bromobenzoic acid, 251
9	**1-Bromo-2,3-dimethylbenzene**	217								Oxid → 3-bromophthalic acid, 188
10	**1,3-Dibromobenzene**	219		1 606	1 952	61	4	190	6	
11	**1-Bromo-4-isopropylbenzene**	219		1 5361	1 2854					Oxid → 4-bromobenzoic acid, 251
12	**1,2-Dibromobenzene**	219		1 609	1 956	114	4,5	176	4	
13	**2-Bromocymene**	234			1 267	97				Anilide, 143
14	**2,5-Dibromotoluene**	236			1 811					Oxid → 2,5-dibromobenzoic acid, 157
15	**3,4-Dibromotoluene**	240			1 81					Oxid → 3,4-dibromobenzoic acid 235
16	**1-Bromonaphthalene**	281		1 658	1 484	85	4	191 3	4	Picrate, 134, Carbonation of Grignard → 1-naphthoic acid, 162
17	**2-Bromobiphenyl**	297								Oxid → 2-bromobenzoic acid, 150

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES
C) Aryl halides 3. Bromides b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of *nitro* groups	M P	Position of sulfonamide group	
1	**4-Bromotoluene**	28–9	184					Oxid → 4-bromobenzoic acid, 251
2	**2-Bromonaphthalene**	59	281			208	8	Picrate, 86, 79, 2,4,7-Trinitrofluorenone adduct, 138–40
3	**1,2-Dibromonaphthalene**	67						Oxid → 3,4-dibromophthalic acid, 196
4	**1,4-Dibromonaphthalene**	82						Oxid → 3,6-dibromophthalic acid, 135
5	**1,4-Dibromobenzene**	89	219	84	2,5	195	2	
6	**4-Bromobiphenyl**	89	310					Oxid → 4-bromobenzoic acid, 251
7	**1,3,5-Tribromobenzene**	120	271			222	2	
8	**4,4'-Dibromobiphenyl**	164						Oxid → 4-bromobenzoic acid, 251
9	**1,2,4,5-Tetrabromobenzene**	180		168	3			

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

C) Aryl halides 4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	**Iodobenzene**	188-7		1 620	1 831	171	4			Br_2 → 1-Bromo-4 iodobenzene 91
2	**3-Iodotoluene**	204			1 698	108	4,6			Oxid → 3-iodobenzoic acid, 187
3	**2-Iodotoluene**	211			1 698	103	6			Oxid → 2-iodobenzoic acid, 162
4	**1-Iodo-4-isopropylbenzene**	236-8								Cl_2 in chl → dichloride ($ArICl_2$) 110
5	**1-Iodonaphthalene**	305								Picrate, 128

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES
C) Aryl halides 4. Iodides b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	**4-Iodotoluene**	35	211					HNO_3 at 200° → 4-iodobenzoic acid, 270
2	**1-Iodo-2,4,5-trimethylbenzene**	37	256–8					Cl_2 in chl → dichloride ($ArICl_2$), 66
3	**1,3-Di-iodobenzene**	40	285					
4	**2-Iodonaphthalene**	55	309					Picrate, 95
5	**4-Iodobiphenyl**	114	320 d					Cl_2 in chl → dichloride ($ArICl_2$), 102
6	**1,4-Di-iodobenzene**	129	289	171	2,5			

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE VI

Phenylurethane.

$$ROH + C_6H_5N{=}C{=}O \rightarrow C_6H_5NHCOOR$$

Phenylurethane
(Phenylcarbamate)

From the dry alcohol with phenylisocyanate without solvent.

For directions and examples see: Linstead, pp. 34–35; Shriner, p. 211; Vogel, p. 264; B. T. Dewey and N. F. Witt, *Ind. Eng. Chem., Anal. Ed.*, **12**, 459 (1940); **14**, 648 (1942).

From the dry alcohol with phenylisocyanate in petrol ether.

See: Wild, pp. 55–57.

*1-Naphthylurethane (α-Naphthylcarbamate).**

$$ROH + 1\text{-}C_{10}H_7N{=}C{=}O \rightarrow 1\text{-}C_{10}H_7NHCOOR$$

1-Naphthylurethane
(α-Naphthylcarbamate)

From the dry alcohol with 1-naphthylisocyanate without solvent.

For directions and examples see: Cheronis, pp. 475–479; Linstead, pp. 34–35; Shriner, p. 211; Vogel, p. 264; V. T. Bickel and H. E. French, *J. Amer. Chem. Soc.*, **48**, 747 (1926); H. E. French and A. F. Wirtel, *J Amer. Chem. Soc.*, **48**, 1736 (1926).

From the dry alcohol with 1-naphthylisocyanate in petrol ether.

See: Cheronis, pp. 476–477; Wild, pp. 55–57.

p-Xenylurethane (4-Biphenylylurethane).

$$ROH + p\text{-}C_6H_5C_6H_4N{=}C{=}O \rightarrow p\text{-}C_6H_5C_6H_4NHCOOR$$

p-Xenylurethane
(4-Biphenylylcarbamate)

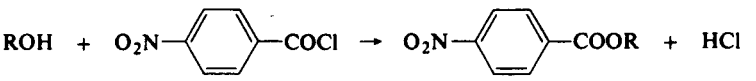
From the alcohol with *p*-xenylisocyanate in toluene.

For directions and examples see: G. T. Morgan and A. E. J. Pettet, *J. Chem. Soc.*, 1124 (1931); B. Witten and E. E. Reid, *J. Amer. Chem. Soc.*, **69**, 2470 (1947).

From the alcohol with *p*-xenylisocyanate in a benzene—petrol ether mixture.

See: M. J. van Gelderen, *Rec. Trav. chim.*, **52**, 969 (1933).

*p-Nitrobenzoate.**



p-Nitrobenzoate

From the alcohol in excess and *p*-nitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467–469, 471; Shriner, p. 212; Vogel, p. 263; Wild, p. 52; M. D. Armstrong and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **65**, 2252 (1943).

From an aqueous solution of the alcohol with *p*-nitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468–469, 472.

From the alcohol with *p*-nitrobenzoyl chloride in pyridine.

See: Shriner, p. 212; Wild, p. 52; L. F. King, *J. Amer. Chem. Soc.*, **61**, 2383 (1939).

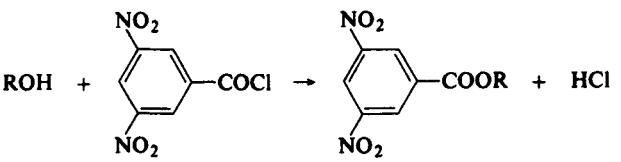
From the alcohol with *p*-nitrobenzoyl chloride in aqueous sodium hydroxide.

See: Wild, p. 52.

From the alcohol with *p*-nitrobenzoyl chloride in an aqueous solution of sodium acetate and potassium hydroxide at low temperature.

See: Wild, p. 53; F. A. Menalda, *Rec. Trav. chim.*, **49**, 967 (1930); H. Henstock, *J. Chem. Soc.*, 216 (1933).

*3,5-Dinitrobenzoate.**



3,5-Dinitrobenzoate

Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)

From the alcohol in excess with 3,5-dinitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467–470; Shriner, pp. 212–213; Vogel, p. 262; G. B. Malone and E. E. Reid, *J. Amer. Chem. Soc.*, **51**, 3424 (1929).

From an aqueous solution of the alcohol with 3,5-dinitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468–469, 472.

From the alcohol with 3,5-dinitrobenzoyl chloride and pyridine in benzene.

See: Linstead, p. 34; Wild, p. 53; T. Reichstein, *Helv. chim. Acta*, **9**, 799 (1926); W. M. D. Bryant, *J. Amer. Chem. Soc.*, **54**, 3758 (1932).

From the alcohol with 3,5-dinitrobenzoyl chloride and a catalytic amount of pyridine in isopropyl or *n*-butyl ether.

See: Cheronis, pp. 469, 471.

From the alcohol with 3,5-dinitrobenzoyl chloride in pyridine.

See: Cheronis, p. 469; Shriner, pp. 212–213; Vogel, pp. 262–263.

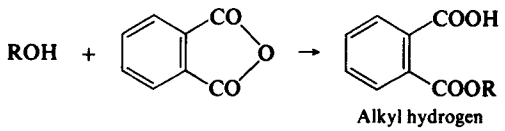
From the alcohol with 3,5-dinitrobenzoyl chloride in aqueous potassium hydroxide.

See: Linstead, p. 34.

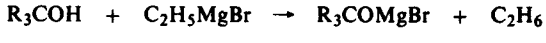
From the alcohol in aqueous sodium hydroxide and potassium acetate with 3,5-dinitrobenzoyl chloride in a benzene-ligroin mixture.

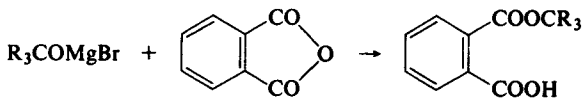
See: Wild, pp. 53–54; W. N. Lipscomb and R. H. Baker, *J. Amer. Chem. Soc.*, **64**, 179 (1942).

*Hydrogen phthalate.**



Alkyl hydrogen phthalate





tert-Alkyl hydrogen phthalate

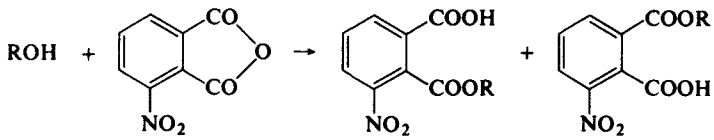
From the alcohol with phthalic anhydride.

For directions and examples see: E. E. Reid, *J. Amer. Chem. Soc.*, **39**, 1250 (1917); J. F. Goggans and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **61**, 2909 (1939).

From the alkoxymagnesium halide derived from a tertiary alcohol (prepared from the alcohol with ethylmagnesium bromide) with phthalic anhydride in ether or an ether-dioxan mixture.

See: W. A. Fessler and R. L. Shriner, *J. Amer. Chem. Soc.*, **58**, 1384 (1936).

*Hydrogen 3-nitrophthalate.**



Main product Trace

Hydrogen 3-nitrophthalates
(3-Nitrophthalic acid monoalkyl esters)

From the alcohol with 3-nitrophthalic anhydride.

For directions and examples see: Cheronis, pp. 473–474; Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **59**, 1094 (1937); B. H. Nicolet and J. Sacks, *J. Amer. Chem. Soc.*, **47**, 2348 (1925); A. J. Veraguth and H. Diehl, *J. Amer. Chem. Soc.*, **62**, 233 (1940).

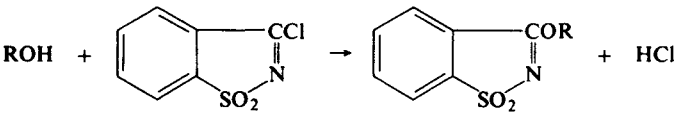
From a high boiling alcohol with 3-nitrophthalic anhydride in toluene.

See: Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **59**, 1094 (1937).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

Pseudosaccharin ether (Pseudosaccharin derivative).



Pseudosaccharin chloride — Pseudosaccharin ether

From the alcohol with pseudosaccharin chloride without solvent.

For directions and examples see: Vogel, p. 266; Wild, pp. 60–61; J. R. Meadoe and E. E. Reid, *J. Amer. Chem. Soc.*, **65**, 457 (1943).

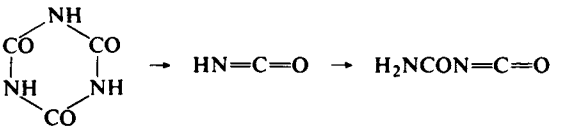
From the alcohol with pseudosaccharin chloride in chloroform.

See: H. Böhme and H. Opper, *Z. Anal. Chem.*, **139**, 255 (1953).

From the alcohol with pseudosaccharin chloride and a catalytic amount of pyridine in chloroform.

See: Cheronis, p. 482; H. Böhme and H. Opper, *Z. Anal. Chem.*, **139**, 255 (1953).

Allophanate



Cyanuric acid — Cyanic acid — Cyanic acid dimer

$$ROH + H_2NCON{=}C{=}O \rightarrow H_2NCONHCOOR$$

Allophanate

From the alcohol with cyanic acid (prepared from the depolymerization of cyanuric acid).

For directions and examples see: Linstead, p. 36; A. Behál, *Compt. rend.*, **168**, 945 (1919); M. A. Spielman, J. D. Barnes and W. J. Close, *J. Amer. Chem. Soc.*, **72**, 2520 (1950); H. W. Blohm and E. I. Becker, *J. Amer. Chem. Soc.*, **72**, 5342 (1950); *Chem. Revs.*, **51**, 471 (1952).

From the alcohol with sodium cyanate and dry hydrochloric acid in dioxane.

See: E. S. Lane, *J. Chem. Soc.*, 2764 (1951).

*Benzoate.**

$$ROH + C_6H_5COCl \rightarrow C_6H_5COOR + HCl$$

Benzoate

Especially for polyhydric alcohols.

From the alcohol with benzoyl chloride.

For directions and examples see: Shriner, p. 212.

From the alcohol with benzoyl chloride in anhydrous pyridine.

See: Cheronis, pp. 481–482; Shriner, p. 212; Vogel, pp. 243, 447.

From the alcohol with benzoyl chloride in aqueous sodium hydroxide.

See: Vogel, p. 447.

Acetate.

$$ROH + (CH_3CO)_2O \rightarrow CH_3COOR + CH_3COOH$$

$$R_3COH + CH_3COCl \rightarrow CH_3COOCR_3 + HCl$$

Acetate

Especially for polyhydric alcohols.

From the alcohol with acetic anhydride and sodium acetate.

For directions and examples see: Linstead, pp. 35, 39; Shriner, p. 212.

From the alcohol with acetic anhydride in pyridine.

See: Shriner, p. 212.

From the alcohol (especially a tertiary alcohol) with acetyl chloride in the presence of magnesium.

See: A. Spassow, *Chem. Ber.*, **70B**, 1926 (1937).

NOTE: For additional information regarding directions and examples for the preparation of derivatives of polyhydric alcohols see explanations and references to Table XIX, p. 326.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Phenylurethane	1 Naphthylurethane	4 Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
1	**Methanol** (Methyl alcohol)	64 65	f p −97	1 3306[15]	0 7915	47, al	124, lgr	96, dil al	108 (cor), al	153 (cor)	82 5 (cor)	Pseudosaccharin ether, 182 (cor)
2	**Ethanol** (Ethyl alcohol)	78 32	f p −117 3	1 3610	0 7894	52	79, lgr	57, al	93, al	158 (cor), w	48	Pseudosaccharin ether, 219 (cor)
3	**2-Propanol** (Isopropyl alcohol)	82 4	−89 5	1 37927	0 78507	75-6, lt pet	106	110 5, lt pet 108	123, pet eth	154 (cor), w		Pseudosaccharin ether, 137 (cor)
4	***d,l*-3-Buten-2-ol** (Methyl vinyl carbinol)	94-6								43-4		Allophanate, 152, Constant boil mixt with 21 76% w , b p 80
5	**2-Propen-1-ol** (Allyl alcohol)	97 1		1 41345	0 8540	70	108	28	49-50	124		
6	**1-Propanol** (*n*-Propyl alcohol)	97 1		1 38499	0 80359	57, pet	80, 76	35, pet	74, pet eth	145 5 (cor), w	54 1-4 (cor), pet eth - bz (9 1)	Pseudosaccharin ether, 124 5 (cor)
7	**2-Butanol** (*d,l-sec*-Butyl alcohol, Ethyl methyl carbinol)	99 5		1 39495[25]	0 80692	64 5, pet	97	25-6, dil al	76	131 (cor)	59-60	Pseudosaccharin ether, 65 5 (cor)
8	**2-Methyl-2-butanol** (*tert*-Amyl alcohol)	102 3	−8 55	1 4052	0 80889	42, pet eth	72	85	116, 117-8			
9	**2-Fluoroethanol**	105		1 3633[25]			128					
10	**2-Methyl-1-propanol** (Isobutyl alcohol)	108 1		1 3939[25]	0 80196	86, lgr	104	69	87	180 5 (cor)	65, pet eth	Pseudosaccharin ether, 100 (cor)
11	**3-Buten-1-ol**	122 5-3 5[755]				23 4-4 5						
12	***d,l*-3-Methyl-2-butanol** (*sec*-Isoamyl alcohol, *d,l*-Isopropyl methyl carbinol)	114, *d* 110-2		1 3973	0 8180	68	109			127	39, *d* 34, *l* 34	*d* $[\alpha]_D^{20}$ +5 34, in al
13	**3-Pentanol** (*sym-sec*-Amyl alcohol, Diethyl carbinol)	116 1		1 4103	0 82037	48-9	95, lgr	17	101, 99, 97	121		
14	**1-Butanol** (*n*-Butyl alcohol)	117 6, 116	−90 2	1 3974[25]	0 80960	61	71	70, 64 35-6	64, 62 5	147 (cor)	73 1-5 (cor)	Pseudosaccharin ether, 96 (cor)
15	***d,l*-2-Pentanol** (*sec*-Amyl alcohol)	119 85		1 4060	0 80919		74 5, 76, *d* 88-91	17	62	102-3	60-1, *d* 34, *l* 34	Pseudosaccharin ether, 38 (cor)
16	**3,3-Dimethyl-2-butanol** (*d,l*-Pinacolyl alcohol, *tert*-Butyl methyl carbinol)	120 4	5 3	1 4148	0 8185	77-8, pet eth			107, yel - wh , pet eth		85-6, lt pet	
17	**2,3-Dimethyl-2-butanol** (Dimethyl isopropyl carbinol)	120 5	−14	1 4140	0 8208	65-6, pet eth	101		111, yel , bz - pet eth			
18	**3-Methyl-3-pentanol**	123	−22	1 4166[25]	$0\ 82334_4^{25}$	43 5	83 5		96 5, yel , pet eth , 62 5			Allophanate, 152 (cor)

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Phenyl urethane	1-Naphthyl urethane	4 Nitro benzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
19	**2-Methyl-2-pentanol** (Dimethyl *n*-propyl carbinol)	123, 121	−103, −108	1 4113	0 81341				72			Benzoate, 182 3, al , Allophanate, 128
20	**2-Methoxyethanol** (Methyl cellosolve, Ethylene glycol monomethyl ether)	124 5		1 40238	0 9647		112 5 3 0	50 5, dil al		129, dil al		Diphenyl urethane, 51
21	**2-Methyl-3-pentanol** (Ethyl isopropyl carbinol)	127 5		1 4168	0 82487	50			85, yel , pet eth	150 7	70 69 71, racemic	
22	**1-Chloro-2-propanol**	127							77			
23	**2-Methyl-1-butanol** (Active amyl alcohol, *d-sec*-Butyl carbinol)	128 9		1 4107	0 8193	31	82, lgr		70	157 8, w		$[\alpha]_D^{20}$ −5 756
24	**2-Chloroethanol** (Ethylene chlorohydrin)	131				51	101			98		
25	***d,l*-4-Methyl-2-pentanol** (Isobutyl methyl carbinol)	132		1 4011	0 80713	143, et ac	88	26	65, yel , pet eth			
26	**3-Methyl-1-butanol** (*prim*-Isoamyl alcohol)	132	−117	$1\ 40851^{15}$	0 80918	56–7, lgr	68	21	61	166 3 (cor), 30% al 165–6, w		Pseudosaccharin ether, 64 (cor)
27	***d,l*-2-Chloro-1-propanol**	133 4		1 436	1 103				76			Alkali + heat → propylene oxide b p 35
28	**3-Methyl-2-pentanol** (*sec*-Butyl methyl carbinol)	$134\ 2^{749}$					72		43 5, yel , pet eth , 41			
29	**2-Ethoxyethanol** (Ethylene glycol monoethyl ether)	135		1 40797	0 9297		67 3- 5		75, al	118 8 6 (*anh*), 94 2 4 (monohyd) *w* -al		Diphenyl urethane, 43
30	**3-Hexanol** (Ethyl *n*-propyl carbinol)	136		1 4159	0 81851				97, yel - wh , pet eth		76–7, pet eth	
31	**2,2-Dimethyl-1-butanol** (*tert*-Amyl carbinol)	136 7		1 4208	0 82834	65–6	80–1, lgr			51, yel , pet eth		Pseudosaccharin ether, 68–9 lt pet
32	**1-Pentanol** (*n*-Amyl alcohol)	138 (cor)	−78 5	1 40994	0 81479	46	68	11	46 4	136 (cor)	75 5	Pseudosaccharin ether, 62 (cor)
33	***d,l*-2-Hexanol** (*n*-Butyl methyl carbinol)	$138\ 9^{745}$		$1\ 4126^{25}$	$0\ 80977_4^{25}$		60 5	40	38 5		*d* 29	3,5-Dinitrophenyl urethane, 40
34	**2,4-Dimethyl-3-pentanol**	140		1 42259	0 8288	95, eth - pet eth , 96–9	95, 99	155		150–1		Camphor-like odor
35	**Cyclopentanol**	140 85		1 4530	0 94688	132 5, al	118					
36	**2-Isopropoxyethanol** (Ethylene glycol monoisopropyl ether)	$141\ 5^{736}$		1 40954	0 9030							Triphenylmethyl ether, 71 0- 5, me al

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS.
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Phenylurethane	1 Naphthylurethane	4 Nitrobenzoate	3 5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
37	**3-Ethyl-3-pentanol** (Triethyl carbinol)	142		1 4305	0 83889							Camphor-like odor, Allophanate, 152 (cor)
38	**2,3-Dimethyl-1-butanol**	145		1 4195	$0\ 8297_4^{20\cdot5}$	28 9			51 5, pa yel , pet eth			
39	**3-Hydroxy-2-butanone** (*d,l*-Acetoin, Acetyl methyl carbinol)	145	−72	1 4178	$0\ 9861_4^{30}$							Semicarbazone, 185, al , 202, 2,4-Dinitrophenylhydrazone, 318, or , $PhNO_2$-tol
40	**1-Hydroxy-2-propanone** (Acetol Acetyl carbinol)	146	−17	1 4295	$1\ 0824_{20}^{20}$							Semicarbazone, 196, al , 2,4-Dinitrophenylhydrazone, 128 5 (cor), or , al
41	**2-Methyl-1-pentanol** (2-Methyl-*n*-amyl alcohol)	148 0		1 4190	0 8208		75 6		50 5, yel , pet eth	145, 141, bz		
42	**2-Ethylbutanol**	148 9		1 4224	0 83345				51 5, pet eth			
43	**2-Bromoethanol** (Ethylene bromohydrin)	149d					86					
44	**2-*n*-Propoxyethanol** (Ethylene glycol mono-*n*-propyl ether)	$150\ 0^{736}$		1 41328	0 9112							
45	**Trichloroethanol**	151	19			87	120	71, al	142 3			Urethane 64 5
46	**3-Methyl-1-pentanol**	151-2 153 7 4 1		1 4188	0 8242		58 *d,l* 40-1, *d* 38-40 *l* 37 8		38, yel pet eth			
47	**4-Methyl-1-pentanol** (Isoamyl carbinol Isohexyl alcohol)	152 3		1 4153	0 8131	48 (cor)			72, pet eth 69 8 (cor)	138 5 40, bz - pet eth		
48	***d,l*-4-Heptanol** (Di-*n* propyl carbinol)	156	−41 5	1 4205	0 8183		78 80	35	64		60	
49	**1-Hexanol** (*n*-Hexyl alcohol)	157 5	−51 6 −46 1	1 41778	0 81893	42	59 62	5	58 4 (cor), 60 1	124 (cor), 123	25	Pseudosaccharin ether 60 (cor)
50	***d l*-2-Heptanol** (*n*-Amyl methyl carbinol, *sec*-Heptyl alcohol)	158 7		1 4210	0 8167		54		49 4		57 5 *d,l* 76 5	
51	**2-Isobutoxyethanol** (Ethylene glycol mono-isobutyl ether)	$159\ 3^{746}$		1 41428	0 8900							
52	**2-*sec*-Butoxyethanol** (Ethylene glycol mono-*sec*-butyl ether)	$159\ 3^{746}$		1 41606	0 8966							
53	**2,4-Dimethyl-1-pentanol**	159 8		1 427	0 793					154-5, bz -pet eth		*p*-Xenylurethane, 74-5, pet

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Phenylurethane	1-Naphthylurethane	4-Nitrobenzoate	3,5 Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
54	**3-Chloro-1-propanol** (3-Chloropropyl alcohol)	161 2				38	76		77			
55	**2-Methyl-1-hexanol**	164 5		1 4250	0 8270					131 2, wh , pet		*p*-Xenylurethane, 88 0- 5, pet
56	**2-Ethyl-1-pentanol** (2-Ethyl-*n*-amyl alcohol)	164 6								127 8, bz - pet		*p*-Xenylurethane, 77-77 5, pet
57	***d,l*-4-Methyl-1-hexanol**	165 173		1 4219	0 8239		50			149		Odor of Amyl alcohol
58	***d,l-cis*-2-Methylcyclohexanol** (*cis*-Hexahydro-*o*-cresol)	165 3	−9 3	1 4640	0 9340	90 1 93 4		51 2 55 6	98 9		103 4 104 5	
59	**4-Hydroxy-4-methyl-2-pentanone** (Diacetone alcohol)	166			$0\ 9306^{25}$			48	55			Oxime, 57 5-8 5 lgr -eth
60	***d,l-trans*-2-Methylcyclohexanol** (*trans*-Hexahydro-*o*-cresol)	167 4	21	1 4611	0 9235	105 mixt *cis* + *trans* 90 105		65 mixt *cis* + *trans* 35-6	114 5 mixt *cis* + *trans* 85 90		124 5 mixt *cis* + *trans* 95 6	
61	**2-*n*-Butoxyethanol** (Ethylene glycol mono-*n*-butyl ether)	$170\text{-}6^{743}$		$1\ 4177^{26}$	0 9188	62				120 0 6		4-Nitrophenylurethane, 58 7 9 1, CCl,
62	**2-Aminoethyl alcohol** (Ethanolamine)	171										N-1-Naphthylurea, 186 (cor) Picrate, 160
63	**2,6-Dimethyl-4-heptanol** (Di-isobutyl carbinol)	171 4 3 4		1 4242	$0\ 8129_{20}^{20}$	61 2, lgr -al					118	*p* Xenylurethane, 118 Allophanate, 156
64	**Furfuryl alcohol** (2-Furyl carbinol)	172, 170		1 4863	$1\ 1351_{20}^{20}$	45	129 30, lgr , 133	76	80 1		85	Urethane, 50, Pseudosaccharin ether 55
65	***d,l-cis*-3-Methylcyclohexanol** (*cis*-Hexahydro-*m*-cresol)	173 4		1 4572	0 919	87 8	128 9	65	91 2		82-3	
66	***d,l-cis*-4-Methylcyclohexanol** (*cis*-Hexahydro-*p*-cresol)	$173\ 4^{750}$		1 4549	0 914	118 9		94	134		72 3	
67	***d,l-trans*-4-Methylcyclohexanol** (*trans*-Hexahydro-*p*-cresol)	$173\ 4\ 5^{74}$		1 4534	0 913	124 5, mixt *cis* + *trans* 112 5		67	139 40, mixt *cis* + *trans* 125 30		119-25, ac a	
68	***d,l-trans*-3-Methylcyclohexanol** (*trans*-Hexahydro-*m*-cresol)	174 5		1 4550	0 9145	93 4 mixt *cis* + *trans* 75 85	122	58	97 8, mixt *cis* + *trans* 80 5		93 4	
69	**2,6-Dimethylcyclohexanol**	$174\text{-}5^{748}$		1 4619	0 9115, 0 9235	158						
70	***cis*-2,5-Dimethylcyclohexanol**	175		$1\ 4522^{1}$	$0\ 9096^{1}$							Allophanate, 157 8
71	***trans*-2,4-Dimethylcyclohexanol**	175		1 4560	0 900	96						Acetate, b p 198^{71}
72	**1,3-Dichloro-2-propanol**	176				73	115					

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Miscellaneous
73	**3-Bromo-1-propanol** (Triethylene bromohydrin)	176d					73					
74	*cis*-**2,4-Dimethylcyclohexanol**	176		1 4582	0 907							
75	**1-Heptanol** (*n*-Heptyl alcohol)	176 8	−34 6 −33 8	1 4245	0 82242	60 65	62	10	46 47	127 (cor)	16 5-17 5	Pseudosaccharin ether, 55 (cor)
76	*trans*-**2,5-Dimethylcyclohexanol**	177		$1\ 4545^{17}$	$0\ 9079_{17}^{17}$							Allophanate, 125
77	**2,2-Dimethylcyclohexanol**	177	8	1 4648	0 9225	85						
78	**Tetrahydrofurfuryl alcohol**	177-8[743]		1 45167	1 0544	61, pet eth		46-8	83-4			Diphenylurethane, 81, me al
79	**2-Methyl-1,2-propanediol** (Isobutylene glycol)	178		$1\ 4358^{17}$	$0\ 999_4^{14}$	*bis* 140 5						
80	*d,l*-**2-Octanol**	179		1 4265	0 8205	oil	63-4, 62 5	28	32		55, *d,l* 75	
81	**2,2-Dibromoethanol**	179-81										Urethane 90-1
82	**1,3,5-Trimethylcyclohexanol**	181		$1\ 454^{16\ 3}$	$0\ 8876_4^{16\ 8}$							
83	**2,3Butanediol** (2,3-Butylene glycol)	*meso* 181 7[42], *d,l* 176 7[42]	*meso* 34 4, *d,l* 7 6	*meso* 1 43637	*meso* 1 0433	*meso* *bis* 201						Dibenzoate *d,l* 53 4, *meso* 75 5-6 2
84	**Cyclohexyl carbinol** (Hexahydrobenzyl alcohol)	182		1 4649	0 9280							Acetate, b p 199-201[740]
85	**2,3-Dichloropropanol**	182				73	93	37-8				2-Naphthylurethane, 99
86	**4-Methyl-1-heptanol**	182 7								133		Pseudosaccharin ether, 34 (cor)
87	**2-Ethyl-1-hexanol**	184 6		1 4328	0 8328	33-4	60 1			108		*p*-Xenylurethane, 80, pet , Pseudosaccharin ether, 53 5 (cor)
88	**3,3-Dimethylcyclohexanol**	185^{754}	11 2	$1\ 4606^{15}$	$0\ 9128_4^{14}$			83				Acetate, b p 194-5[750], *o*-Nitrobenzoate, 62
89	*cis*-**3,5-Dimethylcyclohexanol**	187		$1\ 454^{21}$	$0\ 9109_4^{21}$							Acetate, b p 201-2
90	*trans*-**3,5-Dimethylcyclohexanol**	*d,l* 187		1 4579	*d* 0 9146, *l* 0 9166							Acetate, *d,l*, b p , 196 *d*, $[\alpha]_D^{26}$ +4 55, *l*, $[\alpha]_D^{17}$ −7 74
91	*d,l*-**1,2-Propanediol** (α-Propylene glycol)	187 4		$1\ 43162^{25}$	$1\ 0354_4^{23}$	*bis* 153, 143-4						Monostearate, 59 5, Distearate, 72 3
92	**3,4-Dimethylcyclohexanol**	189		$1\ 458^{16}$	$0\ 9073_4^{16}$	119						
93	**2,4,5-Trimethylcyclohexanol**	*cis* 191-3, *trans* 196				*cis* 83 5, al , *trans* 95, al					81-3 5, eth - lgr	
94	**1,3,3-Trimethylcyclohexen-6-ol**	193 (cor)			$0\ 9310_4^{13}$							Acetate, b p 206 7
95	**2,3,6-Trimethylcyclohexanol**	193-5[747]			$0\ 9119_4^{17}$							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Phenylurethane	1 Naphthyl urethane	4 Nitro benzoate	3 5-Dinitro benzoate	Hydrogen 3-nitro phthalate	Hydrogen phthalate	Miscellaneous
96	**2-(2-Methoxyethoxy)-ethanol** (Diethylene glycol monomethyl ether)	194		1 4244	$1\ 035_{20}^{20}$			92		91 4 2 2 (anh), 87 90 (monohyd) w -al		4-Nitrophenylurethane, 73 5 76
97	**5-Nonanol**	194^{743}		$1\ 4289^{18}$							45	Allophanate, 158
98	**1-Octanol** (*n*-Octyl alcohol)	195	−16, −16 7	$1\ 4274^{25}$	0 8249	74 72	67	12	61 2	128 (cor)	22	Pseudosaccharin ether 46 (cor)
99	**2-Methyl-2,4-pentanediol**	196 198		$1\ 42976^{16\ 7}$	$0\ 9240_4^{17}$							Odor of pinacol, Heating with 2% HBr → diene, b p 75 5-76 0
100	**2-(2-Ethoxyethoxy)-ethanol** (Diethylene glycol monoethyl ether)	196^{763}		1 4298	$1\ 023_{20}^{20}$			oil	oil	oil		4 Nitrophenylurethane, 65 8 6 3
101	**Glycol** (1,2-Ethanediol)	197 85	−12 6	1 43192	1 11361	*di* 157	*di* 176	140, 141	*di* 169			*bis*-4-Nitrophenylurethane, 135 5
102	***d l*-2-Nonanol**	198 2		$1\ 4290^{25}$	$0\ 81910_4^{25}$		55 5, lt pet		42 8 (cor)		42 4, *d,l* 58-9	
103	***l*-Linalool** (*l*-Linalyl alcohol)	199		1 46238	0 8622	65 6	53	70				$[\alpha]_D$ −3 to −17
104	**Benzyl alcohol**	205 5	−15 3	1 53955	1 04540	77 75 5 76, pet eth	134	85	113	176	106, 104	Pseudosaccharin ether, 130 (cor)
105	***d,l*-1,3-Butanediol** (*d l*-1,3-Butylene glycol	207 5, 204		$1\ 44252^{19\ 5}$	1 0053	122-3 *d* 115-6	184					Diphenylurethane *l* 127 8
106	***d l*-2-Decanol** (Methyl *n*-octyl carbinol)	211		*d* 1 4344	*d* 0 8250		69, lt pet				48 9, *d* 38 9	
107	**1-Nonanol** (*n*-Nonyl alcohol)	213 5		1 43105	0 8271	60, 69, 62-4	65 5	60, 66	52 2	125 (cor)	42 5	Pseudosaccharin ether, 49 (cor)
108	**1,3-Propanediol** (Trimethylene glycol)	214 7, 210-2	−30	1 43983	1 0538	*di* 137	*di* 164	*di* 119	*di* 178			Dibenzoate, 57, 59
109	**3-Methylbenzyl alcohol** (3-Tolyl carbinol)	217			$0\ 9157^{17}$		116					
110	α 4-**Dimethylbenzyl alcohol** (α-Methyl-4-tolyl carbinol)	219			$0\ 9668_4^{20\ 5}$	96, pet eth						
111	**1-Phenyl-*n*-propyl alcohol** (*d l*-Phenylethyl carbinol)	219		1 5257	$1\ 0056_{20}^{20}$		102	59-60, 56 5 7 8				
112	**2,3-Dibromo-1-propanol**	219d				84		59-60				3,5-Dinitrophenylurethane, 71
113	**2-Phenethyl alcohol** (2-Phenylethanol)	219 8	−25 8	1 5240	$1\ 0235_4^{25}$	78, 79-80, al	119	61 5-2 (cor), 62-3, al	108	123	188-9	
114	***d,l*-α-Terpineol**	221	35, *d,l* 37-8	1 4834	0 9337	112 3, me al , *d,l* 110	152, 147	139, me al	78-9, lgr		117-8, ac a	Commercial liquid, lilac-like odor

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{t}	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3 5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Miscellaneous
115	**Citronellol**	222 118^{17}										Oxid → Adipic acid, 89, Rose-like odor
116	**α-Isopropylbenzyl alcohol** (*d,l*-Isopropyl phenyl carbinol)	222 4		1 51932[18]	0 9790$_{20}^{20}$		116 7					Oxid → Isopropylphenyl ketone, b p 222
117	***d l*-2-Undecanol** (*d l*-2-Hendecanol Methyl *n*-nonyl carbinol)	228-9			0 8263[18]						49 50	
118	**2-(2-*n*-Butoxyethoxy)-ethanol** (Diethylene glycol mono-*n*-butyl ether)	228-30		1 4341	0 957$_{20}^{20}$							4-Nitrophenyl-urethane 54 5-5 3
119	**1,4-Butanediol** (Tetramethylene glycol)	230, 235	19 0 5	1 4467	1 0171	*di* 183 3 5 chl 180	*di* 199, xyl	*di* 175 ac a				Dibenzoate, 81 2, eth
120	**Geraniol**	230		1 4766	0 8894		47 8	35	62 3	117	47, lgr	
121	**1-Decanol** (*n*-Decyl alcohol)	231	5 99, 6 4	1 43682	0 8292	59 6, bz , then al	73	30 2, al	57 7	122 8 (cor)	38 (cor)	Pseudosaccharin ether, 47 5 (cor)
122	**2-Phenoxyethanol** (Ethylene glycol monophenyl ether)	237, 245		1 534	1 102[22]					112 3		Benzoate 64 4-Toluenesulfonate 80, al
123	**3-Phenylpropanol** (Hydrocinnamyl alcohol)	237 4, 235		1 53565	1 0079	45 47-8, al		45 6, 47	92	117		4 Nitrophenyl urethane 104 pet eth
124	**1,5-Pentanediol** (Pentamethylene glycol)	238-9		1 4499	0 9939$_{20}^{20}$	*di* 174-5 (cor) abs al	*di* 147	*di* 104-5, bz -al				
125	**1-Undecanol** (1-Hendecanol *n*-Undecyl alcohol)	243	15 85, 14 3			62, al , 52		99 5, al	55	123 3 (cor)	43 8 4 1	Allophanate 156 Pseudosaccharin ether 58 5 (cor)
126	**Diethylene glycol** (β,β'-Dihydroxydiethyl ether)	244 5	f p −10 45	1 4475	1 1212$_{15}^{15}$		149	151 (cor), 149, ac a				
127	**2-Methoxybenzyl alcohol** (Saligenin-2-methyl ether)	247		1 549[17]	1 0495$_{15}^{15}$		135-6					Allophanate, 180, Benzoate, 59, lgr
128	**2-Benzyloxyethanol** (Ethylene glycol monobenzyl ether)	265 0		1 5225	1 0700$_{20}^{20}$							Triphenylmethyl ether, 76 7, eth
129	***n*-Hexyl phenyl carbinol**	275		1 501	0 946	75						
130	**Triethylene glycol** (Ethylene glycol di-(β-hydroxyethyl)ether)	285, 165[14]	−9 4	1 4578[15]	1 1274$_{4}^{15}$							*bis*-Triphenylmethyl ether, 142 2 5, acet
131	**Glycerol** (1,2,3-Trihydroxypropane)	290d	17 9	1 4729	1 26134	*tri* 180	*tri* 191-2, al	*tri* 188				4-Nitrophenyl urethane, 216 Tribenzoate, 71 2, 75 6
132	**3,4-Dimethoxybenzyl alcohol** (Veratryl alcohol)	296-7[732]		1 555[17]	1 179$_{17}^{17}$	118						Acetate, b p 170[14], n_D^{17} 1 5245, Benzoate, 36 7

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3 5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Miscellaneous
133	**4-Methoxyphenyl methyl carbinol** (4 Anisyl methyl carbinol)	310d (cor)		1 557	$1\ 086_4^{16}$	82 3						Odor of anise Oxid → 4 Methoxy acetophenone 38
134	***cis*-Octa-9-decen-1-ol** (Oleyl alcohol *cis*-Octadecenyl alcohol)	333 5		1 4607	0 8489	oil	β 44 5 al					Allphanate 135 chl 129 chl 4 Nitrophenyl urethane 85 91

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen phthalate	Pseudo saccharine ether	Miscellaneous
1	**1-Phenylethyl alcohol** (*d l* Methyl phenyl carbinol)	20, 20 1	202	92, 91-2, lgr	106	43 (cor), al	95 93		108 ac a		n_D^{20} 1 5275, D_4^0 1 0129
2	*trans*-**2-Methylcyclohexanol**	21	167 4	*d l* 105	*d l* 155		*d l* 115				Oxalate *d l* 61
3	**1-Dodecanol** (*n*-Dodecyl alcohol, Lauryl alcohol)	24, 26	259	74	80	45, 42	60	124 (cor)	50 3 (cor)	54 (cor)	
4	**1,1-Dimethyl-2-phenylethanol** (Benzyl dimethyl carbinol)	24	216								n_D^{16} 1 5174
5	**4-Methoxybenzyl alcohol** (4 Anisyl carbinol)	24-5	259	92 (cor)							Benzoate, 38, Me eth , b p 225-6, n_D^{25} 1 5422, D_{15}^{15} 1 1129
6	**Cyclohexanol**	25 1	161 1	82	129	50	112 3, al	160	99		$n_D^{\frac{1}{2}}$ 1 46477 D_4^{30} 0 94155
7	*tert*-**Butyl alcohol** (Trimethyl carbinol)	25 5	82 5	136, eth	101	116, al	142, pet eth				n_D^{20} 1 38779, D_4^{20} 0 78670
8	**3-Nitrobenzyl alcohol**	27	175-80[3]								Benzoate, 71 2 Ox → 3-nitro benzoic acid 140
9	**2,3,3-Trimethylcyclohexanol**	28	197								
10	**Diethanolamine** (β,β'-Dihydroxy-diethylamine)	28	270, 217-8[150]								Picrate, 109-10
11	**2,4-Hexadien-1-ol**	30 5-1 5	76[12]	78-9			85				
12	**1-Tridecanol**	α 30 6, β 28 3	155 6[15]			37 4 (cor)		124 (cor)	52 5	66 (cor)	D_4^{31} 0 8223
13	**Cinnamyl alcohol**	33	257	90 0-1 5	114	78, 76 5	121				
14	**2-Methylbenzyl alcohol** (2 Tolyl carbinol)	36, 35	219	79 (cor)							
15	*trans*-**Octa-9-decen-1-ol** (Elaidyl alcohol)	36 7, 35, 34	333, 216[18]	56-7	71						
16	*d,l*-**Fenchyl alcohol**	38-9, *d* α 45, *l* α 47, *l* β 3-4	201 5, *d* α 201-2	104, *d* α 82, *l* α 82	149	109, α 108 9 β 94-5, *l* α 109, *l* β 83	104	95	169, *d* α 145, *l* α 146, *l* β 153		
17	**1-Tetradecanol** (Myristyl alcohol)	39, 37 7	170-3[20]	74, 71	82	51 2 (cor)	67	123 5 (cor)	60 (cor)	62 (cor)	
18	**1,2,2-Trimethylcyclohexanol**	41 ($+\frac{1}{2}$ H_2O)	81 4-8[20]								$n_D^{18.4}$ 1 469, $D_4^{18.4}$ 0 9274
19	**Pinacol** (Tetramethylethylene glycol)	43, 45-6	172								Diacetate, 65, Hydrate, 46
20	*l*-**Menthol**	44, 42 5, 35, 33, 31, *d* 38-40 *d,l* 34	216	111-2, al , *d l* 103-4	119, 126	61-2	153		112, 129-31, ac a		Allophanate, 215
21	**1-Pentadecanol**	α 44, β 38 9		72, bz	72	45 8 (cor)		122 5 (cor)	60 4	72 (cor)	
22	**1,3,5-Trimethyl-1-cyclohexen-3-ol**	46	87-90[17]								$n_D^{19.3}$ 1 4735, $D_4^{20.2}$ 0 9132
23	*d,l*-α-**Propylbenzyl alcohol**	*d* 49, *l* 49	168-70[100]		99	58			91, 53-4		
24	**1,1,1-Trichloroisopropanol**	50-1	161 8[773]								Camphor-like odor
25	**1-Hexadecanol** (Cetyl alcohol)	50, 49 27	190[18]	73	82	58 4 (cor), 52	66	122 (cor)	66 8	69 5 (cor)	
26	**2,2,6-Trimethylcyclohexanol**	51, al	186-7[753]								n_D^{20} 1 4600, D_4^{20} 0 9128

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	1 Naphthyl urethane	4 Nitro benzoate	3 5 Di nitro benzoate	Hydrogen 3 nitro phthalate	Hydrogen-phthalate	Pseudo sac charine ether	Miscellaneous
27	**3,3,5-Trimethylcyclohexanol**	*trans* 52, 37	*cis* 201–3^{750}, *trans* 196 5^{770}								Acetate, *cis* b p 209–10, *trans* b p 209–10
28	**2,2-Dimethyl-1-propanol** (*tert*-Butyl carbinol, Neopentyl alcohol)	52–3	113	144, lgr	100				71		
29	**4-Methylbenzhydrol** (Phenyl 4-tolyl carbinol)	53, 58, 42									Ox → Phenyl 4-tolyl ketone, 60
30	**1-Heptadecanol**	α 54	310		88 5	53 8 (cor)	121 5 (cor)	121 0–8	66 6–7 (cor)	76 (cor)	
31	**Piperonyl alcohol**	58		102 5							Benzoate, 66, Allophanate, 176 5
32	**4-Methylbenzyl alcohol** (4-Tolyl carbinol)	59–60	217	79			117 8				
33	**1-Octadecanol** (Stearyl alcohol)	59 5	210 5^{15}	79–80		64 3 (cor)	66	119 (cor)	72 5 (cor)	74 5 (cor)	
34	**1-Nonadecanol**	62				58 9			71	80 5	
35	**Eicosanol**	65	220^{3}			69 4			77		Acetate, 40
36	**1-(1-Naphthyl) ethanol** (*d,l*-Methyl 1-naphthyl carbinol)	66							131–2, bz		
37	**1,2-Diphenylethanol** (*d l*-Benzyl phenyl carbinol)	67	167^{10}						131 (cor), eth -lt pet		
38	**4,4′-Dimethylbenzhydrol** (Di-4-tolyl carbinol)	68, al									Carbinyl bromide 48 5–9 lgr
39	**Benzhydrol** (Diphenyl carbinol)	68, lgr	288, 180^{20}	139 40, bz	135 6, 139	131–2	141		164 5		Acetate 41 2 Benzoate 88–9, al
40	**1-Glyceryl phenyl ether**	69, eth									Conc H_2SO_4 → pa red
41	**Erythritol** (*d,l*-1,2,3,4 Tetrahydroxybutane)	72									Tetraacetate, 53
42	**Dihydroxyacetone** (1,3-Dihydroxy-2-propanone)	72									Diacetate, 48, Dibenzoate, 120 5, 2,4-Dinitrophenylhydrazone, 277–8
43	**2-Nitrobenzyl alcohol**	74	270· 165^{20}								Benzoate, 101–2
44	**1,10-Decanediol** (Decamethylene glycol)	75 5, 72									1 10-Dibromide, 27 4 b p 162 5 5^{10}
45	**2,2,2-Tribromoethanol**	80	92–3^{10}								Urethane, 86–7
46	**10-Nonadecanol** (Myricyl alcohol)	85		96	54						
47	**Phenacyl alcohol** (α-Hydroxyacetophenone, Benzoyl carbinol)	86	118–20^{11}			128 6					Benzoate, 118 5, 3-Nitrobenzoate, 104 5
48	***n*-Triacontanol** (1-Hydroxytriacontane)	86 5, bz									Acetate, 69, pet eth
49	**2-Hydroxybenzyl alcohol** (Saligenin)	86–7									2-Benzoate, 66
50	***d*-Sorbitol**	89–93, 112 (anh)									Hexaacetate, 99, Hexabenzoate, 216–7, et ac
51	**3-Nitrophenacyl alcohol** (3-Nitrobenzoyl carbinol)	92 5–3 0, pa yel									Acetate, 53, eth -lgr , Semicarbazone, 214, al

*Derivative data given in order m p , crystal color, solvent from which crystallized

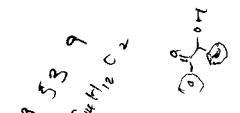


TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenylurethane	1 Naphthyl urethane	4-Nitro benzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogenphthalate	Pseudosaccharine ether	Miscellaneous
52	**4-Nitrobenzyl alcohol**	93	185[12]								Acetate, 78, Benzoate, 94 5
53	**4,4',4''-Trimethyltriphenyl carbinol** (Tris-*p*-tolyl carbinol)	96									Et eth 111 pet eth H_2SO_4 → gr-red
54	***meso*-Erythritol**	121, 120 (cor)	330								Tetraacetate 85 89 Dibenzylidene, 201-2
55	**4-Nitrophenacyl alcohol** (4-Nitrobenzoyl carbinol)	121									Acetate, 124, et ac-lgr, Phenylhydrazone, 178, bz
56	***d l*-Benzoin** (Benzoyl phenyl carbinol)	137, 133	344	165	140	123					4 Nitrophenylurethane 183 Acetate, 83
57	**Cinchol** (β-Sitosterol)	137					202 4				Acetate, 134, Benzoate, 145
58	**Furoin** (Furoyl furyl carbinol)	138 9 (cor), 135									Acetate, 76-7 Benzoate, 92-3
59	**Cholesterol** (anh) (*l*-Cholesterol)	148 5	360d	168	176	185 190 3			161		4-Nitrophenylurethane, 205 Benzoate, 151-2
60	**Triphenylmethanol** (Triphenyl carbinol)	161 2, bz	380								Acetate, 87 8
61	**Ergosterol**	165		185	202		202, chl				Acetate, 176, 180, eth, Benzoate, 168
62	***d*-Mannitol**	166, *l* 163-4, *d l*-α 168		303							Hexaacetate, 126, eth, Benzoate, 149-50, 147-8, al
63	**1,1,1-Tribromo-*tert*-butyl alcohol** (Brometone)	167-76, w-al									Acetate, 43 4, al, Benzoate, 27, al
64	**Dulcitol** (1,2,3,4,5,6-Hexanehexol)	188 5									Hexaacetate, 171, 168 9, abs al, Hexabenzoate, 189-91, eth-chl
65	**4,4',4''-Triaminotriphenyl carbinol** (Pararosaniline base)	205									4 4 ,4'' Triacetyl, 192 acet-eth Me eth 105, eth, 135, bz
66	***d*-Borneol** ("Borneo camphor")	208, 205, *d l* 210 5	212	138-9	132, *iso* 130, 127	153, *d l* 134, 137	154 5		161 4, aca, 165 (cor)		
67	***meso*-Inositol** (1,2,3,4,5,6-Hexahydroxycyclohexane)	225 (cor), 218					86, al				Hexaacetate, 212, subl, tol, Hexabenzoate, 258, al
68	***d*-Quercitol** (Pentahydrocyclohexane)	232, 234									Pentabenzoate, 155
69	**Pentaerythritol** (2,2-Bishydroxymethyl-1,3-propanediol)	262 253									Tetraacetate, 84, wh, al, Tetrabenzoate, 99-101, al

*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE VII

Phenylurethane

$$ArOH + C_6H_5N{=}C{=}O \rightarrow C_6H_5NHCOOAr$$

Phenylurethane
(Phenylcarbamate)

From the phenol with phenylisocyanate without solvent

For directions and examples see Linstead, pp 34–35, J B McKinley, J E Nickels and S S Sidue, *Ind Eng Chem, Anal Ed*, **16**, 304 (1944)

From the phenol with phenylisocyanate in kerosene

See Cheronis, p 489

From the phenol with phenylisocyanate and a catalytic amount of pyridine

See Shriner, p 265

From the phenol with phenylisocyanate in toluene

See O L Brady and J Harris, *J Chem Soc*, **127**, 2175 (1925)

1-Naphthylurethane (α-Naphthylcarbamate) *

$$ArOH + 1\text{-}C_{10}H_7N{=}C{=}O \rightarrow 1\text{-}C_{10}H_7NHCOOAr$$

1-Naphthylurethane
(α-Naphthylcarbamate)

From the phenol with 1-naphthylisocyanate without solvent

For directions and examples see Cheronis, p 488, Linstead, pp 34–35, Vogel, p 683, Wild, p 68

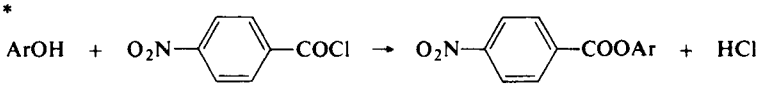
From the phenol with 1-naphthylisocyanate and a catalytic amount of pyridine, triethylamine or trimethylamine in ether

See Shriner, p 211, Vogel, p 683, Wild, p 68, H E French and A F Wirtel, *J Amer Chem Soc*, **48**, 1736 (1926)

From the phenol with 1-naphthylisocyanate and a catalytic amount of a tertiary aliphatic amine in petrol ether

See Cheronis, p 488, Vogel, p 684

p-Nitrobenzoate *



p-Nitrobenzoate

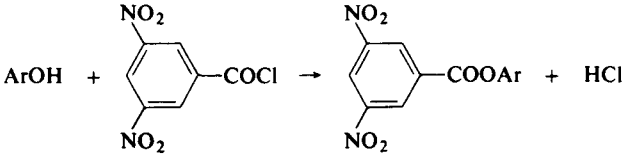
From the phenol with *p*-nitrobenzoyl chloride in pyridine

For directions and examples see Vogel, p 682, Wild, p 52

From the phenol with *p*-nitrobenzoyl chloride without solvent

See Wild, p 52

3,5-Dinitrobenzoate *



3,5-Dinitrobenzoate

From the phenol with 3,5-dinitrobenzoyl chloride in pyridine

For directions and examples see Cheronis, p 486, Vogel, p 682, Wild, p 65, R C Brown and R E. Kremers, *J Amer Pharm Ass*, **11**, 607 (1922), M Phillips and G L Keenan, *J Amer Chem Soc*, **53**, 1924 (1931)

From the phenol with 3,5-dinitrobenzoyl chloride without solvent

See Shriner, pp 212–213

Benzoate

$$ArOH + C_6H_5COCl \rightarrow C_6H_5COOAr + HCl$$

Benzoate

From the phenol with benzoyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 481–482, 487, Linstead, p 20, Wild, p 65

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)

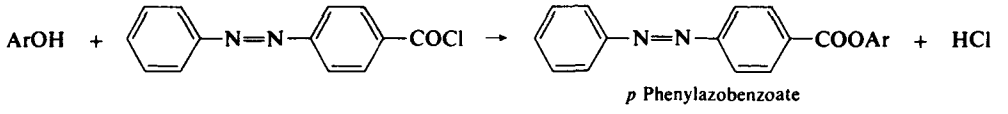
From the phenol with benzoyl chloride in pyridine
See Linstead, p 19

Acetate

$$ArOH + (CH_3CO)_2O \rightarrow \underset{\text{Acetate}}{CH_3COOAr} + CH_3COOH$$

From the phenol with acetic anhydride in aqueous sodium hydroxide
For directions and examples see Linstead, p 21, Vogel, p 682, Wild, p 64, F D Chattaway, *J Chem Soc*, 2495 (1931)
From the phenol with acetic anhydride and sodium acetate
See Linstead, p 21, Wild, p 64
From the phenol with acetic anhydride and a catalytic amount of sulfuric acid
See Cheronis, p 487

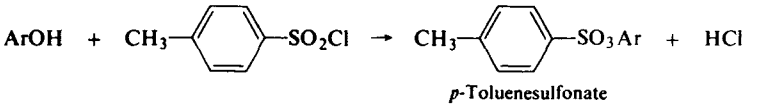
p-Phenylazobenzoate



p Phenylazobenzoate

From the phenol with *p*-phenylazobenzoyl chloride in pyridine
For directions and examples see Cheronis, p 486, E O Woolfolk and J M Taylor, *J Org Chem*, **22**, 827 (1957)

p-Toluenesulfonate



p-Toluenesulfonate

From the phenol with *p*-toluenesulfonyl chloride in pyridine
For directions and examples see Linstead, p 20, Vogel, p 684, Wild, p 66
From the phenol with *p*-toluenesulfonyl chloride in aqueous sodium hydroxide
See Linstead, p 20
From the phenol with *p*-toluenesulfonyl chloride and sodium hydroxide in aqueous acetone
See Wild, p 66

Bromo derivative *

$$ArOH + Br_2 \rightarrow \underset{\substack{\text{Mono}\\\text{bromophenol}}}{Ar(OH)Br} + HBr$$

$$ArOH + nBr_2 \rightarrow \underset{\substack{\text{Poly}\\\text{bromophenol}}}{Ar(OH)Br_n} + nHBr$$

From the phenol in aqueous methanol, in ethanol, in acetone or in dioxane with bromine in aqueous potassium bromide
For directions and examples see Cheronis, p 490, Shriner, p 264
From the phenol in aqueous hydrochloric acid with bromine in water
See Linstead, p 19
From the phenol in glacial acetic acid and bromine
See Wild, p 73
From the phenol with bromine in carbon disulfide
See Vogel, p 679
For a discussion on the effect of solvents in the bromination of phenols
See N D Cheronis, *Micro and Semimicro Methods (Technique of Organic Chemistry)*, Vol 6, Interscience, New York, 1954, pp 286–287

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)

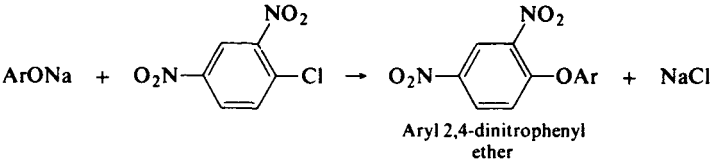
*Aryloxyacetic acid.**

$$ArONa + ClCH_2COOH \rightarrow \underset{\text{Aryloxyacetic acid}}{ArOCH_2COOH} + NaCl$$

From the phenol in aqueous sodium hydroxide with aqueous chloroacetic acid.

For directions and examples see: Cheronis, pp. 489–490; Linstead, p. 20; Shriner, p. 264; Vogel, p. 683; Wild, p. 72; C. F. Koelsch, *J. Amer. Chem. Soc.*, **53**, 304 (1931); N. V. Hayes and G. E. K. Branch, *J. Amer. Chem. Soc.*, **65**, 1555 (1943).

Aryl 2,4-dinitrophenyl ether.



Aryl 2,4-dinitrophenyl ether

From the phenol in aqueous sodium hydroxide with 2,4-dinitrochlorobenzene in alcohol.

For directions and examples see: Cheronis, pp. 490–491; Vogel, p. 684; Wild, p. 71; R. W. Bost and F. Nicholson, *J. Amer. Chem. Soc.*, **57**, 2368 (1935).

From the phenol with 2,4-dinitrochlorobenzene and aqueous potassium hydroxide.

See: Linstead, pp. 20–21.

NOTE: For additional information regarding directions and examples for the preparation of derivatives of phenols which are similar to those of alcohols (e.g., 1-naphthylurethanes, 3,5-dinitrobenzoates, etc.) see explanations and references to Table VI, p. 77, 78, 79.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

a) Liquids. (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Phenyl-urethane	α-Naphthyl-urethane	*p*-Nitro-benzoate	3,5-Di-nitro-benzoate	Bromo derivative	*p*-Toluene sulfonate	Miscellaneous
1	**2-Chlorophenol**	175.6	7	1.5473[40]	1.2410$^{18}_{15}$	121	120	115	143	*mono* 48.9, *di* 76	74	Aryloxyacetic acid, 145, 2,4-Dinitrophenyl ether, 99, 4,6-Bis(dimethylaminomethyl) deriv., 62.3, *p*-Phenylazobenzoate, 120-1
2	**2-Bromophenol**	195	5		1.4924		129			95	78	*p*-Phenylazobenzoate, 126-7
3	**2-Chloro-4-methylphenol** (2-Chloro-*p*-cresol)	195.6		1.5200[2]	1.1785[27]							Benzoate, 71.2, Aryloxyacetic acid, 108, Acetate, b.p. 238
4	**2-Hydroxybenzaldehyde** (Salicylaldehyde)	197 (cor.)	1.6	1.574	1.1690$^{20}_{20}$	133		128			63.4	Aryloxyacetic acid, 132, Acetate, 39
5	**3-Methylphenol** (*m*-Cresol)	203	12	1.540	1.03401	125, 121.2, al.-lgr	127.8	90	165.4 (cor.), al.	*tri* 84	51	Aryloxyacetic acid, 103, 2,4-Dinitrophenyl ether, 74, Benzoate, 55
6	**2-Ethylphenol**	207			1.0371[0]	143.4, 141		56.7	108			Aryloxyacetic acid, 141, Benzoate, 38-9, al.
7	**2-Isopropylphenol**	212	16	1.5315	1.012							Aryloxyacetic acid, 132.3, Methyl urethane, 96.7, 4,6-Dinitro deriv., 53
8	**2-Bromo-4-ethylphenol**	213.4									121	
9	**3-Ethylphenol**	217	−4		1.0250[0]	137, 138.8		68				Aryloxyacetic acid, 77, Benzoate, 52, 95% al.
10	**2-Allylphenol**	220	−6	1.5181	1.0255$^{15}_{15}$	116, 106.0 6.5				6-*mono* 50		Aryloxyacetic acid, 148.5-50
11	**2-Chloro-4,6-dimethylphenol**	221.3				129.30		94-5				
12	**Methyl salicylate** (Methyl 2-hydroxybenzoate)	224	−8	1.5369	1.184	117, bz		128				Acetate, 52, Benzoate, 92, al.
13	**2-Propylphenol**	224.6-6.6, 220.0-0.5		1.5280	1.000$^{15}_{15}$	111, formic a.			96			Aryloxyacetic acid, 99-100
14	**2-*sec*-Butylphenol**	227-8, 116[21]	12-3	1.5288	0.9876	86, lgr						Aryloxyacetic acid, 109.5-110
15	**4-Allylphenol**	230-1[750]	16	1.5441[18]	1.033[18]				103.0-3.5			Urethane, 122.3, Acetate, b.p. 238-9
16	**Ethyl salicylate** (Ethyl 2-hydroxybenzoate)	234	1.3	1.5226	1.131	98 100		107-8, yel., bz				Benzoate, 79-80, 87, al., 3,5-Dinitro deriv., 92-3
17	**2-*n*-Butylphenol**	234-7 113.5[14]		1.5180[25.5]	0.975				97			Aryloxyacetic acid, 104-5, Acetate, 105.5
18	**4-Isobutylphenol**	236, 235-9		1.5319[25]	0.9796$^{20}_{20}$							Aryloxyacetic acid, 124-5
19	**Carvacrol** (5-Isopropyl-2-methylphenol)	237.8	1	1.524	0.9760	134.5, 138	116, lgr	51	83, 76-7	46		Aryloxyacetic acid, 151, *p*-Xenylurethane, 116, al.
20	**Isopropyl salicylate** (Isopropyl 2-hydroxybenzoate)	240-2		1.50650	1.0729							3,5-Dinitro deriv., 101.2, al.

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

a) Liquids. (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Phenylurethane	α-Naphthylurethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Miscellaneous
21	**3-Methoxyphenol** (Resorcinol monomethyl ether)	243 244	−17 5				128 9			*tri* 104		Aryloxyacetic acid, 118, 111-3, w , 2,4-Dinitrophenyl ether, 87-8
22	**2-Allyl-6-methoxyphenol**	250-1 115[9]		1 5393				96 7				
23	**4-Allyl-2-methoxyphenol** (Eugenol)	254 8, 127[15]	−9 1, 16 9	1 5410	1 0664	95 5	122, lgr	81	130 8 (cor), al	*tetra* 118	85	Acetate, 29, al , Benzoate, 70, al , Aryloxyacetic acid, 81 100, 2,4-Dinitrophenyl ether, 115, N,N-Diphenylurethane, 108
24	**Isobutyl salicylate** (Isobutyl 2-hydroxybenzoate)	260 2		1 50872	1 0639							3,5-Dinitro deriv , 72 3, al
25	***d,l*-1,2,3,4-Tetrahydro-2-naphthol**	264[716]		1 5523[17]	1 0715[17]	99						Acetate, b p 169[34], Benzoate, b p 254 5[40]
26	**2-Methoxy-4-propenylphenol** (Isoeugenol)	267 5		*cis* 1 5700, *trans* 1 5782	*cis* 1 0851, *trans* 1 0852	*cis* 118, *trans* 152	149 50, lgr	109	154 8 (cor), *n*-BuOH			Acetate, 79-80, bz - lgr , Benzoate, *cis*, 68, *trans*, 103 4, al Aryloxyacetic acid, 116 (94), 2,4-Dinitrophenyl ether, 128
27	***n*-Butyl salicylate** (*n*-Butyl 2-hydroxybenzoate)	270-2, 259-60	−5 9	1 51148	1 0728							3,5-Dinitro deriv , 60 1, al , *p*-Nitrobenzyl ether, 92
28	**Isoamyl salicylate** (Isopentyl salicylate)	276 8		1 50799	1 0535							3,5-Dinitro deriv , 61-2, al
29	**3-Acetoxyphenol** (Resorcinol monoacetate)	283		1 5328								Saponification → resorcinol, 110 + ac a , Diacetate, b p 130 1[7]

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitro benzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
1	**2-Benzylphenol** (2-Hydroxydiphenylmethane) (Labile form)	21, stable 52, 54	312	117–8								Me eth, 30, Urethane, 110–1
2	**4-*n*-Propylphenol**	22	232	129			123			b p 245 6^{745}	38	n_D^2 1 5220
3	**4-*n*-Butylphenol**	22	248, 138–9[18]	115, al		67–8, yel al	92			b p 138–41[15]	27	$n_D^{25.5}$ 1 5165, D_4^{20} 0 978, Aryloxyacetic acid, 81
4	**4-*n*-Amylphenol** (4-*n*-Pentylphenol)	23	248–53								51 0 0 5, al	n_D^{2} 1 5272, D_{20}^{20} 0 9621, Aryloxyacetic acid, 90
5	**3-*n*-Propylphenol**	26	228				75 (117–8)					n_D^{20} 1 5223, D_4^{20} 0 9887, Aryloxyacetic acid, 96–7, lgr
6	**2-Chloro-3,4-dimethylphenol**	27, pet eth									87, aq al	
7	**2,4-Dichloro-3-methylphenol** (2,4-Dichloro-*m*-cresol)	27	240 5–2 5						92 0 2 5, al		90 5	Benzenesulfonate, 70, al
8	**2,4-Dimethylphenol** (*m*-4-Xylenol)	27 8	211 5 (cor)	103, 112, CCl_4	135	102, 105	164 6 (cor), 95% al				37 8, ac a	n_D^{14} 1 5420, D_4^{14} 1 0276, *p*-Xenylurethane, 184, Aryloxyacetic acid, 141, *p*-Phenylazobenzoate, 110–3 2 4-Dinitrophenyl ether, 102–3
9	**2-Ethoxyphenol**	28	217								31	Allophanate, 212
10	**2-Acetylphenol** (2-Hydroxyacetophenone)	28	215							89, al	87 8, al	n_D^{20} 1 5590, D_4^{20} 1 131, Semicarbazone, 210, Oxime, 118, Phenylhydrazone, 110
11	**2-Methylphenol** (*o*-Cresol)	31	191–2	141, 143	141 2, lgr	94	138 4 (cor), al	*di* 56	54 5, pyr			Aryloxyacetic acid, 152, *p*-Phenylazobenzoate, 110–11 5, 2,4-Dinitrophenyl ether, 90, N,N-Diphenylurethane, 73
12	**2-Methoxyphenol** (Guaiacol)	32, 28 2	205	136, al	118	93	141 2 (cor), al	4,5,6-*tri* 116, al	85, lgr		57 8	n_D^{20} 1 5441, $D_{(vac)}^{20.4}$ 1 1287, Aryloxyacetic acid, 116, 2,4-Dinitrophenyl ether, 97
13	**5-Fluoro-2-nitrophenol**	32, lgr									110 11	Me eth, 52, lgr
14	**3-Bromophenol**	33	236		108				52 4	b p 149[40]	86	Aryloxyacetic acid, 108, *p*-Phenylazobenzoate, 125–6
15	**3-Chlorophenol**	33	214		158	99	156				71	Aryloxyacetic acid, 110, 2,4-Dinitrophenyl ether, 75, *p*-Phenylazobenzoate, 127–8
16	**2-Bromo-4-chlorophenol**	33–4	123[10]								99–100	Aryloxyacetic acid, 139–40

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
17	**4-Methylphenol** (*p*-Cresol)	36	202	115	146	98	188 6 (cor), al	*di* 49, *tetra* 198-9, al	69-70, al		70	*p*-Phenylazobenzoate, 134 5-6 5, N,N-Diphenylurethane, 94, *p*-Xenylurethane, 198
18	**2,4-Dibromophenol**	36, 40	238-9			183 5		6-*mono* 95-6	120	36	97 5	Aryloxyacetic acid, 153, 2,4-Dinitrophenyl ether, 135, Me eth , 61 3, b p 272, Et eth , 53 5
19	**4-Methyl-2-nitrophenol** (2-Nitro-*p*-cresol)	36 5, yel , w -al	125[22]				192				100-1	Me eth , 8 5, pa yel , b p 274, Et eth , b p 275 85 d
20	**4-Chlorophenol**	37, 43	217	148 5	166	171	186	2-*mono* 33 4, 2,6-*di* 90	71	7 8	88	Aryloxyacetic acid, 156, 2,4-Dinitrophenyl ether, 126, *p*-Phenylazobenzoate, 153-4, N, N-Diphenylurethane, 97
21	**2,4-Diethylphenol**	37-8	219	170 1								Aryloxyacetic acid, 67-8
22	**3-Fluoro-2-nitrophenol**	39, lgr									114	Me eth , 43 5, lgr
23	**2,6-Dichloro-4-methylphenol** (2,6-Dichloro-*p*-cresol)	39, 42	120-5[14]							48	9	NH_4 salt, 125, Me eth , b p 234
24	**3-Ethoxyphenol** (Resorcinol monoethyl ether)	40	246-7, pa yel , 254-8			183 5					97 5	2,4-Dinitrophenyl ether, 114-5, Picrate, 105-6, red, chl
25	**3-Iodophenol**	40		138		133	183		60-1	38, pet eth	72-3, pet eth	Aryloxyacetic acid, 115
26	**2-Benzoylphenol** (2-Hydroxybenzophenone)	41				124						*p*-Nitrobenzyl ether, 124 5, acet , Phenylhydrazone, 155, Semicarbazone, 250-1, Oxime, 141 3
27	**3-Methyl-2-nitrophenol** (2-Nitro-*m*-cresol)	41, yel , pet eth								59, al	79, al	Me eth , 54, yel , al
28	**Phenol**	41 8, 42	182, 183	126, bz	132 3, lgr	127, bz	145 8 (cor), al	*tri* 95	95 6, al		69	Aryloxybenzoic acid, 99, *p*-Phenylazobenzoate, 148-50, *p*-Xenylurethane, 173, N,N-Diphenylurethane, 105
29	**3-Fluoro-4-nitrophenol**	42, w or lgr	173[12]								118	Me eth , 56 5
30	**Phenyl salicylate** (Salol, Phenyl 2-hydroxybenzoate)	42, 38 8, 28 5 (three forms)		111-2, bz , 242		111				99 5	81	N,N-Diphenylurethane, 144

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl-urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
31	**2-Iodophenol**	43	186-7[160]	122						98 101	34, pet eth	D^{80} 1 8757 Aryloxyacetic acid, 135 *p*-Phenylazobenzoate 126 8 2,4 Dinitrophenyl ether, 95
32	**5-Bromo-2-nitrophenol**	44 yel								74 5		Me eth , 85 5 Et eth , 79 5 80 5, al
33	**2,4-Dichlorophenol**	45	210				142-3	68	125		97	Aryloxyacetic acid, 141, 135, β-Naphthylurethane, 166, 2,4-Dinitrophenyl ether, 119
34	**2-Nitrophenol**	45, yel , al	216		113	141	155	*di* 117	83	40 1, lgr	59	D_4^{40} 1 2942, Aryloxyacetic acid, 158, 2,4-Dinitrophenyl ether, 142, N,N-Diphenylurethane, 114, *p*-Phenylazobenzoate, 136 5 7 0
35	**5-Chloro-2-hydroxybiphenyl**	46									88	
36	**2-Chloro-5-methylphenol** (6-Chloro-*m*-cresol)	46	196						96	b p 122-3[11]	31 40	Benzenesulfonate, 99
37	**4-Bromo-5-isopropyl-2-methylphenol**	46, lgr				53 4						Me eth , b p 147 50[15]
38	**2-*tert*-Butyl-5-methylphenol** (6-*tert*-Butyl-*m*-cresol)	46-7	127[11]							b p 139[17]		Me eth , 22, b p 225 7
39	**3-Chlorocatechol** (3-Chloro-1,2-dihydroxybenzene)	46-8, 48 50	110 11[11]								110-11	2-Me eth , 31 5 3 0
40	**4-Ethylphenol** (4-Hydroxyethylbenzene)	47	219	120	128	80 1	132-3				59 60, al	n_D^{25} 1 5239, D_{20}^{20} 1 0123 Aryloxyacetic acid, 97, *p*-Phenylazobenzoate, 117-8
41	**3-Methyl-2,4,6-trichlorophenol** (2,4,6-Trichloro-*m*-cresol)	47, w	265						92 3	35, 32, eth	53	
42	**4-Chloro-2-methylphenol** (4-Chloro-*o*-cresol)	48	222-5								71	Aryloxyacetic acid, 115 7, Me eth , b p 213 5
43	**2,6-Dibromo-4-methylphenol** (2,6-Dibromo-*p*-cresol)	49, 54				141 2				67	94 5	
44	**Thymol** (2-Isopropyl-5-methylphenol)	49 7, 51 5, acet	233 5	107, aq al	160, lgr	70	103 2, al	55	71	b p 242 3	33	Aryloxyacetic acid, 149, 2,4-Dinitrophenyl ether, 67, *p*-Xenylurethane, 194, *p*-Phenylazobenzoate, 85 6

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitro benzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
45	**2-Hydroxy-4-methoxyacetophenone** (Peonol)	52.3, al								46.5		$n_D^{81.2}$ 1.54322, $D^{81.2}$ 1.310, *m*-Nitro benzoate, 109, *p*-Nitrophenylhydrazone, 238.9, ac a
46	**2-Benzylphenol** (2-Hydroxydiphenylmethane) (stable form)	52.54, labile 21-2	312	117.5-8.0, lgr								Benzyl eth., 38, me al
47	**2-Chloro-3-methylphenol** (2-Chloro-*m*-cresol)	55.6, 49.50	194						96		55.6	Benzenesulfonate, 58
48	**4-Methoxyphenol** (Hydroquinone monomethyl ether)	56.55	243.4							32	87, al	Aryloxyacetic acid, 110-2
49	**3-Methyl-6-nitrophenol** (6-Nitro-*m*-cresol)	56, yel., bz								48, al	77	Me eth., 62, Et eth., 55, pet eth., 50-1
50	**3-Bromo-4-methylphenol** (3-Bromo-*p*-cresol)	56	245								75	Me eth., b.p. 103-5[10]
51	**2-Phenylphenol** (2-Hydroxybiphenyl)	56, 67.5 (cor.)	275						64.6, dil al	62.5.3 pet eth	75-6	*p*-Phenylazobenzoate, 141.4, 2,4-Dinitrophenyl ether, 113-4
52	**2,6-Dibromophenol**	56-7	162[21]					93.3		46	68	Me eth., 13, b.p. 143-5[34], Et eth., 40.6
53	**4-*n*-Caproylresorcinol**	56.7, tol.-pet eth	343.5 d			89.91 pa yel., al						
54	**2-Bromo-4-methylphenol** (2-Bromo-*p*-cresol)	56.7	213-4, 102.4[20]						121	b.p. 120[4]		$D_{4}^{24.5}$ 1.547
55	**5-Bromo-3-methylphenol** (5-Bromo-*m*-cresol)	56-7, 54								83		Me eth., b.p. 139 40[20], Picrate, 130
56	**2-Cyclohexylphenol**	56.7										4,6-Dinitro deriv., 106, al., 2,4-Dinitrophenyl ether 76.7
57	**2,3-Dichlorophenol**	56.7	206					*di* 90				Me eth., 31
58	**4,6-Dibromo-2-methylphenol** (4,6-Dibromo-*o*-cresol)	57				136.7					62	
59	**3-Hydroxy-6-nitrobiphenyl**	57.8, bz				135	171					2,4-Dinitrophenyl ether, 131 4-Nitro deriv., 176-8
60	**2,3,6-Trichlorophenol**	58, pet eth									90, al	
61	**2,6-Dichloro-3-methylphenol** (2,6-Dichloro-*m*-cresol)	58	234						100-1, al		78.0 8.5, al	
62	**2,5-Dichlorophenol**	58-9, pet eth	212								69	
63	**4-Propylcatechol** (1,2-Dihydroxy-4-propylbenzene)	60, bz	175-80[30]									3-Me eth., b.p. 240-2, Di-me eth., b.p. 247
64	**1,2-Dihydroxynaphthalene** (1,2-Naphthalenediol)	60 (hyd.), 103-4 (anh.)									*di* 106	
65	**4-Isopropylphenol**	61	223-5								71-2	

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
66	**5,6,7,8-Tetrahydro-2-naphthol**	61 5–2 5	275[705]			113, 106 5				b p 158[14]	96	N,N-Diphenylurethane, 114, Cinnamate, 77 5
67	**2,3,5-Trichlorophenol**	62 (hyg)									103, lgr	Me eth , 84, al
68	**2-Methyl-3,5,6-trichlorophenol** (3,5,6-Trichloro-*o*-cresol)	62, ac a									110, al	
69	**3,4-Dimethylphenol** (*o*-4-Xylenol)	62 5, w	225[757]	120, dil al	141 2, lgr		181 6 (cor), al	*tri* 171		22	58 5	Aryloxyacetic acid, 162 5 2 4-Dinitrophenyl ether 105–6 *p*-Xenylurethane, 183, al Picrate, 83 8, yel Me eth , 204 5, *p*-Phenylazobenzoate, 104–7
70	**2,6-Dinitrophenol**	63–4							135			Picrate, 122, Me eth , 118
71	**4-Bromo-3-methylphenol** (4-Bromo-*m*-cresol)	63 5, pet eth	118–23[7]						84 5		83 5	Benzenesulfonate, 79–80, Me eth , b p 108 5[12]
72	**4-Bromo-2-methylphenol** (4-Bromo-*o*-cresol)	64	235 (subl)							b p 132[12]	67 8	Et eth , b p 238–40
73	**1-Acetyl-2-naphthol**	64, lgr									85 6, pyr	
74	**4-Bromophenol**	64, 66 4	238	140	169	180	191	*tri* 171		22	58 5	Aryloxyacetic acid, 157, 2,4-Dinitrophenyl ether, 141, N,N-Diphenylurethane, 99, *p*-Phenylazobenzoate, 167 5–8 5
75	**2-Methyl-1-naphthol**	64–5								81 2	94–5	Picrate, 133–4
76	**4-Methylcatechol** (3,4-Dihydroxytoluene)	65, bz	252	*di* 166						*di* b p 260–4	*di* 58	Diaryloxyacetic acid, 58, Di-*p*-xenylurethane, 193
77	**3-Bromo-2-nitrophenol**	65–7, pet eth (anh), 35 (hyd), w							136 5–7 5, al		133	Me eth , 73
78	**4-Chloro-3-methylphenol** (4-Chloro-*m*-cresol)	66, 55	235		153–4				98		86	2,4-Dinitrophenyl ether, 112, Benzenesulfonate, 66
79	**4-Hydroxy-3-nitrobiphenyl**	66								85–6, lgr	111	Me eth , 91–2
80	**4-Methyl-2,3,5-trichlorophenol** (2,3,5-Trichloro-*p*-cresol)	66–7, ac a								37–8, w -ac a	89, w -al	
81	**2,6-Dichlorophenol**	67	219–20, 80–5[4]								74 0–4 5	Me eth , b p 105–6[20]
82	**3,5-Dimethylphenol** (*m*-5-Xylenol)	68	219 5 (subl)	148, 151		109	195 4 (cor), al	*tri* 166	83, ac a	b p 130[26]	24	Aryloxyacetic acid, 111, 81, 2,4-Dinitrophenyl ether, 100, *p*-Phenylazobenzoate, 104 5–6 5, *p*-Xenylurethane, 150
83	**2-Bromo-6-nitrophenol**	68, yel								39 5–40		Me eth , 67

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α Naphthyl urethane	*p*-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	*p*-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
84	**3-Methylcatechol** (2,3-Dihydroxytoluene)	68, bz										2-Me eth, 39, b p 204, Di-Me eth, b p 202-3
85	**3,5-Dichlorophenol**	68	233					*tri* 189	116	38	55	
86	**2,6-Di-iodophenol**	68								107, aca		Me eth, 35, ac a, Et eth, 41-2, ac a
87	**2,4,5-Trichlorophenol**	68, pet eth									92 3, al	Aryloxyacetic acid, 157, Me eth, 77-5, al
88	**5,6,7,8-Tetrahydro-1-naphthol**	68 5-9 0, 74-5	264 5-5 0							73 5	46	Me eth, b p 124[10], Et eth, b p 259[705]
89	**2-Bromo-4,6-dichlorophenol**	68 9	268 d						82-3			2,4-Dinitrophenyl ether, 140-1
90	**2-Bromo-4-methyl-6-nitrophenol** (2-Bromo-6-nitro-*p*-cresol)	69, yel							128	110-11		
91	**2,4,6-Trichlorophenol**	69 5, ac a, 68	245			105 6				b p 261-2	75 5, al	Aryloxyacetic acid, 182 6, 2,4-Dinitrophenyl ether, 136, N,N-Diphenylurethane, 143, Me eth, 61-2, al, Et eth, 43-4
92	**2,4,6-Trimethylphenol**	70, 69	220	141-2 lgr				*di* 158			62, pet eth	Aryloxyacetic acid, 142
93	**2,3,4,6-Tetrachlorophenol**	70	150[15]							65 6	108	Me eth, 64-5, Et eth, 55, Benzenesulfonate, 127
94	**1-Chloro-2-naphthol**	70, lgr, 72								42 3	99 100	Me eth, 70-1, Et eth, 58
95	**Methyl 3-hydroxybenzoate**	70	280	115-6, bz								
96	**2-Methyl-6-nitrophenol** (6-Nitro-*o*-cresol)	70, w -al							66, al		42, al	Me eth, 30, pet eth, Et eth, b p 249 50, yel
97	**3-Propylcatechol** (1,2-Dihydroxy-3-propylbenzene)	70-2, pet eth										3-Me eth, b p 144-6[25], Di-Me eth, b p 134-7[22] Aryloxyacetic acid, 132, *p*-Xenylurethane, 196
98	**2,4,5-Trimethylphenol** (Pseudocumenol)	71	232	110				35		34 0-4 5, pet eth	63, al	Aryloxyacetic acid, 132, *p*-Xenylurethane, 196
99	**4,6-Dichloro-3-methylphenol** (4,6-Dichloro-*m*-cresol)	72	235-6, 110[18]						104-5, al		57 5, al	n_D^{20} 1 5722, Benzenesulfonate, 86, al
100	**2,4-Di-iodophenol**	72, w							165-7 (cor)	70-1, w -al	98	Me eth, 68, w -al, Et eth, 46, me al, 51
101	**2-Chloro-4,5-dimethylphenol**	72									43	
102	**3,5-Dimethylcatechol** (4,5-Dihydroxy-*m*-xylene)	73-4, w								*di* 161, ac a		4-Me eth, b p 227-8

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl-urethane	*p*-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
103	**5-Chloro-2-methylphenol** (5-Chloro-*o*-cresol)	73 4	225					*tri* 190	110		53 4	Me eth , b p 206-8, Et eth , b p 210 20
104	**2,5-Dibromophenol**	73 4							110			
105	**3-Iodo-2-nitrophenol**	73 5, w								102 5		Me eth , 83-4
106	**Ethyl 3-hydroxybenzoate**	73 8, bz	295 282							35	58, al	
107	**1,3-Dibromo-2-naphthol**	75								102		
108	**2,5-Dimethylphenol** (*p*-2-Xylenol)	75, al -eth	212	160 1, bz , 162, 166	172 3 lgr	87	137 2 (cor)	*tri* 178			61	Aryloxyacetic acid, 118 *p*-Xenylurethane, 162, *p*-Phenylazobenzoate, 95 5-7 5, Picrate, 81-2, or , al
109	**2,3-Dimethylphenol** (*o*-3-Xylenol)	75, w -al		193 5								Aryloxyacetic acid, 187, *p*-Phenylazobenzoate, 134 6, Me eth , 29, b p 199, Et eth , 10, b p 212 5
110	**8-Hydroxyquinoline** (Oxine)	75 6, dil al	266 6[752]			174 5			115	b p 280	118 20, al	Picrate, 203 4, Methiodide, 143 d (hyd)
111	**4-(Dimethylamino) phenol**	76							130	78		
112	**3-Chloro-4-hydroxybiphenyl**	76 7, 80									110 11, 95 7	2,4-Dinitrophenyl ether, 109-11
113	**3-Bromo-2,6-dichlorophenol**	76 5, lgr	264-70[751]								102	Me eth , b p 260 5[50]
114	**2-Methyl-4,5,6-trichlorophenol** (4,5,6 Trichloro-*o*-cresol)	77, pet eth								45, w -me al		Me eth 51 5, al
115	**2-Bromo-4-methyl-3-nitrophenol** (2-Bromo-3-nitro-*p*-cresol)	77, yel , w								81		Me eth , 74
116	**3-(Diethylamino) phenol**	78	276 80								22 3	Methylurethane, 85 6, Methiodide, 140 3
117	**3-Phenylphenol** (3-Hydroxybiphenyl)	78, 75	>300						52 5		60 1, al	Et eth , 34
118	**4-Bromo-2,6-dinitrophenol**	78 yel							136, al	110 5, bz	154, al	Me eth , 88, Et eth , 66
119	**4-Chloro-2-iodophenol**	78		128						57	88, 84	
120	**2,4-Diaminophenol** (4 Hydroxy-*m*-phenylenediamine)	78 80 unstable										Me eth , 68, Et eth , 67 8, 4,N-Acetyl, 249, N,N'-Diacetyl, 220-2, O,N,N'-Triacetyl, 180 2, N,N'-Dibenzoyl, 253-4, Picrate, 120 d , yel
121	**4-Methyl-3-nitrophenol** (3-Nitro-*p*-cresol)	79, yel , eth							91			Me eth , 17, b p 266 7
122	**2,3,4,6-Tetramethylphenol** (Isodurenol)	79 81	230 50	178 9, wh , w -al							71-2, wh , w -al	
123	**2-Bromo-4,5-dimethylphenol**	80, pet eth									51	Me eth , b p 86[3], *o*-Nitrobenzoate, 151-2

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p* Toluenesulfonate	Acetate	Benzoate	Miscellaneous
124	**5-Bromo-2-methylphenol** (5-Bromo-*o*-cresol)	80									41	
125	**4-Iodo-2-nitrophenol**	80 1									102 3	Me eth , 98, Et eth , 80
126	**4-Hydroxy-3-methoxybenzaldehyde** (Vanillin)	81	285	116 7					115	102	78	Aryloxyacetic acid, 187 2,4-Dinitrophenyl ether, 131, 2,4-Dinitrophenylhydrazone, 271 d
127	**3,5-Dibromophenol**	81								53	77	Me eth , 140
128	**4-Chloro-2,6-dinitrophenol**	81								110 11		Me eth , 66 Et eth , 54 5
129	**4-Methyl-2-naphthol**	81 2								117 8		
130	**5-Chloro-2,3-dimethylphenol**	81 2									88, al	
131	**3-Methyl-2,4,6-tribromophenol** (2,4,6-Tribromo-*m*-cresol)	81 5-2 0, al							113 4, al	68, al	84 5 al	*p*-Phenylazobenzoate, 130-2
132	**2-Hydroxy-1-naphthaldehyde**	82	192[2]							87, al *tri* 124, al		Me eth , 84 Et eth , 115, Oxime 157, Picrate, 120
133	**3,4-Di-iodophenol**	83									123	
134	**2-Hydroxyazobenzene** (2-Benzeneazophenol)	83								−20	93 pet eth	Me eth , 41, Et eth , 44 Cu deriv , 225 6, al
135	**5-Propylresorcinol** (1,3-Dihydroxy-5-propylbenzene, Divarinol)	83 4, bz , (anh), 51, w								*di* 12-5		Di-Me eth , b p 147[29]
136	**2,3,4-Trichlorophenol**	83 5, lgr									141, al	Me eth , 69 5, al
137	**4-Benzylphenol** (4-Hydroxydiphenylmethane)	84	321, 308								*mono* 87, pet	2,4-Dinitrophenyl ether, 75 6, Benzyl eth , 49 5, al
138	**4-Chloro-2,3-dimethylphenol**	84									102	
139	**2,4-Dimethyl-1-naphthol**	84 5	169 70[10]	174 5								Me eth , b p 150-1[12], Picrate 143 4, dk red
140	**4-Methyl-1-naphthol**	84 5									81	
141	**1-Bromo-2-naphthol**	85								56		Me eth , 85
142	**3-Bromo-2-naphthol**	85								94		Me eth , 77-8
143	**2-Nitroresorcinol** (1,3-Dihydroxy-2-nitrobenzene)	85, or -red, w -al								*di* 63		Di-Me eth , 131, yel , al Di-Et eth , 106 7
144	**3-(Dimethylamino)phenol** (3-Hydroxydimethylaniline)	85	265-8, 138[10]							36 5, b p 160[5]	94	Picrate, 162, Methylurethane, 87, Ethylurethane, 150, 99 100, Me eth , b p 237, Et eth , b p 247
145	**3-Hydroxy-2-nitrobiphenyl**	85-6, bz , 81 2, yel , al								61 5 2 5	131 0 2 5	Benzenesulfonate, 130-1, 4-Nitro deriv , 126 7, 6-Nitro deriv , 214, 4,6-Dinitro deriv , 168 70
146	**2-Hydroxybenzyl alcohol** (Saligenin)	86 7, w									*di* 51, 70% al	Aryloxyacetic acid, 120, w

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenylurethane	α-Naphthylurethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p* Toluenesulfonate	Acetate	Benzoate	Miscellaneous
147	**4,6-Dinitro-2-methylphenol** (4,6-Dinitro-*o*-cresol)	86 5								95-6	135, 132	
148	**3-Nitrocatechol** (1,2-Dihydroxy-3-nitrobenzene)	86 5, yel, pet eth								*di* b p 103-4[1]	2-*mono* 66	1-Me eth, 62, yel, 2-Me eth, 102-3, Di-Me eth, 64-5, al
149	**4-Chloro-2-nitrophenol**	86-7								47 8		Me eth, 98 Et eth, 61-2
150	**2,4,5-Tribromophenol**	87, CH_2Cl_2-pet eth									99	Me eth, 105, *o*-Br-*p*-toluenesulfonate, 107 8, al
151	**4-Bromocatechol** (4-Bromo-1,2-dihydroxybenzene)	87									*di* 111	1-Me eth, 65
152	**4-(Methylamino) phenol**	87, bz							135, bz - lgr	43, pet eth	173-4, 50% al	Aryloxyacetic acid, 213 4, Me eth, 37
153	**2-Methyl-3,4,5-tribromophenol** (3,4,5-Tribromo-*o*-cresol)	89, pet										
154	**2-Amino-6-methylphenol** (6-Amino-*o*-cresol)	89, w							89, 90	78-9		N-Acetyl, 100 1
155	**N-Benzylidene-2-aminophenol**	89								93-6		Et eth, b p 215-6[20]
156	**3-Nitro-2,4,6-tribromophenol**	89-90, lgr							146-7, al			Me eth, 82, al, Et eth, 79, eth
157	**2-Amino-6-chloro-4-methylphenol** (2-Amino-6-chloro-*p*-cresol)	89-90										N,O-Diacetyl, 162 3
158	**1,3-Dimethyl-2-naphthol**	89-90		197					85 o			Picrate, 132-3
159	**2-Propylhydroquinone** (1,4-Dihydroxy-2-propylbenzene)	90, bz										Di-Me eth, b p 240-6
160	**4-Chlorocatechol** (4-Chloro-1,2-dihydroxybenzene)	90-1	136[8.5]							*di* b p 145-7[7]	*di* 96-7, eth	Di-Me eth, b p 242 4
161	**3-Chloro-4,6-dimethylphenol**	90-1										
162	**2-Methyl-3,4,6-tribromophenol** (3,4,6-Tribromo-*o*-cresol)	91, pet								76-7, ac a	85, 133, bz	Me eth, 71, al
163	**5-Chloro-2,4-dinitrophenol**	92								69		Me eth, 105, Et eth, 112, 6-Nitro deriv, 113 5
164	**4-Chloro-2,6-dibromophenol**	92							107-8			2,4-Dinitrophenyl ether, 145-6 Me eth, 74
165	**4-Bromo-2-nitrophenol**	92, 89								75		Me eth, 88 Et eth, 47, Benzenesulfonate, 83-4
166	**4-*tert*-Amylphenol**	92-3	260-5	108					55		61	
167	**4-Hydroxyphenylethyl alcohol** (Tyrosol)	93, chl	310, 156[15]							*β-mono* 59, eth - lgr *di* b p 187[18]	*di* 111, al	4-Et eth, 40

*Derivative data given in order: m.p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p* Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p* Toluene sulfonate	Acetate	Benzoate	Miscellaneous
168	**4-Iodophenol**	93 4, w		148, bz					99, me al	32	119	Aryloxyacetic acid 156, N,N-Diphenylurethane 127, 2,4-Dinitrophenyl ether, 156
169	**1-Naphthol** (α-Naphthol)	94	278-80	177-8, al	152, lgr	143, 140	217 4 (cor), yel , al	2,4-*di* 105	89	48-9, al	56, al	Aryloxyacetic acid, 193 5, *p*-Xenylurethane, 190 2,4-Dinitrophenyl ether, 128, *p*-Phenylazobenzoate, 118-9
170	**2-Iodo-4-nitrophenol**	94, 86-7								68		Me eth , 97, Et eth , 96
171	**2,4,6-Tribromophenol** (Bromol)	95, HCOOH 94, ac a (+1 ac a)			153	153	174	*tetra* 120	113, al	82, 87 ac a	81, al	Aryloxyacetic acid, 200, N,N-Diphenylurethane, 153, 2,4-Dinitrophenyl ether, 137 8 *p*-Phenylazobenzoate, 116-9
172	**2,2'-Stilbenediol** (2,2'-Dihydroxystilbene)	α 95, al , β 197, al									α *di* 107-8	β Di-Me eth 136
173	**6-Chloro-1-naphthol**	95								47		Picrate, 165
174	**3-Bromo-4-hydroxybiphenyl**	95								74 5	93 4	Benzenesulfonate 102 3
175	**1,3,6-Trihydroxynaphthalene** (1,3,6-Naphthalenetriol)	95								*tri* 112-3		Me eth , 103-4
176	**2,3,4-Tribromophenol**	95, w -HCOOH										Me eth , 106
177	**2,3,5-Trimethylphenol**	95 6	233	174, pet eth						241	50, pet eth	
178	**2-Naphthyl salicylate** (Betol)	95 5, stable, 93 5, labile		268, yel , ac a						136, al		
179	**3-Amino-2,4,6-trichlorophenol**	95 5-6 0, lgr										N-Acetyl, 185 0 6 5, tol
180	**3-Acetylphenol** (3-Hydroxyacetophenone)	96	296, 153[5]							44 0-4 5	52-3	D^{109} 1 099, n_{α}^{109} 1 5348 Me eth b p 240, Semicarbazone, 194-6
181	**5-Iodo-2-nitrophenol**	96, yel , pet eth								95	122	Me eth , 92, Et eth , 86-7
182	**2-Methoxy-5-propenylphenol**	96, 92	147[19]							101		Et eth , 49 50
183	**2-Methyl-4-nitrophenol** (4-Nitro-*o*-cresol)	96, yel , bz , 30-40 (+1 H_2O), w	186 90						107, al		128	Me eth , 64, al , Et eth , 71, w -al
184	**2-(Methylamino)phenol**	96-7, 86 7, pet eth									157 9	N-Benzoyl, 160 1, Me eth , 33 0-3 5
185	**3-Nitrophenol**	97	194[70]	129	167	174	159	*di* 91	112 3	55-6	95	D^{100} 1 2797, Aryloxybenzoic acid, 156, 2,4-Dinitrophenyl ether 136, *p*-Phenylazobenzoate, 160 5-2 5

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	l Toluene sulfonate	Acetate	Benzoate	Miscellaneous
186	**2,3-Dibromo-5,6-dimethylphenol**	97, aq al								78, pet eth	153, al	
187	**5-Methyl-1-naphthol**	97-8									77 8	
188	**3-Acetylcatechol** (2,3-Dihydroxyacetophenone)	97-8, yel, w								*di* 109, bz		1-Me eth, 152 3 Di-Me eth, 48, Oxime 96 7 Semicarbazone, 166 7
189	**2-Cyanophenol**	98									106, pet eth	$D_4^{99.6}$ 1 1052 $n_\alpha^{99.6}$ 1 53716
190	**3-Chloro-4,5-dimethylphenol**	98									42, al	
191	**2,5-Di-iodophenol**	99, pet eth								70, ac a		
192	**4-*tert*-Butylphenol**	100	237	148 5	110			50 *di* 64 7	109 10		81-2	Aryloxyacetic acid, 86 5, 2,4-Dinitrophenyl ether 108 10 Benzenesulfonate 70 1
193	**3,4,5-Trichlorophenol**	101, lgr, 91	271 7^{746}								120, al	Me eth, 130, b p 256 61, *m*-Nitrobenzenesulfonate, 176
194	**3,5-Dibromo-2-methylphenol** (3,5-Dibromo-*o*-cresol)	101 98 101									91-3	
195	**4,6-Dinitro-3-methylphenol** (4,6-Dinitro-*m*-cresol)	101 73 4							110 11		95	Me eth, 115 Et eth, 97
196	**2-Acetyl-1-naphthol**	102, pa grn, al, 98, br-yel, bz	325, sl d							107 5, al	128, al	
197	**2-Methyl-3,4,5-trinitrophenol** (3 4,5-Trinitro-*o*-cresol)	102, or yel, acet										Me eth, 111 2, w-al
198	**4-Methyl-2,3,6-tribromophenol** (2,3,6 Tribromo-*p*-cresol)	102, pet								77, lgr		
199	**1-Nitro-2-naphthol**	103, yel, al								61, pet eth		*m*-Nitrobenzenesulfonate, 176, ac a, Et eth, 104-5, yel, al
200	**3,3'-Dihydroxydiphenylmethane**	103, yel, al								*di* 57 5 8 5, lgr		
201	**4-Chloro-2-naphthol**	104								56		
202	**3,5-Di-iodophenol**	104, w								79, me al	93	Me eth, 85, pet eth, Et eth, 30, me al
203	**2-Bromo-4-methyl-5-nitrophenol** (2-Bromo-5-nitro-*p*-cresol)	104, yel								121		Me eth, 94, yel, eth
204	**3-Hydroxybenzaldehyde** (3-Formylphenol)	104, 108 (cor)	240	158-60						b p 203	38, 48 5-9 0	Aryloxyacetic acid, 148, 2,4-Dinitrophenylhydrazone, 257d, Semicarbazone, 198
205	**5-Methyl-2-naphthol**	104 5									107 8	Picrate, 156 7

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
206	**3-Hydroxy-4-nitrobiphenyl**	104 5, al				157	199					
207	**Catechol** (Pyrocatechol, 1,2-Dihydroxybenzene)	105	245 6	*di* 169	175	*mono* 159 *di* 169, al	*di* 152	*tetra* 192 3, wh - vlt		*mono* 57 8, *di* 65	*mono* 181, 131 *di* 84, al - eth	Aryloxyacetic acid 136 8 Monobenzenesulfonate *monoacetate*, 86 me al Dibenzenesulfonate, 155-6, acet
208	**2,4-Dibromo-1-naphthol**	105, 111								92-3		Me eth , 54-5, al *sym* -TNB add comp , 97, Picrate, 97, yel
209	**2,4-Dichloro-5-nitrophenol**	105 6									111 2	*m*-Nitrobenzoate, 154, *o*-Nitro-*p*-toluenesulfonate, 143
210	**Chlorohydroquinone**	106								*mono* 62, *di* 72, 99		
211	**4,6-Dinitro-2-iodophenol**	106 7, w							149	113		
212	**1,6-Dibromo-2-naphthol**	106-7 (+1 ac a , 84)								125		Me eth , 102, Et eth , 94
213	**2-Amino-5-chloro-4-methylphenol** (2-Amino-5-chloro-*p*-cresol)	106-7										N-Acetyl, 115, aq al , Me eth , 106, lgr
214	**4-Chlororesorcinol** (4-Chloro-1,3-dihydroxybenzene)	106-7 89	259, 147[18]						*di* 46 7	*di* 66		3-Me eth , 79-80 Di-Me eth , b p 135 7[17]
215	**2-Hydroxypyridine** (α-Pyridone)	106 7, bz	280 1			120			158-9, 53	b p 150-60[0 09]	42	Picrate, 176 7, Benzyl eth , 42
216	**2-Phenoxyphenol** (2-Hydroxydiphenyl ether)	106 7	151 5[11]							b p 358-60	48 5	Me eth , 79, lgr
217	**5-Methylresorcinol** (Orcinol, 3,5-Dihydroxytoluene)	106 5 8, 56 8 (+1 H_2O)	287-90	154	160, lgr	214	190	*tri* 104		*di* 25	*di* 88, al	Aryloxyacetic acid 217 *p*-Xenylurethane, 196 2,4-Dinitrophenyl ether, 153 4
218	**6-Amino-4-chloro-2-methylphenol** (6-Amino-4-chloro-*o*-cresol)	107								2,3-*di* 196		
219	**2,4-Dichloro-1-naphthol**	107-8								74-6		Me eth , 58
220	**1,2-Dihydroxynaphthalene** (1,2-Naphthalenediol, β-Naphthohydroquinone)	108, 105 5								*di* 104-6, 109, ac a	*di* 106	Diaryloxyacetic acid, 104 6, 1-Me eth , 90 5, Di-Me eth , 31
221	**1,2,3,4-Tetrahydroanthranol**	108, lgr								109, al	142	Me eth , b p 197[14]
222	**4-Methyl-5,6,7,8-tetrahydro-2-naphthol**	108				114 6					89	
223	**4-Acetylphenol** (4-Hydroxyacetophenone)	109								54		Semicarbazone, 199, 2,4-Dinitrophenylhydrazone 261 5 (cor), br , al
224	**3-Methyl-2,4,6-trinitrophenol** (2,4,6-Trinitro-*m*-cresol)	109 10, yel , al								135, pa yel , bz	140	Di-Me eth , 155, al , Di-Et eth , 36 7, w -al

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
225	**2-Iodo-6-nitrophenol**	109 10								96-7		Me eth , 96-7
226	**Resorcinol** (1,3-Dihydroxybenzene)	110 (stable), 108 8 5 (labile)	280 8 (cor), 275 9	*di* 164, chl		*di* 182 175	*di* 201	*tri* 112	*di* 80-1, acet - dil al	57-8, dil al	*mono* 135-6, *di* 117, dil al	Aryloxyacetic acid, 175, 195, 2,4-Dinitrophenyl ether, 194, N,N-Diphenylurethane, 194, Me eth , 43-4, me al
227	**2,2 -Biphenol** (2 2 Dihydroxybiphenyl)	110 109, tol	326	*di* 145, dil al				*di* 188	190	*di* 95, xyl	*di* 101, al	Di-Me eth , 155, al , Di-Et eth , 36-7, w -al
228	**Bromohydroquinone**	110						*di* 186		*di* 72		
229	**4-Hydroxy-2'-nitrobiphenyl**	110 1, 116								122	156-7	Aryloxyacetic acid, 160-1, Benzenesulfonate, 106, yel , al , Me eth , 60 0-0 5, Et eth , 51 5-nitro deriv , 151-2
230	**7-Methyl-1-naphthol**	110-11								39-41		Picrate, 164-5
231	**1-Methyl-2-naphthol**	111								66	116 7	Picrate, 163 4
232	**2-Chloro-4-nitrophenol**	111, w								63		Me eth , 98, Et eth , 82, 142
233	**2-Amino-6-nitrophenol**	111-2 aq al								2-*mono* 102-3 (hyd), 122 (anh)		Me eth , 198
234	**2,4,6-Tribromoresorcinol** (1,3-Dihydroxy-2,4 6-tribromobenzene)	112, w								*mono* 114, CS_2, *di* 108	*mono* 120, chl - pet - eth	Me eth , 104, Di-Me eth , 68-9, w - al
235	**4',5-Dimethyl-2-hydroxyazobenzene** (2-*p*-Toluene-azo-*p*-cresol)	112 3, tol								91, yel , ac a	95, yel , al	Et eth , 43, ac a , Propionate, 62, lgr
236	**4-Hydroxyphenanthrene** (4-Phenanthrol)	112-3 5, pet eth								58-9, al		Me eth , 68, me al
237	**2,2'-Dihydroxy-3,3'-dimethylbiphenyl**	113, pet eth									*di* 147, me al	
238	**2,6-Dinitro-4-iodophenol**	113, w							138		175	
239	**2-Chloro-4,6-dinitrophenol**	113, 110							155			
240	**4,4'-Dihydroxy-2,2'-dimethylbiphenyl**	114								*di* 75	*di* 127	
241	**2-Bromo-4-nitrophenol**	114								62, 86	131-2	Me eth , 106, Et eth , 98, yel
242	**4-Nitrophenol**	114		156	150-1	159	186, 188 (+1 ac a)	2,6-*di* 142	97	81-2, w -al	142 5	Aryloxyacetic acid, 187, 2,4-Dinitrophenyl ether, 120, N,N-Diphenylurethane, 112, *p*-Phenylazobenzoate, 203-6
243	**2,4-Dinitrophenol**	114				139		6-*mono* 118	121	72	132	2,4-Dinitrophenyl ether, 248
244	**2,3,5-Tri-iodophenol**	114, bz - lgr								123		Et eth , 121

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
245	**4-Hydroxy-3-methoxybenzyl alcohol**	115								4-*mono* 51, *di* 48, bz-lgr	4-*mono* 90, et ac-al, *di* 121	4-Et eth, 56 7
246	**1-Hydroxyfluorenone**	115, yel								130–1, aq al	128–9	Me eth, 141 5 2 5 Oxime, 169–70, Phenylhydrazone, 173–4
247	**Ethyl 4-hydroxybenzoate**	115, 116	297–8								94, eth	
248	**4-Chloro-3,5-dimethylphenol**	115–6								47 8		
249	**3,5-Dimethyl-2,4-dinitrophenol**	115–6, 106							171	148	156	
250	**4-Bromo-1,5-dihydroxynaphthalene** (4-Bromo-1,5-naphthalenediol)	116								*di* 138		Di-Me eth, 115
251	**3-Benzoylphenol** (3-Hy	116 al										Oxime *anti* 76 bz *syn* 126 (on heating *anti*)
252	**4-Hydroxybenzaldehyde**	116–7									90	Aryloxyacetic acid 198, 2,4-Dinitrophenylhydrazone 270 1
253	**3-Bromo-1,2-dihydroxynaphthalene** (3-Bromo-1,2-naphthalenediol)	117								*di* 160		Naphthalene add comp, 100
255	**Phloroglucinol** (1,3,5-Trihydroxybenzene)	117 (+2H$_2$O), 217–9 (anh)				283		*tri* 151		*tri* 104	*tri* 185	Picrate, 101–3
256	**2,4'-Dihydroxydiphenylmethane**	117–8, w-al								*di* 70, ac a	*di* 108	Di-Me eth, 26 Di-Et eth, 60, w-al
257	**2,3,5,6-Tetramethylphenol** (Durenol)	118, wh, pet	249					4-*mono* 118, or, dil al				
258	**4-Amino-2-methyl-6-nitrophenol** (4-Amino-6-nitro-*o*-cresol)	118, al								4-*mono* 217, yel, al		
259	**2,4-Dibromo-6-nitrophenol**	118, ac a							140	89		Me eth, 76–7, yel, Et eth, 46
260	**2-Methyl-5-nitrophenol** (5-Nitro-*o*-cresol)	118, yel, lgr							123–4, al	74		Me eth, 74, al, Et eth, 61, al
261	**2-Bromo-4,6-dinitrophenol**	118–9, yel							157	104 5	94, aq al	Me eth, 48, yel
262	**2-Bromo-5-nitrophenol**	118 5–21, pet eth							131 5–2 5, al			Me eth, 104, al
263	**2-Amino-4-methyl-6-nitrophenol** (2-Amino-6-nitro-*p*-cresol)	119, 110, br, al										N-Acetyl, 143, yel al
264	**3-Amino-2,4,6-tribromophenol**	119, pet eth							146–7, al			O,N,N-Triacetyl, 136

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
265	**2-Methylresorcinol** (1,3-Dihydroxy-2-methylbenzene, 2,6-Dihydroxytoluene)	119 20, bz	271 (cor)								*di* 105–6, me al	Di-Me eth , 39
266	**4-Acetylcatechol** (3,4-Dihydroxyacetophenone)	119 2 7 116							*di* 144–5, et ac	4-*mono* 58, *di* 91, 88	*di* 118, al	Oxime, 184 d , et ac , 1-Me eth , 91, 2-Me eth , 115, Di-Me eth , 51
267	**2-Chloro-5-nitrophenol**	119 5, w								82	127–8	Me eth , 83, Et eth , 64 5, al
268	**5-Methyl-1,2,3-trihydroxybenzene** (3,4,5-Trihydroxytoluene, 5-Methylpyrogallol)	120 (subl), bz								*tri* 99		3,5-Di-Me eth , 36, al
269	**9-Hydroxyanthracene** (9-Anthrol, Anthranol)	120, yel								126 31	286 8	
270	**6-Bromo-2-methyl-4-nitrophenol** (6-Bromo-4-nitro-*o*-cresol)	120 d , yel , lgr								137		
271	**2,2′-Dihydroxy-4,4′-dimethylbiphenyl**	120									*di* 148, al - acet	
272	**4-Nitro-2-naphthol**	120, yel , pet eth							122, pa yel , al			*m*-Nitrobenzenesulfonate, 149, ac a , Me eth , 100–3, br , bz -al
273	**4-Chloro-1-naphthol**	120 1, 116 7, al or chl								44		Picrate, 171, Carbonate, 228
274	**2-Chloro-3-nitrophenol**	120 5, w								51 5	94	Me eth , 94, Et eth , 51, me al
275	**4-Chloro-3,5-dibromophenol**	121									132	Me eth , 82 5
276	**3,4-Dimethyl-1-naphthol**	121 5 3 0, lgr	205 10^{15}				222 4			89 5 91		Turns red in air, Picrate, 168
277	**3-Aminophenol** (3-Hydroxyaniline)	122				143	179					N-Acetyl, 148, N-*p*-Toluenesulfonyl, 157, N-Phenylthiourea, 156
278	**2-Amino-3-chlorophenol**	122										N-Acetyl, 123, N-Benzoyl, 123, HNO_3 salt, 137
279	**4-Bromo-2-naphthol**	122								61		Me eth , 64
280	**4-Nitroresorcinol** (1,3-Dihydroxy-4-nitrobenzene)	122, yel , CCl_4	178–9[11]							*di* 90–1, al	1-*mono* 124, ac a , 3-*mono* 189, ac a , *di* 110	Di-Et eth , 85
281	**2,4,6-Trinitrophenol** (Picric acid)	122 (subl on slow htng , exp on rapid htng)								76		Naphthalene add comp , 149-51

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
282	**3-Hydroxyphenanthrene** (3-Phenanthrol)	122-3, al								114-5, aq al		Me eth, 63, me al, Et eth, 46, me al, Picrate, 124-5, red, al
283	**2,4-Dichloro-6-nitrophenol**	122-3								77		3-Nitrobenzoate, 149-50
284	**2-Naphthol** (β-Naphthol)	123	286	155-6, al	156-7, lgr	169	210-2 (cor.), al	84	125, al	71-2 70	106-7	Aryloxyacetic acid, 95, 2,4-Dinitrophenyl ether, 95, N,N-Diphenylurethane, 141, p-Phenylazobenzoate, 190-3
285	**2,3,4,5-Tetrabromophenol**	123, aq al						225-6		110-5, aq ac a	133, al	
286	**2,4-Dimethyl-2-methoxyphenol**	123							137-8	114		Et eth, 91
287	**2-Nitro-4,5,6-tribromophenol**	123, yel, bz										Me eth, 109, al, Et eth, 74
288	**1,4-Dichloro-2-naphthol**	123-4								90-1		
289	**4-Butyl-2-methylphenol** (4-Butyl-*o*-cresol)	124	127 9^{15}							268-70		
290	**3,3'-Biphenol** (3,3'-Dihydroxybiphenyl)	124, w								*di* 82-5, dil al	*di* 92	Di-Me eth, 36, w-al, b.p. 328
291	**1,3-Dihydroxynaphthalene** (1,3-Naphthalenediol)	124, w								*di* 56, w-ac a		*sym*-Trinitrobenzene add. comp., 174-5, red
292	**3-Iodo-4-nitrophenol**	124, yel, pet eth								73-7	119	Me eth, 69-70
293	**2-Methylhydroquinone** (2,5-Dihydroxytoluene)	124-5, bz						84	125	*mono* 92, pet eth, *di* 49, 45, w	*di* 119-20	Aryloxyacetic acid, 153, Di-Et eth, 24-5, b.p. 247-9
294	**4-Hydroxybenzyl alcohol** (α,4-Dihydroxytoluene)	124-5-5-5								*α-mono* 84, *di* 75	*α-mono* 88-9	
295	**4,6-Dimethylresorcinol** (4,6-Dihydroxy-*m*-xylene)	124-5-5.0, w (+1 w)	276-9							*di* 45, al, b.p. 285-7		Di-Me eth, 76, Di-Et eth, 75, al
296	**4-Benzyl-1-naphthol**	125-6								87-8	103	
297	**Pentamethylphenol**	126	267	215						273	127	Me eth, 163-4
298	**3,5-Dinitrophenol**	126, 122								126-7		Me eth, 105-6, Et eth, 97
299	**7-Chloro-2-naphthol**	126-5								104-5		
300	**4-Chloro-3-nitrophenol**	126-5 w								83-5	96-7	Me eth, 98, al, Et eth, 47-5, al
301	**2-Nitro-3,4,6-tribromophenol**	127, pa yel, w-HCOOH								118		Me eth, 72, w-HCOOH
302	**2-Nitro-1-naphthol**	127-8, yel, al								118		Me eth, 80, Et eth, 84, yel, lgr
303	**1,3-Dibromo-2,4-dihydroxynaphthalene** (1,3-Dibromo-2,4-naphthalenediol)	128-9, ac a						186, CS_2		4-*mono* 148, *di* 125, al		

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	*p* Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
304	**4-Iodo-2-naphthol**	128.5								59		Me eth., 67
305	**4-Bromo-1-naphthol**	129								51		
306	**3-Methyl-4-nitrophenol** (4-Nitro-*m*-cresol)	129, w								34, al	74	Me eth., 55, lgr., Et eth., 45, al
307	**3-Hydroxypyridine** (β-Pyridone)	129								b.p. 210, 92°	50.0–0.5	Hydrochloride, 105–7, Picrate, 200–1
308	**4-Hydroxy-3-nitroazobenzene**	129, lgr								120.5, ac a	132, bz	Me eth., 107
309	**3-Amino-2-methylphenol** (3-Amino-*o*-cresol)	129, w								108		Turns br. in air
310	**6-Bromo-2-naphthol**	129.30								103		Me eth., 108
311	**8-Nitro-1-naphthol**	130										*m*-Nitrobenzenesulfonate, 166, ac a
312	**4-Amino-2-nitrophenol**	131, dk red										Me eth., 243, Et eth., 170, N-Acetyl, 157–8, yel
313	**Methyl 4-hydroxybenzoate**	131		134–5, bz						85	135	
314	**5-Methyl-1,2,4-trihydroxybenzene** (2,4,5-Trihydroxytoluene)	131.2, bz								*tri* 114.5, al		4-Me eth., 124, w., 4-Et eth., 131 (subl.), bz., Trime eth., 55, w.-me al
315	**5-Chloro-1-naphthol**	131.2, w or CS_2								53		Picrate, 160
316	**4-Cyclohexylphenol**	132		145.5		137, al	168 (cor.)			35	118.5, me al	
317	**Pyrogallol** (1,2,3-Trihydroxybenzene)	133	309	*tri* 173		*tri* 230	*tri* 205	*di* 158		*di* 110–11, *tri* 165, 173	*mono* 140, *di* 108, *tri* 90, al	Tris-N,N-Diphenylurethane, 212
318	**2-Amino-4,6-dimethylphenol**	134–5, al										N-Acetyl, 96, aq al., O,N-Dibenzoyl, 153.5 Me eth., b.p. 239–40
319	**4-Amino-5-isopropyl-2-methyl-6-nitrophenol** (4-Amino-5-isopropyl-6-nitro-*o*-cresol)	134.5 yel., al									1-*mono* 280–3, *di* 222.5, bz	
320	**4,6-Dibromo-2-naphthol**	134–5								128	128.9	Me eth., 103, Et eth., 98
321	**2,3-Dichloro-1,4-dihydroxynaphthalene**	135, 155–6, aq al								*di* 239–40	*di* 252	Di-Me eth., 107–8, Dipropionate, 166–7, Dibutyrate, 128
322	**4-Benzoylphenol** (4-Hydroxybenzophenone)	135								81, me al	115, 94–5	2,4-Dinitrophenylhydrazone, 242.4 (cor.), Semicarbazone, 194

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	*p*-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	*p* Toluenesulfonate	Acetate	Benzoate	Miscellaneous
323	**2-Amino-4-methylphenol** (2-Amino *p*-cresol)	135, w										N-Benzoyl, 191, al, O,N-Dibenzoyl, 190–1, al, O,N-Diacetyl, 128–9, Me eth, 93–4, pet eth
324	**3-Amino-4,6-dichlorophenol**	135–6 w							113–4			N-Acetyl, 233–6, Me eth, 51
325	**2,6-Dinitrohydroquinone**	135 6 (anh)								4-*mono* 95–6, *di* 135–6	4-*mono* 150 1	4-Me eth, 102, Di-Me eth, 95–6 112
326	**1,4-Dimethyl-2-naphthol**	135 6								77–8	124–5	
327	**Trichlorohydroquinone**	136, w								*di* 153 (subl)		Di-Et eth, 68 5, al
328	**5-Iodo-3-nitrophenol**	136, w								110	100 5	Me eth, 84
329	**Trichlorophloroglucinol**	136, al								*tri* 167 8, ac a		Di-Me eth, 93–5 Tri-Me eth, 130–1, al
330	**1,6-Dihydroxynaphthalene** (1,6-Naphthalenediol)	137–8, bz								*di* 73, al	*di* 103–4	Di-Me eth, 60–1 pet eth, Di-Et eth, 83, lgr, 2-Naphthylamine add comp, 110 5
331	**2,4-Dinitro-1-naphthol**	138									174	Me eth, 97, Et eth, 92
332	**4-Amino-2,6-dimethylphenol**	138 d, bz										N-Acetyl, 136–7, aq al, O,N-Diacetyl, 160, Me eth, 66, w
333	**2-Amino-3-bromophenol**	138							120–1, al			Me eth, 65, Hydrochloride, 225
334	**2-Amino-4-chlorophenol**	138 (unstable)							115	73–4		N-Acetyl, 185, O,N-Dibenzoyl, 157–8, Me eth, 82–3
335	**1,4,6-Trihydroxynaphthalene** (1,4,6-Naphthalenetriol)	138–40								94 5		
336	**2,6-Dibromo-3,4,5-trihydroxybenzoic acid** (Dibromogallic acid)	139 d (+1H_2O)								*tri* 168	*tri* 95–6	Triacetate of Me eth, 150–2
337	**2-Hydroxy-2′-nitrobiphenyl**	139–40				116	180	3,5-*di* 149	100		116	3-Nitrobenzenesulfonate, 161, 4-Nitrobenzenesulfonate, 147, 2,4-Dinitrophenyl ether, 118, Me eth, 82, 3,5-Dinitro deriv, 123
338	**4-Phenyl-1-naphthol**	140									73–4	
339	**1,3-Dihydroxy-2-methylnaphthalene** (2-Methyl-1,3-naphthalenediol)	140								118		
340	**1,2,4-Trihydroxybenzene**	140–5, eth								*tri* 96–7, wh, abs al	*tri* 120, al	Tri-Et eth, 34, al, Picrate, 96
341	**2-Amino-5-iodophenol**	141										N-*p*-Toluenesulfonyl, 175–6

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p* Nitrobenzoate	3 5-Dinitrobenzoate	Bromo derivative	*p* Toluene sulfonate	Acetate	Benzoate	Miscellaneous
342	**4-Hydroxy-2-nitrobiphenyl**	141-3								169	105 6	Me eth , 72
343	**1,8-Dihydroxynaphthalene** (1,8-Naphthalenediol)	142, ac a , 140, w								*di* 155 ac anh	*di* 174 5	Di-Me eth , 50, pet eth Picrate, 135 7 2-Naphthylamine add comp , 124
344	**2-Amino-4-nitrophenol**	142 3 (anh), 80-90 (hyd)				122			122, yel , al			N-Acetyl, 279, N-Benzoyl, *ca* 200 d , Me eth 124 5 Et eth , 97 8
345	**3,4-Dihydroxyphenanthrene** (Morphol)	143, pet eth								*di* 159, eth		Me eth , 62 3, Di-Me eth , 45, me al
346	**3-Chloro-1-naphthol**	143, 134 5, lgr								69, lgr	118 9	Me eth , b p 162-4[18]
347	**2-Isopropyl-5-methylhydroquinone** (Thymoquinol)	143, 139 5	290	232 3, al	147 8, al					*di* 73 5	141 2, al	
348	**2,6-Dibromo-4-nitrophenol**	144							128 9	181		
349	**3,4,5-Tribromocatechol**	144 (+1H_2O)								*di* 120		Di-Me eth , 86-7
350	**3-Amino-4-methylphenol** (3-Amino-*p*-cresol)	144										N-Acetyl, 178 O,N-Diacetyl, 128 9 N-Benzenesulfonyl, 183, Me eth , 47, w
351	**8-Nitro-2-naphthol**	144-5, yel								101-2, w -al		*m*-Nitrobenzenesulfonate, 144-6, ac a , Me eth , 69, Et eth , 72-3, yel , pet eth
352	**4-Benzoylresorcinol** (2,4-Dihydroxybenzophenone)	144 6								*di* 78		
353	**1-Hydroxyacenaphthene** (1-Acenaphthenol)	144 5-5 5 (cor), 148		137						b p 166-8[5]		
354	**4-Amino-2,3,6-trinitrophenol**	145 d , ac a										N-Acetyl, 178-9, N-Benzoyl, 205, ac a , Me eth , 138-9, al
355	**4-Benzoylcatechol** (3,4-Dihydroxybenzophenone)	145, 134									*di* 95	Me eth , 131-2, Di-Me eth , 103 4
356	**3-Bromo-5-nitrophenol**	145								99		Me eth , 88
357	**3,4-Dihydroxybiphenyl** (4-Phenylcatechol)	145								*di* 77 5 8 0		
358	**2,4,6-Tri-iodoresorcinol**	145, CS_2								*di* 170		
359	**2,4'-Dihydroxychalcone**	145								*di* 94 5	*di* 120	4'-Me eth , 148 d , al
360	**2,6-Diamino-4-methylphenol** (4-Hydroxy-3,5-toluenediamine)	146										N,N'-Diacetyl, 225-7, dil al , 1,2,6-Triacetyl, 228, al
361	**5-Aminoresorcinol** (3,5-Dihydroxyaniline)	146-52										N-Benzoyl, 139, Di-Me eth , 46, Picrate, 167-70 d , yel , aq al

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p Toluene sulfonate	Acetate	Benzoate	Miscellaneous
362	**4-Acetylresorcinol** (Resacetophenone, 2,4-Dihydroxyacetophenone)	147								3-*mono* 119 20, 4-*mono* 74, *di* 38	3-*mono* 67, 4-*mono* 106 7	Semicarbazone, 216, 2,4-Dinitrophenylhydrazone, 218, Oxime, 199, Phenylhydrazone, 159
363	**3-Chloro-5-nitrophenol**	147								84	78	Me eth , 101, Et eth , 47, al
364	**5-Nitro-2-naphthol**	147, yel , w										*m*-Nitrobenzenesulfonate, 106, ac a , Et eth , 115, yel , al
365	**2-Methyl-3-nitrophenol** (3-Nitro-*o*-cresol)	147, yel , w							94, al			Me eth , 52 3, w - me al
366	**2-Chloro-4-hydroxybenzaldehyde**	147 8								52	97	Semicarbazone, 214, Oxime, 194, *p*-Nitrophenylhydrazone, 288 d
367	**1,5-Dibromo-4,8-dihydroxynaphthalene**	147 5								*di* 131		
368	**5-Acetylresorcinol** (3,5-Dihydroxyacetophenone)	148								*di* 91 2		Semicarbazone, 205 6 *p*-Nitrophenylhydrazone, 236 7
369	**2,4-Dinitroresorcinol**	148							*mono* 126–7	*di* 119 20	*di* 182 4	Aryloxyacetic acid, 155, Me eth , 108, Di-Et eth , 57
370	**4-Propionylphenol** (4-Hydroxypropiophenone)	148								62, lgr	107 5	2,4-Dinitrophenylhydrazone, 229
371	**9,10-Dihydroxyphenanthrene** (9,10-Phenanthrenediol)	148								*mono* 168 70, *di* 202	*di* 216 7	
372	**3,4,5-Trihydroxyphenanthrene** (3,4,5-Phenanthrenetriol)	148, w								*tri* 138, bz - pet eth		Tri-me eth , 90, me al
373	**4-Hydroxypyridine** (γ-Pyridone)	148 5 (anh), 65 (+1 H_2O)	>350							140 50	81	Picrate, 240, Methiodide, 108 9
374	**3-Nitrosalicylic acid**	148 5–9 0										Amide, 155, 145
375	**3-Acetamidophenol** (3-Hydroxyacetanilide)	148 9, w								99 5 100 5		
376	**2-Amino-3,6-dimethylphenol**	149 50, bz										N-Benzoyl, 210–11, O,N-Dibenzoyl, 178–9
377	**2,6-Dimethylhydroquinone**	149–51, xyl										4-Me eth , 77, pet eth
378	**2,4'-Dihydroxybenzophenone**	150								84 5		
379	**5-Amino-2-bromophenol**	150 d							135 6			
380	**2-Amino-5-bromophenol**	150										O,N-Dibenzoyl, 133 4, H_2SO_4 salt, 239 40
381	**1-Hydroxyanthracene** (1-Anthrol)	150–3, br , al								128–30		Me eth , 70, Et eth , 69
382	**2-Amino-4-chloro-6-nitrophenol**	152										N-Acetyl, 150 60, yel

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α Naphthyl-urethane	*p*-Nitrobenzoate	3,5-Di-nitro-benzoate	Bromo derivative	*p* Toluene sulfonate	Acetate	Benzoate	Miscellaneous
383	**4-Hydroxyazobenzene** (4-Benzeneazophenol)	152, al								89, 84 5, yel, al	136–8, yel, al	Hydrochloride, 169 HNO_3 → 2,4-Dinitrophenol, 113 Propionate, 75, red
384	**Tribromophloroglucinol**	152 3 (anh), w								*mono* 169, bz - pet eth, *tri* 181 3, al		Me eth , 123, bz Tri-Me eth 145, al Di-Et eth , 63 5, w -ac a , Tri-Et eth , 102 4, ac a
385	**4-Amino-2-chlorophenol**	153							116–7, aq al			N-Acetyl, 144 O,N-Diacetyl, 124 Me eth , 62
386	**2,2'-Dihydroxy-5,5'-dimethylbiphenyl**	153–4, w								*di* 88		Diformate, 61, 70% al
387	**2-Amino-5-chlorophenol**	154, aq al										O,N-Dibenzoyl, 140, al Me eth , 46, Hydrochloride 226 d
388	**1,2,4-Trihydroxynaphthalene** (1,2,4-Naphthalenetriol)	154								*tri* 134 5		
389	**6-Hydroxybiphenyl-2-carboxylic acid**	154 (anh)							177, ac a	88–9, al	121, 150	Benzenesulfonate, 104–5 Butyrate, 59–60
390	**4-Amino-3-nitrophenol**	154, dk red							134, al	185		N-Acetyl, 218, yel , w O N-Diacetyl, 146, O-*m*-nitrobenzenesulfonate, 184
391	**2-Azoxyphenol** (2,2'-Dihydroxyazoxybenzene)	154 5								*di* 150, bz	*di* 108 al	Di-Me eth 81 Di-Et eth , 102
392	**3,5-Stilbenediol** (3,5-Dihydroxystilbene, Pinosylvyn)	155 5–6 0, ac a								*di* 100–i me al	*di* 150 1 ac a me al	Me eth , 122–3, ac a Di-Me eth , 56 7 me al
393	**1-Hydroxyphenanthrene** (1-Phenanthrol)	156, eth								135–6, al		Me eth , 105, me al , Picrate 182, or -red, me al
394	**4-Iodo-3-nitrophenol**	156, yel , al								107 5		Me eth , 62, Et eth , 63 5
395	**1,4,5-Trichloro-2-naphthol**	157–8, ac a								129		
396	**9-Hydroxyphenanthrene** (9-Phenanthrol)	158, bz, 153								77–8, al	99–100	Me eth , 95–6, me al , Picrate, 185, red, Propionate, 95, ac a
397	**5-Nitroresorcinol**	158, w								*di* 105		Me eth , 141–2, yel , Di-Me eth , 89, eth -et ac , Et eth , 80, w
398	**4,4'-Dihydroxydiphenylmethane**	158, w								*di* 69–70, al	*di* 156, al	Di-Me eth , 52, Di-Et eth , 38–9
399	**2,4,6-Tri-iodophenol**	158–9, w - al					181			156, bz	137	Me eth , 98–9, bz Et eth , 83, eth

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p* Toluene sulfonate	Acetate	Benzoate	Miscellaneous
400	**Salicylic acid** (2-Hydroxybenzoic acid)	158 3	211[20]			205, me al				135, wh	132	Aryloxyacetic acid, 191, Amide, 142, Anilide, 136, *p*-Toluidide, 156
401	**4-Amino-2,3,6-trichlorophenol**	159, al								153, yel		N-2,4-Dinitrophenyl, 211, or-red
402	**4-Amino-3-chlorophenol**	160										N-Acetyl, 121
403	**6-Amino-2,4-dinitro-3-methylphenol** (6-Amino-2,4-dinitro-*m*-cresol)	160, al										N-Acetyl, 225, yel
404	**2,2'-Dihydroxychalcone**	160–1								*di* 85 5 6 0	*di* 114	2-Me eth , 112, al 2-Et eth , 61, al
405	**4-Amino-6-nitroresorcinol**	160–1 d , eth -lgr										N-Acetyl, 261, yel , ac a , Di-Me eth 136 7, red aq al
406	**4,4'-Dihydroxy-3,3'-dimethylbiphenyl**	160–1								*di* 131, al , 135 5	185, ac a	
407	**2,3-Dihydroxynaphthalene** (2,3-Naphthalenediol)	160 1, w									*di* 235	Me eth , 108, Di-Me eth , 116 5, lgr , Et eth , 109–10, Di-Et eth , 96–7, 2-Naphthylamine add comp 168
408	**1,2-Dihydroxyanthracene** (1,2-Anthracenediol)	160–2								*di* 157 0–7 5, al -ac a		
409	**6-Retenol** (6-Hydroxyretene)	161, xyl							110 5 11	134–5		Picrate, 152–2 5, red, al
410	**5-Amino-2-methylphenol** (5-Amino-*o*-cresol)	161, w							111–2, aq al			N-Acetyl, 225, N,N-Diacetyl, 132–3, O,N-Di-benzoyl, 162, Me eth , 58
411	**4,4'-Dihydroxytriphenylmethane**	161, w -al								*di* 109 10		Di-Me eth , 100 1, chl -me al
412	**3-Hydroxyphthalic acid**	161 d								114–6	148	
413	**1,2,3,4-Tetrahydroxybenzene** (Apionol, Phenetrol)	161, pink, et ac								*tetra* 142	*tetra* 191 2	1,4-Di-Me eth , 106, Tetra-Me eth , 89
414	**5-Amino-2-nitrophenol**	162, or-yel , w										N-Acetyl, 221, yel , ac a , O,N-Di-acetyl, 149, w
415	**1,3,4-Trichloro-2-naphthol**	162								133 5–4 0, ac a		
416	**2-Amino-5-methylphenol** (6-Amino-*m*-cresol)	162 d										N-Benzoyl, 169, acet -pet eth , O,N-Dibenzoyl, 162 3, me al , Me eth , 171, 50% al
417	**1-Amino-2,4-dihydroxynaphthalene**	162 (at 130 → vlt)										O,O,N-Triacetyl, 155–6, bz

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p Toluenesulfonate	Acetate	Benzoate	Miscellaneous
418	**2,4'-Biphenol** (2,4'-Dihydroxybiphenyl)	162 3	342							*di* 94, al		Di-Me eth , 70
419	**2,5-Dimethylresorcinol** (2,6-Dihydroxy-*p*-xylene)	163, bz	277 80							*di* 69, al		Me eth , 118–21, bz
420	**2-Amino-3,5-dimethylphenol**	163, bz								186 7		O,N-Diacetyl, 87–8, N-Benzoyl, 211 2, al O,N-Dibenzoyl, 148–9, me al , Hydrochloride, 270 80, dil HCl
421	**4-Nitro-1-naphthol**	164, w										*m*-Nitrobenzenesulfonate, 135, Me eth , 81, yel , bz 85–6, Et eth , 120, al , 116 7
422	**3,5-Dinitrocatechol** (1,2-Dihydroxy-3,5-dinitrobenzene)	164								120, *di* 112 4, 124, al		1-Me eth , 123, 2-Me eth , 80 Di-Me eth , 102, al , 1-Et eth , 155, al , Di-Et eth , 78 94 5
423	**2,2'-Dihydroxy-6,6'-dimethylbiphenyl**	164								*di* 87, al	*di* 136, al	
424	**2-Amino-3,4-dihydroxynaphthalene**	164								*di* >200 d		N-Acetyl, 170 d , 3-O,N-Diacetyl, 195 d , acet
425	**2,6-Dibromohydroquinone**	164								*di* 117		
426	**2-Benzoylphloroglucinol** (2,4,6-Trihydroxybenzophenone)	165									*tri* 125–6	2,4-Di-Me eth , 83, 2,6-Di-Me eth , 178–9
427	**5-Amino-3-nitrophenol**	165, yel										N-Acetyl, 260–70, et ac
428	**2-Methoxy-4-nitrophenol**	165 d , yel , chl								156–8	188, yel , al	Me eth , 105 6
429	**3-Amino-4,5-dimethylphenol**	165, eth , br , (173–5, subl)										N-Acetyl, 191 (sinters, 184), O,N-Diacetyl, 157, al , O,N,N-Triacetyl, 100–1, al , N-Benzoyl, 195–6
430	**1,2,3,5-Tetrahydroxybenzene**	165								*tri* 74		1,3-Di -Me eth , 159, 83, 1,2,3-Tri-Et eth , 105
431	**4-Phenylphenol** (4-Hydroxybiphenyl)	165	305 8	167 5					177, ac a , 179, al - acet	88–9, 87–8, al	150–1, al	*p*-Phenylazobenzoate, 213 5–4 0, 2,4-Dinitrophenyl ether, 118
432	**4-Amino-2-bromophenol**	165, 155										N-Benzoyl, 145, O,N-Dibenzoyl, 192
433	**Benzeneazocatechol** (3,4-Dihydroxyazobenzene)	165 d , dk red, al										3-Me eth , 70–1, red, lgr , Di-Me eth , 53–4, red, lgr , 44–5
434	**4-Amino-2-chloro-3-nitrophenol**	165 5 d , bz										N-Acetyl, 184–5, Et eth , 74, or

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitro benzoate	3 5-Di nitro-benzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
435	**4-Amino-2,5-dinitrophenol**	166–7, al										N-Acetyl, 144–5, Me eth , 153, bz - lgr , red, Et eth , 139
436	**4-Amino-2,6-dinitro-3-methylphenol** (4-Amino-2,6-dinitro-*m*-cresol)	167, red, 50% al										N-Acetyl, 231 d , ac a , Et eth , 96 7, Hydrochloride, 200 d , dil, HCl
437	**2-Benzamidophenol** (2-Hydroxybenzanilide	167 d							109–10, al	134 40, al		Me eth , 60
439	**2,3,4-Trichloro-1-naphthol**	168, lgr								123–4		
440	**2-Hydroxyphenanthrene** (2-Phenanthrol)	168, al								142–3	139–40, al	Et eth , 112, al , Picrate, 156, red
441	**1,5-Di-(2-hydroxyphenyl)-1,4-pentadiene-3-one**	168								*di* 128, al	135, al	Di-Me eth , 125, al , Di-Et eth , 89, al
442	**3,5-Diaminophenol**	168–70										3,5-Diacetyl, 195
443	**4-Acetamidophenol** (4 - Hydroxyacetanilide)	169								150–1		
444	**2-Amino-4,6-dinitrophenol** (Picramic acid)	169, dk red, al										N-Acetyl, 201, N-Benzoyl, 230, 220, N-*p*-Toluenesulfonyl, 191
445	**4-Amino-2-chloro-5-nitrophenol**	169 5 d										N-Acetyl, 166, yel , Et eth , 128 5, or
446	**3,3'-Dihydroxybenzophenone**	170								89–90	101–2	
447	**1,4-Dihydroxy-2-methylnaphthalene** (2-Methyl-1,4-naphthohydroquinone)	α 170, β 60, ac a								*di* 113, al	181	
448	**4-Amino-2,6-dinitrophenol** (Isopicramic acid)	170, br , w										N-Acetyl, 182, N-Benzoyl, 263, 250, Me eth , 212, Et eth , 172
449	**Benzeneazoresorcinol** (2,4-Dihydroxyazobenzene)	170, dk red								*di* 104, or - red, al		Di-Me eth , 92, red, al , Di-Et eth , 70 yel -red, al
450	**3,4-Diaminophenol**	170 2, 167 8, unstable										N,N'-Diacetyl, 205–7, 3,4-Dibenzoyl, 203 5, 1,3,4-Tribenzoyl, 225, Et eth , 71 2 b p 294–6
451	**5-Nitro-1-naphthol**	171, dk yel -red, w								114, w - al	109, me al	Me eth , 96–7, yel pet eth
452	***Hydroquinone*** (1,4-Dihydroxybenzene)	171, 172	286	*di* 224, 205 7		*di* 258, al	*di* 317	*di* 186	*mono* 98–9, bz , *di* 159, 25% al	*di* 123, w	*di* 199, 204 (cor), tol	Aryloxyacetic acid, 250, 2,4-Dinitrophenyl ether, 243–6, N,N-Diphenylurethane, 250

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	*p*-Nitrobenzoate	3 5-Di nitro benzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
453	**2-Azophenol** (2,2'-Dihydroxyazobenzene)	172, yel, bz								*di* 150, or -red		Di-Me eth, 153, or, Di-Et eth, 131, red
454	**2,3,4-Trihydroxyacetophenone** (Gallacetophenone)	173 192 0-2 5								2,4-*di* 107-8, 3,4-*di* 78-81, *tri* 85		Semicarbazone, 225 d, Oxime, 162-3, Picrate, 133
455	**3,5-Dinitrosalicylic acid**	173-4 (anh)									163	Amide, 181, Anilide, 180 (subl), 194
456	**2-Aminophenol** (2-Hydroxyaniline)	174									175	N-Acetyl, 209, 201, N-Benzenesulfonyl, 141, N-*p*-Toluenesulfonyl, 146
457	**3-Benzamidophenol** (3-Hydroxybenzanilide)	174, tol									153	Et eth, 103
458	**4-Amino-2-methylphenol** (4-Amino *o*-cresol)	175, bz							109-10, bz-lgr			N-Acetyl, 179, O,N-Dibenzoyl, 194, ac a, Me eth, 59 0-9 5, 92-3, aq al
459	**1,6,7-Trihydroxynaphthalene** (1,6,7-Naphthalenetriol)	175								*tri* 143 4		
460	**4-Nitrocatechol**	176, yel, w								*di* 98	*di* 156, al	Di-Me eth, 96, w-al, Di-Et eth, 73 5, pa yel
461	**1,4-Dihydroxynaphthalene** (1,4-Naphthalenediol, 1,4-Naphthohydroquinone)	176, 192								*di* 128 30, al	*di* 169, ac a	Me eth, 131, Di-Me eth, 85, CS_2
462	**1,7-Dihydroxynaphthalene** (1,7-Naphthalenediol)	178, bz		203 4		182-3				*di* 108, bz	*di* 101 5, 113-5	Di-Et eth, 67
463	**1,2-Dihydroxyphenanthrene** (1,2-Phenanthrenediol)	178, w-al								*di* 147, me al		Di-Me eth, 100 2, lgr
464	**4-Amino-6-isopropyl-3-methylphenol** (4-Amino-6-isopropyl-*m*-cresol)	178-9, bz										N-Benzoyl, 178-9, O,N-Dibenzoyl, 166-7, aq al, Hydrochloride, 255
465	**1,8,9-Trihydroxyanthracene** (1,8,9-Anthracenetriol, Anthralin)	178 80, 176 7								*tri* 209 10		
466	**4-Amino-3-methylphenol** (4-Amino-*m*-cresol)	179, 50% al									92, pet eth	N-Acetyl, 138, Hydrochloride, 215, Me eth, 29-30
467	**2,5-Dihydroxyphenanthrene** (2,5-Phenanthrenediol)	180, xyl								*di* 144, w-ac a		Di-Me eth, 117, ac a
468	**9,10-Dihydroxyanthracene** (9,10-Anthradiol)	180, yel								*di* 260, ac a	*di* 292, yel xyl-chl	Di-Me eth, 202, bz, Di-Et eth, 148, bl fluor, al

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p* Toluene sulfonate	Acetate	Benzoate	Miscellaneous
469	**1,2,5,8-Tetrahydroxynaphthalene** (1,2,5,8-Naphthalenetetrol)	180 d								*tetra* 202		
470	**4-Hydroxy-3-iodo-5-methoxybenzaldehyde** (5-Iodovanillin)	180								105-6	135 5-6 5	Oxime, 178 9 Semicarbazone, 187 8 d
471	**6-Nitro-1-naphthol**	181 2								121		
472	**4-Amino-3,5-dimethylphenol**	181 2, chl										N-Acetyl, 178 80 N-Benzyl, 104 5, Me eth , 43, pet eth
473	**2-Amino-4-nitroresorcinol**	182, br , aq al										N-Acetyl, 213, yel
474	**3-Azoxyphenol** (3,3'-Dihydroxyazoxybenzene)	183								*di* 102, 50% al	*di* 75, ac a	Di-Me eth , 49 50, 47 6
475	**N-Benzylidene-4-aminophenol**	183								92	144	Me eth , 62, Et eth , 76 (71), Hydrochloride, 167-77
476	**4-Aminophenol** (4-Hydroxyaniline)	184 (subl)					178 5 (cor)			168		O,N-Diacetyl, 150, 2,4-Dinitrobenzoyl, 204 5 (cor), N-*p*-Toluenesulfonyl, 253
477	**1,9-Dihydroxyphenanthrene** (1,9-Phenanthrenediol)	184 5, bz								*di* 154-5, w -al		9-Me eth , 131 2, bz -pet eth Di-Me eth , 113 4, me al
478	**4,6-Diacetylresorcinol** (Resodiacetophenone)	185, al								*di* 120	*mono* 214-5, *di* 118	Di-Me eth , 171 5, Dioxime, 242, Phenylhydrazone, 233
479	**4-Amino-2-naphthol**	185							137			O,N-Dibenzoyl, 309
480	**7-Hydroxy-4-methylcoumarin** (4-Methylumbelliferone)	185 6, al		155-6		143				150, al	159-60, al	Me eth , 159, *m*-Nitrobenzoate, 210-11, Picrate, 108
481	**3-Amino-4-nitrophenol**	185-6, or , w										N-Benzoyl, 166, Me eth , 131, Et eth , 105-6
482	**1,2,6-Trihydroxynaphthalene** (1,2,6-Naphthalenetriol)	188								*tri* 262		
483	**α,2,4-Trihydroxyacetophenone** (ω-Hydroxyresacetophenone)	189								*tri* 129	*α-mono* 200	α-Me eth , 136, *p*-Nitrophenylhydrazone, 205 d , Oxime, 105-7
484	**2,7-Dihydroxynaphthalene** (2,7-Naphthalenediol)	190, 185-6, w							150, chl	*mono* 171-2, me al , *di* 136, w	*mono* 199, me al , *di* 139, al	Aryloxyacetic acid, 149, N,N-Diphenylurethane, 176, Me eth , 117 Di-Me eth , 139, Di-Et eth , 104, al
485	**1,4,5,8-Tetrahydroxynaphthalene** (1,4,5,8-Naphthalenetetrol)	190								*tetra* 277 9		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	*p*-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	*p* Toluenesulfonate	Acetate	Benzoate	Miscellaneous
486	**1,5-Diacetyl-2,3,4-trihydroxybenzene** (4,6-Diacetylpyrogallol Gallodiacetophenone)	190 1, w								*mono* 207 9	*tri* 189	Tri-Me eth , 73-4
487	**3,9-Dihydroxyacridine**	190 2 lt br → dk in air al										9-Me -3-Et eth , 144, yel , w In al → grn fluor
488	**Pentachlorophenol**	190 2							145	149-50	164-5, 159	Aryloxyacetic acid, 196
489	**5-Amino-2-naphthol**	191										O,N-Diacetyl, 187, O,N-Dibenzoyl, 223
490	**1,4-Dihydroxynaphthalene** (1,4-Naphthalenediol)	192								*di* 128-30	*di* 169	
491	**5-Amino-1-naphthol**	192										O,N-Dibenzoyl, 276
492	**Tetrabromocatechol**	192-3								*di* 215-6	*di* 197-8, bz-lgr	Me eth , 162-3, Di-Me eth , 151-2, 118-20
493	**6-Hydroxyquinoline**	193, al							98	36 8	230-1, ac a	Methiodide, 236 d , Picrate, 235 6
494	**3-Methyl-2,4,5,6-tetrabromophenol** (2,4,5,6-Tetrabromo-*m*-cresol)	194, ac a								165 6	153-4	Me eth , 145 6, al , Et eth , 108, eth
495	**1,5-Dichloro-4,8-dihydroxynaphthalene**	194, ac a								4-*mono* 148-60, ac a *di* 154, 143, acet	4-*mono* 157-8, ac a , *di* 179, acet	
496	**1,6-Dinitro-2-naphthol**	195 d							181			Me eth , 204, 198, Et eth , 144, yel , Alc NH_3 at 160° → 1,6-dinitro-2-naphthylamine, 248, Oxid → 4-nitrophthalic acid, 165
497	**5,6-Dihydroxyacenaphthene** (5,6-Acenaphthenediol)	196-9, bz								*di* 194-5		
498	**1,2,7-Trihydroxynaphthalene** (1,2,7-Naphthalenetriol)	197								181-2		
499	**4-Methyl-2,3,5,6-tetrabromophenol** (2,3,5,6-Tetrabromo-*p*-cresol)	199								156		
500	**2-Hydroxyquinoline**	199										2-Ph eth , 69
501	**2-Amino-4-methyl-5-nitrophenol** (2-Amino-5-nitro-*p*-cresol)	199-200 d										N-Acetyl, 242, ac a , Me eth , 132, yel
502	**6-Amino-1-naphthol**	199 5										O,N-Diacetyl, 130, N-Benzoyl, 203, O,N-Dibenzoyl, 230
503	**Hexahydroxybenzene**	200 d								*hexa* 203	*hexa* 313	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p Toluene sulfonate	Acetate	Benzoate	Miscellaneous
504	**Methylenedi-2-naphthol** (2,2'-Dihydroxy-1,1'-dinaphthylmethane)	200, ac a								*di* 214, al		Di-Me eth, 144–7, al, Picrate, 178 9, red-br
505	**3-Hydroxybenzoic acid**	200								131		Aryloxyacetic acid, 206, Amide, 170, *p*-Bromophenacyl ester, 176
506	**Methyl gallate** (Methyl 3,4,5-trihydroxybenzoate)	200–1								*tri* 120, 120 2, al	*tri* 139, al	
507	**3-Hydroxyquinoline**	200–1, bz							90			Picrate, 240 5
508	**7-Amino-2-naphthol**	201, 208									177	N-Acetyl, 232, O,N-Diacetyl, 156, N-Benzoyl, 243–6, O,N-Dibenzoyl, 181
509	**4-Amino-3-methyl-2-nitrophenol** (4-Amino-2-nitro-*m*-cresol)	201, al										O,N-Diacetyl, 127 8
511	**2-Acetamidophenol** (2-Hydroxyacetanilide)	201 3, 209, aq al								122	140	O,N-Diacetyl, 77
512	**2-Acetylhydroquinone** (2,5-Dihydroxyacetophenone)	202								*di* 68	*di* 113	*p*-Nitrophenylhydrazone, 215–6, Oxime, 149–50
513	**2,8-Dihydroxyphenanthrene** (2,8-Phenanthrenediol)	202, w -al								*di* 125, al		
514	**4-Hydroxy-4'-nitrobiphenyl**	203, 200–1							159, bz	138 9, lgr	208–10, ac a	Me eth, 111, yel., al, 3,5-Dinitro deriv, 197–8
515	**3,5-Dimethoxy-4-hydroxybenzoic acid**	205								191	229–32	
516	**4-Hydroxycoumarin** (Benzotetronic acid)	206, 232 3								103		Me eth, 124, w
517	**2,3,5-Trihydroxyacetophenone**	206–7, yel, ac a								*tri* 106–7, lgr	*tri* 106–7	*p*-Nitrophenylhydrazone, 241–2 d, w -al
518	**2,4,5-Trihydroxyacetophenone**	206–7, red								2,4-*di* 165–6, bz		
519	**6-Chloro-3-hydroxy-4-methylbenzoic acid**	206–8									146	Amide, 239–40, Anilide, 222
520	**8-Amino-2-naphthol**	207 d										O,N-Diacetyl, 178, O,N-Dibenzoyl, 208
521	**3-Azophenol** (3,3'-Dihydroxyazobenzene)	207, yel								*di* 144, yel, al	*di* 188, w -al	Di-Me eth, 73–4, Di-Et eth, 91, yel
522	**2-Amino-5-nitrophenol**	207–8, or, 201–2, w							188, yel, al			N-Acetyl, 271–2, O,N-Diacetyl, 187, Me eth, 139
523	**2-Methyl-3,4,5,6-tetrabromophenol** (3,4,5,6-Tetrabromo-*o*-cresol)	208								154		
524	**2,6-Dichloro-3,4,5-tribromophenol**	209									202	Me eth, 143–4

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	*p* Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	*p*-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
525	**4-Hydroxy-3-methoxybenzoic acid** (Vanillic acid)	210 (subl)				140 1 d				110, w	178, aq al	Hydrazide, 207, Phenylhydrazide, 150 2 5
526	**4,4'-Dihydroxybenzophenone**	210									156, 152	Me eth, 151-2, Di-Me eth, 146, 2,4-Dinitrophenylhydrazone, 190-2
527	***cis*-1,2-Dihydroxyacenaphthene** (*cis*-Acenaphthylene glycol)	212 3, w								*mono* 122-3, al, *di* 130, me al		
528	**4-Hydroxy-4'-nitroazobenzene**	212 3 219 0-9 5								147, or	195, or	Me eth, 157 5 8 0
529	**6-Amino-2-naphthol**	213 d										O,N-Diacetyl, 220
530	**2,4-Dihydroxybenzoic acid**	213, 216 d										Amide, 222, Anilide, 126-7, *p*-Nitrophenyl ester, 189
531	**Methylphloroglucinol** (2,4,6-Trihydroxytoluene)	214-6, et ac								*tri* 76, lgr		2-Me eth, 91 (+1H_2O), 117 9 (anh), 4-Me eth, 124, Tri-Me eth, 10 13, b p 140-2[18]
532	**4-Hydroxybenzoic acid**	215, 210								187	221-3	Aryloxyacetic acid, 278, Anilide, 198, *p*-Toluidide, 204
533	**4,6-Dinitroresorcinol**	215, yel				*di* 178			*mono* 135	*di* 139	*di* 343-4	Me eth, 113, Di-Me eth 157, Et eth, 77, Di-Et eth, 133
534	**4-Chloro-2,3,5,6-tetrabromophenol**	215									203	Me eth, 161
535	**2,6-Dihydroxynaphthalene** (2,6-Naphthalenediol)	215, 218								*di* 175	*di* 215	Di-Me eth, 50, bz, Di-Et eth, 162, al
536	**1,2,4,5-Tetrahydroxybenzene**	215-20								*tetra* 226-7		2-Me eth, triacetyl, 142, Tetra-Me eth, 103
537	**4-Azophenol** (4,4'-Dihydroxyazobenzene)	α 216, grn (anh), β 216, dk red (anh)								*di* 198-9, yel, ac a	*di* 210 5 1 5, 249-51, red-yel, bz	Di-Me eth, 160 5 2 5, me al, Di-Et eth, 157-9, yel, al, 160
538	**2-Amino-3-nitrophenol**	216 7, red							136			N-Acetyl, 172, Me eth, 75-6
539	**4-Benzamidophenol** (4-Hydroxybenzanilide)	216 7, 227								171	235	Me eth, 153-4, al, Et eth, 173, aq al, Benzyl eth, 226-7
540	**2,5-Dimethylhydroquinone** (Hydrophlorone)	217								*mono* 117, *di* 135	*mono* 162-3, pet eth, *di* 159, me al	Me eth, 90, lgr

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	*p*-Nitro benzoate	3,5-Dinitro benzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
541	**Phloroglucinol** (1,3,5 Trihydroxybenzene)	217 9, rapid htng , 200 9, slow htng		*tri* 190 1		283	*tri* 162	*tri* 151		*tri* 104 6, al	*tri* 173 4, al	Monobenzenesulfonate, 163 4 (anh) Monobenzenesulfonate, di acetate, 95 6, bz Dibenzenesulfonate, 120-1, bz , Dibenzenesulfonate monoacetate, 81 me al
542	**2-Amino-3,5-dinitrophenol**	218, yel , al							186			O,N-Di *p*-Toluene sulfonyl, 188 N Acetyl, 171 Me eth , 181
543	**2,2′-Dihydroxy-1,1′-binaphthyl**	218								*di* 109, al	*mono* 204, *di* 160	Dipicrate, 175 6, Di-Me eth , 190, Di-Et eth , 90
544	**7-Hydroxybenzo [a]pyrene**	218 9, yel								194 5, yel	191 2, yel	Me eth , 183 4, pyr *p*-Nitrobenzyl eth , 252-3
545	**Acetylphloroglucinol** (2,4, 6-Trihydroxyaceto phenone, Phloracetophenone)	219, w , 222								*tri* 103	2-*mono* 168, 4 *mono* 210-11, *tri* 117 8	2-Me eth 205 7 4-Me eth , 139 40, Tri-Me eth , 103 Tri-Et eth , 75, aq al
546	**1,1′-Dihydroxy-2,2′-binaphthyl**	220								*di* 169		Di-Me eth , 122, lgr
547	**3,5-Dihydroxypyrene**	220 d , ac a								*di* 155		Di-Me eth , 177-8
548	**3,6-Dihydroxyphenanthrene** (3,6-Phenanthrenediol)	221, w -al								*di* 124 5, al		3-Me eth , 135 6 w -me al Di-Me eth , 104-5, w -me al
549	**2,3-Dimethylhydroquinone** (3,6-Dihydroxy-*o*-xylene)	221, sl d , w								*mono* 174 5, acet - pet eth , *di* 182, acet - pet eth		Di-Et eth , 68 9
550	**3-Hydroxy-2-naphthoic acid**	222								184-6		Amide, 218, Anilide, 244 *p*-Toluidide, 222
551	**4-Amino-6-chloro-3-methylphenol** (4-Amino-6-chloro-*m*-cresol)	223-5 d										O,N-Diacetyl, 162 O,N-Dibenzoyl, 220
552	**4-Azoxyphenol** (4,4′-Dihydroxyazoxybenzene)	224 d								*di* 163, or , al	*mono* 200, al , 212, bz , *di* 187-90	Di-Me eth , 118-9 yel , Di-Et eth , 137-8

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p Toluene sulfonate	Acetate	Benzoate	Miscellaneous
553	**5-Hydroxyquinoline**	224							85			Hydrochloride, 240, Methiodide, 224, Picrate, 187
554	**2-Amino-4-chloro-5-nitrophenol**	225 d, yel										N-Acetyl 193 Me eth, 132
555	**1,2,3,4-Tetrahydroxynaphthalene** (1,2,3,4-Naphthalenetetrol)	225								*tetra* 220		
556	**1,8-Dihydroxyanthracene** (1,8-Anthracenediol, Chrysazol)	225, yel, al -w								*di* 184, et ac		Di-Me eth, 198, al, Di-Et eth, 139, al
557	**4-Amino-6-nitrocatechol**	228, yel										O,O,N-Triacetyl, 207, ac a
558	**5-Hydroxycoumarin**	229								88 9, 84		Me eth, 85 7
559	**2-Hydroxy-5-nitro-benzoic acid**	229 30										Amide, 225, Anilide, 224
560	**Pentabromophenol**	229 5, 225 6								197, 171		Me eth, 173 4, Et eth, 136
561	**2,6-Dihydroxyphenanthrene** (2,6-Phenanthrenediol)	234, w -al								*di* 122-3, al	*di* 252 3	Di-Me eth, 87, me al
562	**3-Amino-2-naphthol**	235										O,N-Diacetyl, 188, O,N-Dibenzoyl, 184
563	**5-Hydroxy-1-naphthoic acid**	235								202	241	
564	**2,3-Dihydroxyacridine** (2,3-Acridinediol)	235 d										Di-Me eth, 107, yel -wh, al
565	**Tetrachlorohydroquinone**	236 7								*di* 245	*di* 233	
566	**7-Hydroxyquinoline**	238-40, al, (br at 200)							116		88-9, al	Methiodide, 251 d, al, Picrate, 244-5
567	**1,7-Dihydroxyanthrone** (Euxanthone)	240								7-*mono* 160, al, *di* 185, bz	*di* 221 2, 214	7-Me eth, 130-5
568	**1,6-Dihydroxypyrene** (1,6-Pyrenediol)	240 d, sinters at 175										Sol red with grn fluor In alkali red soln with bl fluor, Zn dust → pyrene, 149-50
569	**4-Amino-2,5-dimethylphenol**	242 d, al										N-Acetyl, 177 9, al, Et eth, 69 5
570	**3,8-Dihydroxyphenanthrene** (3,8-Phenanthrenediol)	247, lt red, w -al								*di* 184, al		Di-Me eth, 117, me al
571	**3-Hydroxy-1-naphthoic acid**	248								169 70	222-3	Amide, 209-11, Anilide, 112-3
572	**2,5-Dihydroxypyridine** (2,5-Pyridinediol)	248								5-*mono* 156		Hydrochloride, 106 (hyd), 154 (anh)
573	**1,4-Dihydroxyisoquinoline** (1,4-Isoquinolinediol)	>250, ac a turns red at 200								4-*mono* 207-8		4-Me eth, 171, acet -pet eth
574	**2,3-Dihydroxyquinoline** (3-Hydroxycarbostyril, 2 3-Quinolinediol)	257 8, >300								3-*mono* 211	3-*mono* 286 7, *di* 45 6, pet eth	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
575	**1,5-Dihydroxynaphthalene** (1,5-Naphthalenediol)	265, 258								*di* 159–61, dil al	*di* 235, 242, pyr	Di-Me eth, 183 4, Di-Et eth, 130, w-al, 2 Naphthylamine add comp, 229 5
576	**2,7-Dihydroxyphenanthrene** (2,7-Phenanthrenediol)	265, w-al								*di* 181 5, al		Di-Me eth, 169–70, me al
577	**Phenolphthalein**	265 (cor), 261		*di* 135, bz						*di* 143, al	*di* 169, bz-lgr	
578	**1,5-Dihydroxyanthracene** (Rufol, 1,5-Anthracenediol)	265 d, yel								*di* 198, et ac		Di-Me eth, 224, me al, Di-Et eth, 179, al
579	**4,4'-Biphenol** (4,4'-Dihydroxybiphenyl)	274 5, al							*di* 189 90, bz	*di* 161, dil al, 164 (cor)	*di* 241, ac a	Aryloxyacetic acid, 274, Di-Me eth, 173 (subl), Di-Et eth, 176
580	**1-Amino-2-naphthol**	276 d										O,N-Diacetyl, 206, O,N-Dibenzoyl, 235
581	**2,7-Dihydroxyanthracene** (2,7-Anthracenediol)	280–5 d, bz, turns dk at 250								282		Di-Me eth, 216 7, ac a, Di-Et eth, 192–3
582	**2,3-Dihydroxyanthracene** (2,3-Anthracenediol)	282 d, yel								*di* 175		Di-Me eth, 204, al
583	**4,4'-Dihydroxystilbene** (4,4'-Stilbenediol)	284, ac a								*di* 213		Di-Me eth, 214–5, Di-Et eth, 208
584	**3,5'-Dimethoxy-5,7,4'-trihydroxyflavonol** (Syringetin)	288 9, pa yel, ac a								*tetra* 224–6		4'-Benzyl eth, 240 1
585	**2,7-Dihydroxy-4-methylquinoline**	290–300, w-al (+1H_2O), turns br at 280								7-*mono* 250–4, al	7-*mono* 288, al	
586	**2,6-Dihydroxyanthracene** (Flavol 2,6-Anthracenediol)	295–300 d, al, turns dk at 270								*di* 260 1, ac a		Di-Me eth, 255–6, ac a, Di-Et eth, 230–1
587	**Bi-α-naphthol** (4,4'-Dihydroxy-1,1'-binaphthyl)	300, 250								*di* 217		Di-Me eth, 252, Di-Et eth, 211
588	**2,8-Dihydroxyacridine** (2,8-Acridinediol)	>300, turns red at 275										Di-Me eth, 138–9, Di-Et eth, 142 3
589	**2,6-Dibromo-1,5-dihydroxynaphthalene**	>300, 224 d turns dk at 200								1-*mono* 273, *di* 228	*di* 262, pyr	1-Acetate, 5-benzoate, 164, Di-Me eth, 161, Di-Et eth, 148
590	**3,7-Dihydroxyacridine** (3,7-Acridinediol)	324, pa yel, w-al										In al sol → grn fluor
591	**3,8-Dihydroxypyrene** (3,8-Pyrenediol)	330, Tri-cl-bz-ph hydraz, turns dk at 280								*di* 224, ac a		Di-Me eth, 244, cl-bz

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	*p* Nitro benzoate	3 5-Di nitro benzoate	Bromo derivative	*p*-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
592	**1,3-Dihydroxyacridone**	370								*mono* 200, yel	*mono* 295 7	Me eth (i) 203, dk br , (ii) 252, yel , Di-Me eth , 286-7 d , Anil , 269 70, Zn dust → acridine, 111

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE VIII

Cleavage to alkyl bromide or alkyl iodide

$$ROR' + 2HBr \rightarrow \underset{\text{Mixture of alkyl bromides}}{RBr + R'Br} + H_2O$$

$$ROR' + 2HI \rightarrow \underset{\text{Mixture of alkyl iodides}}{RI + R'I} + H_2O$$

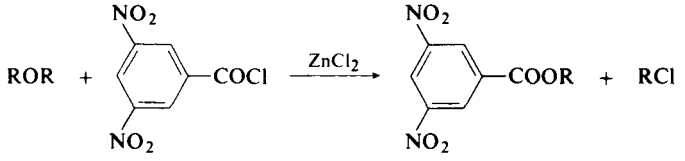
$$ArOR + HI \rightarrow \underset{\text{Phenol}}{ArOH} + \underset{\text{Alkyl iodide}}{RI}$$

From the ether with concentrated hydrochloric acid

For directions and examples see Cheronis, p 543, Linstead, pp 46 7, Shriner, p 116, Vogel, p 316

NOTE For directions and examples for preparation of derivatives of alkyl iodides and alkyl bromides formed on cleavage of ethers see explanations and references to Table V, pp 52, 53, 54

Alkyl 3 5-dinitrobenzoate *



Alkyl 3 5-dinitrobenzoate

From a symmetrical aliphatic ether with freshly fused zinc chloride and 3,5-dinitrobenzoyl chloride

For directions and examples see Cheronis, pp 542, 543, Linstead, p 46, Shriner, p 239, Vogel, p 316, Wild, p 96 H W Underwood, O L Baril and G C Toone, *J Amer Chem Soc*, **52**, 4087 (1930)

Bromo derivative

$$ArOR \xrightarrow{Br_2} \underset{\text{Bromoaryl ether}}{Ar(OR)Br}$$

$$ArOR \xrightarrow{nBr_2} \underset{\text{Polybromoaryl ether}}{Ar(OR)Br_n}$$

From alkyl aryl or diaryl ether with bromine in glacial acetic acid or chloroform

For directions and examples see Cheronis, p 545, Shriner, p 240

From the aromatic ether with bromine in alcohol, acetic acid, ether, chloroform or petrol ether

See Wild, pp 98–9, 101, H W Underwood, O L Baril and G C Toone, *J Amer Chem Soc*, **52**, 4087 (1930)

Sulfonamide *

$$ArOR \xrightarrow{ClSO_2OH} \underset{\text{Sulfonyl chloride}}{Ar(OR)SO_2Cl} \xrightarrow{(NH_4)_2CO_3} \underset{\text{Sulfonamide}}{Ar(OR)SO_2NH_2}$$

The sulfonyl chloride is prepared from the aromatic ether with chlorosulfonic acid in chloroform or without solvent The sulfonamide is obtained from the sulfonyl chloride with ammonium carbonate and/or aqueous ammonia

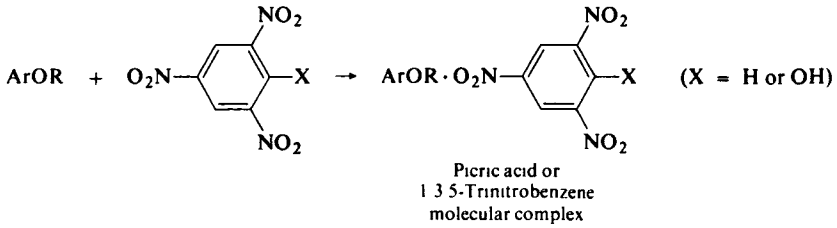
For directions and examples see Cheronis, pp 545, 546, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, pp 27, 101, E H Huntress and F H Carten, *J Amer Chem Soc*, **62**, 511, 603 (1940)

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE VIII (Continued)

Picric acid and 1,3,5-trinitrobenzene addition complexes



Picric acid or
1 3 5-Trinitrobenzene
molecular complex

From the aromatic ether with the aromatic polynitro compound in chloroform

For directions and examples see Cheronis, pp 545, 547, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, p 100, O L Baril and G A Megrdichian, *J Amer Chem Soc*, **58**, 1415 (1936), E K Andersen, *Acta Chem Scand*, **8**, 157 (1954)

From the aromatic ether with picric acid in ethanol

See V H Dermer and O C Dermer, *J Org Chem*, **3**, 289 (1938)

NOTE For additional information regarding directions and examples for the derivatization of aromatic ethers (nitration, side-chain oxidation, etc) see explanations and references to Table IV, pp 32, 33, 34

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1 3 5 Tri-nitro-benzene addition com pound	3 5 Dinitro benzoate	Miscellaneous
1	**Ethylene oxide** (Epoxyethane)	10 7	−111 7	1 3614[4]	$0\ 89713_4^0$							HBr → Ethylene bromohydrin, b p 149
2	**Ethyl methyl ether**	10 8, 10			$0\ 7260_4^0$							
3	**Furan**	31 27	−85 6	1 42157	0 9366							Maleic anhydride → 3,6-Endoxo-Δ^4-tetrahydrophthalic anhydride, 125d, 118d, abs eth
4	**Diethyl ether** (Ethyl ether)	34 60	−116 3, stab, −123 3, unst	1 3526	0 71352						93	Iodide, b p 72
5	**Propylene oxide** (1,2-Epoxypropane)	35		1 466	0 830							Heating with dil H_2SO_4 → *d l*-propylene glycol, b p 187 4
6	**Ethyl vinyl ether**	35 75	−115 8	1 3768	0 7589							Dil acid → al + acetaldehyde
7	**Methyl *n*-propyl ether**	39		1 3579	$0\ 7356_4^{13}$							
8	**Allyl methyl ether**	46							*β,γ-di* b p 185, D_4^{20} 1 8329			
9	**Ethyl isopropyl ether**	53 4			0 7211 ($0\ 745_4^0$)							Heating with 1% H_2SO_4 (sealed tube) → al + isopropyl alcohol
10	***tert*-Butyl methyl ether**	55 2		1 3689	0 7405							Constant boil mixt with w, b p 52 6, with 4% w
11	**2,3-Epoxybutane**	*cis* 58 9^{745} *trans* 53–4[741]			*cis* $0\ 8226_4^{25}$, *trans* $0\ 8010_4^{25}$							Normal crude mixt is 65% *trans* + 35% *cis*
12	**Chloromethyl methyl ether**	59		1 3974	1 015	163						
13	**α-Butylene oxide** (1,2-Epoxybutane)	61–2		1 385[17]	0 837[17]							
14	**Ethyl *n*-propyl ether**	63 6	< −79	1 36948	0 7386							Constant boil mixt with al, b p 61 2, with 25% al
15	**2-Methylfuran** (Sylvan)	64		1 434	0 913							
16	**Tetrahydrofuran**	65		1 407	0 889							
17	**Allyl ethyl ether**	66–7[742]		1 3881	0 7651				*β,γ-di* b p 193–5			Heating with 2% H_2SO_4 → al + allyl alcohol
18	**Di-isopropyl ether** (*Isopropyl ether*)	67 5	−60	1 3688	0 726						123, 120–1, CCl_4	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Trinitrobenzene addition compound	3,5-Dinitro benzoate	Miscellaneous
19	***n*-Butyl methyl ether**	70	−115 5	1 3728, 1 3736	0 7455, 0 774							Oxid by alkaline $KMnO_4$ at 35 40° → ac a + methoxyacetic acid
20	***tert*-Butyl ethyl ether**	73 1 (cor)		1 3760	0 7404							Constant boil mixt with w , b p 65 2, with 6% w
21	**Tetrahydrosylvan**	79		1 407	0 855							
22	**Chloromethyl ethyl ether**	80, 83d		1 40398	1 014							
23	**Ethyl isobutyl ether**	81 1 (cor)		$1\ 3739^{25}$	$0\ 7323_4^{25}$							
24	***sec*-Butyl ethyl ether**	81 2 (cor)		1 3802	0 7503							
25	**Isopropyl *n*-propyl ether**	83		1 376	0 7370							
26	**Ethylene glycol dimethyl ether**	84 7		1 37965	0 8665							
27	**Dihydropyran**	86		1 440	0 923							
28	***tert*-Amyl methyl ether**	86 3		1 3885	0 7703							Constant boil mixt with w , b p 73 8, with 9% w , Constant boil mixt with me al , b p 62 3, with 50% me al
29	**Tetrahydropyran**	88		1 421	0 881							
30	**Di-*n*-propyl ether** (*n*-Propyl ether)	90 1	−122	1 38829	0 74698						74	Constant boil mixt with w , b p 75 4, Constant boil mixt with *n*-propyl alcohol, b p 85 8
31	***n*-Butyl ethyl ether**	92 3 (cor)	−124	1 3820	0 7505							
32	**2,5-Dimethylfuran**	94		$1\ 4363^{21\ 6}$	$0\ 888_4^{20\ 1}$				*penta* 180, chl			Maleic anhydride → 3,6-Endoxo-3,6-dimethyl-Δ^4-tetrahydrophthalic anhydride, 78, eth
33	**α-Chloroethyl ethyl ether**	98		1 404	0 966							
34	***n*-Amyl methyl ether**	99–100		1 3873	0 761							
35	***tert*-Amyl ethyl ether**	101		1 3912	0 7657							Constant boil mixt with 13% w , b p 81 2
36	**1,4-Dioxane**	101 4	11 8	1 4232	1 03361				65–6			Iodine derivative, 84 5, Constant boil mixt with 48 mole % dioxane, b p 82 8

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1 3 5 Tri nitro benzene addition com pound	3 5 Dinitro benzoate	Miscellaneous
37	**Ethylene glycol mono-ethyl monomethyl ether** (1-Ethoxy-2-methoxyethane)	102		1 38677	0 8529							
38	**Cyclopentyl methyl ether**	105		1 4206	0 862							
39	**β-Chloroethyl ethyl ether**	107		1 411	0 989							
40	***n*-Butyl isopropyl ether**	108^{738}		$1\ 3889^{21.9}_{5461}$	$0\ 7594^{15}$							Boil HI → *n*-butyl iodide + isopropyl iodide
41	**α-Epichlorohydrin**	115 7		1 438	1 181							
42	**α,α′-Dichloroethyl ether**	116, 114		$1\ 4183^{24}$	$1\ 138^{12}_4$							
43	***n*-Amyl ethyl ether**	118		1 3927	0 762							
44	**Di-*sec*-butyl ether**	121		$1\ 3928^{25}$	0 760				b p 90 1 n_D^{25} 1 250		75 5	
45	**Cyclopentyl ethyl ether**	122		1 423	0 853							
46	**Di-isobutyl ether** (Isobutyl ether)	123			$0\ 7616^{15}_{15}$						87, 84 5 5 5	
47	**Ethylene glycol monomethyl mono-*n*-propyl ether** (1-Methoxy 2-*n* propoxyethane)	124 5		1 39467	0 8472							
48	***n*-Hexyl methyl ether**	126		1 3972	0 772							
49	**2-Methoxy-1-propanol**	130^{758}									97	α-Naphthylurethane, 60
50	**Cyclohexyl methyl ether**	134		1 435	0 875							
51	**Ethylene glycol monoethyl ether** ("Cellosolve", 2-Ethoxyethanol)	134 8, 135 1		1 40797	0 9297 0 9311						75	Miscible with w , with al and with eth , Diphenylurethane, 43, Xanthate, 202 5 (cor), acet abs eth
52	**3-Ethoxy-2-methyl-2-butanol**	141										Phenylurethane, 226
53	***n*-Hexyl ethyl ether**	142		1 4008	0 772							
54	**Di-*n*-butyl ether** (Butyl ether)	142 4, 144	−98	1 3989	0 76829						62 3, 64	
55	**Cyclohexyl ethyl ether**	149		1 435	0 864							
56	**Anisole** (Methoxybenzene, Methyl phenyl ether)	153 8, 155 (43^{10})	−37 5	1 52211	0 99393	79 81, unst in air	113, 110 1, al	2,4-*dt* 86 9, al , 95 5	2,4-*dt* 61, al		87	
57	**3-Methoxy-2-methyl-1-propanol**	155		$1\ 4140^{27}$							64	
58	**Diethylene glycol dimethyl ether**	162 0	−75	1 4099	$0\ 9440^{20}_{20}$							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3 5 Tri-nitro benzene addition com pound	3,5-Dinitro-benzoate	Miscellaneous
59	**Furfuryl alcohol** (2-Furancarbinol)	170		1 4868	1 1351						80-1, pyr	*p*-Nitrobenzoate, 76, N-Phenyl-urethane, 45
60	**Ethylene glycol mono-*n*-butyl ether** (*n*-Butyl "cellosolve")	171[743]		1 4177	0 9188				172		oil	3-Nitrophthalate, 120
61	**Benzyl methyl ether**	170-1 (cor)		1 5008	0 9649	115 6						
62	**2-Methoxytoluene** (2-Methyl anisole, Methyl 2-tolyl ether, 2-Cresyl methyl ether)	171		1 505	0 9853	116, 113 4, pa yel	137, al	3,5-*di* 69, pa yel , me al	5-*mono* 63-4, al			Oxid → *o*-Meth-oxybenzoic acid, 101
63	**Phenyl ethyl ether** (Phenetole)	172	-33	1 5080, 1 5074	0 9666	92	150	*p-mono* 58				
64	**Di-isoamyl ether** (Iso-amyl ether)	172 5		1 409	0 778						60 1	Constant boil mixt with w , b p 97 2
65	**4-Methoxytoluene** (4-Methylanisole, Methyl 4-tolyl ether, 4-Cresyl methyl ether)	173, 176		1 512	0 970	88-9, yel -or	182, al					Oxid → *p*-Anisic acid, 184-6, 184, w
66	**3-Methoxytoluene** (3-Methylanisole, Methyl 3-tolyl ether, 3-Cresyl methyl ether)	173, 177 (cor)		1 513	0 972	113 4, yel -or	129 30, al	2-*mono* 54-5, pet eth , 2,4,6-*tri* 92, al				Oxid → *m*-Meth-oxybenzoic acid, 110
67	**Tetrahydrofurfuryl alcohol**	117		1 45167	1 0544						83-4	*p*-Nitrobenzoate, 46-8, N-Phenyl-urethane, 61, pet eth
68	**Phenyl isopropyl ether**	178		1 4992	0 975							conc H_2SO_4 + ac a → *o*-Isopro-pylphenol, b p 213-4, m p 130
69	**β,β'-Dichloroethyl ether**	178		1 4568	1 220							
70	**2-Ethoxytoluene** (2-Cresyl ethyl ether, Ethyl 2-tolyl ether)	184		1 505	0 953	117 5 8 5, pa yel	148-9, al	*di* 51				Oxid → *o*-Ethoxy-benzoic acid, 25, 19 0- 5, well dried
71	**Benzyl ethyl ether** (Homophenetole)	184-6 (cor)		1 4958	0 9478							Refluxed in bz + P_2O_5 → Ethylene + Diphenyl-methane, 25 1
72	**Di-*n*-amyl ether** (*n*-Amyl ether)	187 5	-69 3	1 416	0 78298						42 3	
73	**Diethylene glycol diethyl ether**	188		1 411	0 906							
74	**Phenyl *n*-propyl ether** (*n*-Propoxybenzene)	188, 189 3 (cor)		1 5014, 1 5011	$0\ 9494_{20}^{20}$		116 7, al					

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS
a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Trinitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
75	**4-Ethoxytoluene** (4-Cresyl ethyl ether Ethyl 4-tolyl ether)	190 5		1 505	0 949	110 1, or yel	138 0 5, al					Oxid → *p*-Ethoxybenzoic acid, 198, 195 0- 5, al
76	**3-Ethoxytoluene** (3-Cresyl ethyl ether Ethyl 3-tolyl ether)	190 5		1 506	0 949	114 5 or -yel	110 1 al					Oxid → *m*-Ethoxybenzoic acid, 137
77	**Diethylene glycol monomethyl ether**	194		*1* 4244	*1* 035$_{20}^{20}$							*p*-Nitrophenylurethane, 73 5
78	**3-Chloroanisole**	194					131					
79	**2-Chloroanisole**	195		1 5433^{25}	1 1865$_4^{25}$			95				
80	**Diethylene glycol monoethyl ether**	196		1 4298	1 023$_{20}^{20}$						oil	*p*-Nitrophenylurethane, 66
81	**4-Chloroanisole**	200			1 1851$_4^{12\ 8}$		151	2-*mono* 95				
82	***n*-Butyl phenyl ether** (*n*-Butoxybenzene)	206		1 5049		110-2, pa yel chl	103 4, al					
83	**2-Chlorophenetole**	208	17				133	82				
84	**2-Bromoanisole**	210					140	106				
85	**Benzyl isobutyl ether**	210 2 (cor)		1 4826	0 9233							
86	***p*-Bromoanisole**	215, 216			1 494$_4^9$		148	88				
87	**Methyl thymyl ether**	216			0 954$_4^0$			*tri* 92				
88	**Triethylene glycol dimethyl ether**	216	-47	1 4233	0 9871$_{20}^{20}$							
89	**1,3-Dimethoxybenzene** (Resorcinol dimethyl ether)	217 (cor)	-58, -52	1 4233	1 0552$_{25}^{25}$	56 8, or -yel , unst in air	166-7, al	2,4-*di* 72, pa yel , al , 4,6-*di* 157 al , 2,4,6-*tri* 123-4, pa red, al	4,6-*di* 140, al			
90	**2-Bromophenetole**	218					135	98				
91	**Benzyl *n*-butyl ether**	219-21 (cor)		1 4833	0 9227							
92	**Creosol** (4-Methylcatechol 2-methyl ether)	221	5 5	1 5353^{25}	1 0919$_4^{25}$	112, yel						
93	***n*-Butyl 2-tolyl ether** (2-Butoxytoluene)	223			0 9437$_0^0$		95-6, al					
94	**2-Methoxyaniline** (2-Anisidine)	225	5		1 0978$_{15}^{15}$							N-Formyl, 83 5, N-Acetyl, 87-8
95	**Di-*n*-hexyl ether** (*n*-Hexyl ether)	228-9^{761}			0 7936						54 5-5 5	
96	**Safrole** (4-Allyl-1,2-methylenedioxybenzene)	233	11	1 5383	1 100	104 0 5 5, or -red			*tri* 108, *penta* 169-70, bz	51		
97	**4-Bromophenetole**	233, 229	12				145	47				

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^t	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1 3 5 Trinitro benzene addition compound	3 5 Dinitro benzoate	Miscellaneous
98	**Resorcinol diethyl ether**	235	12 4			109	184		*tri* 69			
99	**Eugenol methyl ether** (4-Allyl-1,2-dimethoxybenzene)	244		1 5360	1 0336	114 5, red-br, chl	7		*tri* 78, abs al			
100	**2-Iodophenetole**	246			1 800	84			*tri* 110			
101	***trans*(β)-Isosafrole** (1,2-Methylenedioxy-4-propylbenzene)	248	6 8	1 5782	1 122	74 5, dk red, chl			*di* 52-3, eth, *tri* 109 10, pet eth	85 6, brt scar		
102	**3-Methoxyaniline** (3-Anisidine)	251				169d, yel						N-Formyl, 57, N-Acetyl, 81, N-*p*-Toluenesulfonyl, 68
103	**Di-*n*-heptyl ether** (*n*-Heptyl ether)	263, 260		1 427	$0\ 8056_{20}^{20}$						47	
104	**Isoeugenol methyl ether**	264	16-7	1 5692	1 0528	42 5, dk red, chl			*di* 101 0 5, abs eth	69-70, brt scar		Oxid → Veratric acid, 181
105	**Tetraethylene glycol dimethyl ether**	266, 275		1 432	1 009							
106	**Methyl 1-naphthyl ether** (1-Methoxynaphthalene)	271 (cor)	< −10	$1\ 6940^{25}$	1 09159	129 5 30 5 yel-or, chl	156 7, al	2-*mono* 80, 4 *mono* 85, yel, al	4-*mono* b p 181-2, 5-*mono* 67 5 8 0, *x*-*mono* 46, al, 2,4-*di* 54 5, al	139 40, 137 8, yel		
107	**2-Nitroanisole**	277	10	1 562	1 254							Reduct → *o*-anisidine, b p 225
108	**Ethyl 1-naphthyl ether** (1-Ethoxynaphthalene)	280 5 (cor)	5 5	$1\ 5973^{25}$	1 074	118 5 9 0 (cor)	164-5, al	2-*mono* 84, 4-*mono* 116-7, al	4-*mono* 48, al	125 5, yel		
109	**Dibenzyl ether** (Benzyl ether)	290 300d	3 6		1 0428	77 8, or-yel, chl			*di* 107-8, al		112	
110	**Isoamyl 1-naphthyl ether**	317 5 (cor)	< −10	$1\ 57049^{14\ 2}$	$1\ 00689_4^{14\ 2}$	96 0-7 0						

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	n_D^{20}	D_4^{20}	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri nitro-benzene addition com-pound	3,5 Dinitro ben zoate	Miscellaneous
1	**4-Chlorophenetole** (1-Chloro-4-ethoxybenzene)	21	212	1 5227[19]	1 1231 $^{20}_{20}$		134		2,6 *di* 54			
2	**Veratrole** (1,2-Dimethoxy-benzene)	22 5	207, 205	1 5287[21]	1 080	56 7, red	135 6, al	95	4,5-*di* 92-3			
3	**Anethole** (1-Methoxy-4-propenylbenzene)	22 5, al	235	1 558	0 989 $^{25}_{4}$	69 70d, or -red, al			*di* 67, eth, 65, 62 4, *tri* 108, pet eth			
4	**4-Methoxybenzyl alcohol** (Anisyl alcohol)	24	151[27], 138[14]									Phenylurethane, 93 *p*-Nitroben-zoate, 94
5	***n*-Amyl 2-naphthyl ether**	24 5	327 5 (cor)	1 5587[20]		66 5 7 0, or , h al	159	*di* 135	*di* 58			
6	**4-Iodophenetole** (1-Ethoxy-4-iodobenzene)	27	252					96				
7	**Diphenyl ether** (Phenyl ether)	28	259	1 5826[24]	1 073	110	*di* 159, al	4,4'-*di* 144 4, al , 2,4,2',4'-*tetra* 195 7, pa yel , ac a	4,4'-*di* 54 5, al			
8	**Isoamyl 2-naphthyl ether**	28 0 5	321 0 (cor)			93 5-4 0, al						
9	**2-Methoxyphenol** (Guaia-col, Catechol mono-methyl ether)	28 2	205	1 5441	1 1287 $^{20.4}_{vac}$	86 7			4,5,6-*tri* 116, al		141 2 (cor), al	
10	**2-Methoxybiphenyl** (2-Biphenyl methyl ether)	29, pet eth	274					5-*mono* 95 6, pa yel , me al				
11	**β-Bromoethyl phenyl ether**	32							56			
12	**Isobutyl 2-naphthyl ether**	33	304			84 5						
13	**Didodecyl ether** (Dilauryl ether)	33, 28-30	190-5[1]									
14	**2-Ethoxybiphenyl** (2-Biphenyl ethyl ether)	34	132[6]									
15	***sec*-Butyl 2-naphthyl ether**	34	298 5 (cor)			86						
16	**3-Ethoxybiphenyl** (3-Biphenyl ethyl ether)	35	158[8]									
17	**3-Nitrophenetole**	35	284									Reduct → *m*-Phenetidine, (Picrate, 158)
18	***n*-Butyl 2-naphthyl ether**	35 5	309 (cor)			67						
19	**Ethyl 2-naphthyl ether** (Neonerolin)	36, 37	282 (cor)	1 5932[17]	1 064	101	161-3, al		1-*mono* 66, pet eth , 1,6-*di* 94, pet eth			
20	**3-Aminodiphenyl ether**	37, lgr	315									N-Hydrochloride, 141, 139, N-Acetyl, 83, lgr

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	n_D^{20}	D_4^{20}	Picrate	Sulfonamide	Nitroderivative	Bromo derivative	1,3,5-Trinitrobenzene addition compound	3,5 Dinitrobenzoate	Miscellaneous
21	**3-Nitroanisole**	39	258		1 373[18]							Reduct → *m*-Anisidine, (Picrate, 169d)
22	**Isopropyl 2-naphthyl ether**	40	285			95						
23	**2-Naphthyl *n*-propyl ether**	40	297			81						
24	**Catechol diethyl ether** (1,2-Diethoxybenzene)	43, dil al	217			69–71, red-br, unst in air	3,4-*di* 162 3, al	*tri* 122				
25	**bz-Tetrahydro-6-methoxyquinoline**	43	130	1 5718[50]								
26	**2,4,6-Trichlorophenetole**	44	246					*di* 100				
27	**8-Methoxyquinoline**	45	175[29]			162						
28	**2-Aminodiphenyl ether**	47	173[14]									Acetate, 81
29	**Pyrogallol trimethyl ether** (1,2,3-Trimethoxybenzene)	47, dil al	241			78 5–80 0, yel	2,3,4-*tri* 123 4	5-*mono* 106, ac a	*mono* oil, *di* oil, 4,5,6-*tri* 73 4	81, pa yel		
30	**4-Iodoanisole**	52	139									
31	**Phloroglucinol trimethyl ether** (1,3,5-Trimethoxybenzene)	52 3, al	255 5 (cor)						2 *mono* 96 7, dil al, 2,4-*di* 129–30, al, 2,4,6-*tri* 145, al			
32	**Hydroquinone monomethyl ether**	52 5	244[754 2]									
33	**4-Nitroanisole**	54	274	1 5707[60]	1 233$_4^{20}$							Reduct → *p*-Anisidine, 57
34	**Hydroquinone dimethyl ether** (1,4-Dimethoxybenzene)	56, 75% al	213 (cor)			47–8, or-red, unst in air	148, al	2-*mono* 72, yel, 2,3-*di* 177, 2,5-*di* 202	*di* 142, ac a	*di* 86 5, red		
35	**4-Methoxyaniline** (4-Anisidine)	57	246		1 071$_4^{55}$							N-Formyl, 81, N-Acetyl, 130–2, w, N-Benzoyl, 216 7
36	**4-Cyclohexylphenyl methyl ether**	59	116[4]									
37	**2,4,6-Trichloroanisole**	60						*di* 95				
38	**1,3-Diphenoxypropane** (Trimethylene glycol diphenyl ether)	61, al	338–40 (cor)				4,4′-*di* 245 55, al					
39	**Catechol dibenzyl ether** (1,2-Dibenzyloxybenzene)	63 4, wh, me al						4-*mono* 98, pa yel, al				
40	**1-Phenyl-2-phenoxymethanol**	64										*p*-Nitrobenzoate, 84
41	**α-Glyceryl phenyl ether**	70	187[15]									
42	**2,4,6-Tribromophenetole**	72						79				

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	n_D^{20}	D_4^{20}	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Trinitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
43	**Hydroquinone diethyl ether** (1,4-Diethoxybenzene)	72						*mono* 49, yel, 2,3-*di* 130, yel, al, 2,5-*di* 176, yel, al		86 5		
44	**Methyl 2-naphthyl ether** (Nerolin)	73 (cor), eth	273			116 5-7 0, dk yel, 113 0-3 5	150 1, al	1-*mono* 128, 1,6,8-*tri* 215d	*x-mono* 62 3, pet eth, 1-*mono* 83-4, 3-*mono* 77 8, 6-*mono* 108	93 5, yel		
45	**2,4,5-Tribromophenetol**	73						79				
46	**4-Ethoxybiphenyl** (4-Biphenyl ethyl ether)	76, 74	188[13]									
47	**Benzyl 1-naphthyl ether**	77 (cor)	200[12]			85-100 (cor)						
48	**2-Phenyl-2-phenoxyethanol**	81										*p*-Nitrobenzoate, 87
49	**4-Aminodiphenyl ether**	83 5, 84, w	189[14]									N-Acetyl, 127, N-HCl, 122
50	**Biphenylene oxide** (Dibenzofuran)	86, wh, al	288 (cor)			94		3-*mono* 181-2, *di* 245, ac a		96, yel		
51	**4-Methoxybiphenyl** (4-Biphenyl methyl ether, 4-Phenylanisole)	90, 89					3-*mono* 91 2, al, 3,5-*di* 137-8, yel, al, 3,4'-*di* 171	3-*mono* 79, 4'-*mono* 144, pet, 3,4'-*di* 134, 3,5-*di* 87, pet				
52	**1,2-Diphenoxyethane** (Ethylene glycol diphenyl ether)	98, al					4,4'-*di* 228-9, al	2',4'-*di* 215 2 (cor), pa yel, acet	*di-p* 134-5, al			
53	**Benzyl 2-naphthyl ether** (2-Benzyloxynaphthalene)	101 5 (cor), al	d			123 0 (cor)						
54	**Anisoin** (4,4'-Dimethoxybenzoin)	113										Methyl ether, 52-3, yel, CCl_4, Ethyl ether, 103-4, al-w
55	**Hydroquinone dibenzyl ether** (1,4-Dibenzyloxybenzene)	128-9, al						83				

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE VIII. ORGANIC DERIVATIVES OF ETHERS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	n_D^{t}	D_4^{t}	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1 3 5 Trinitrobenzene addition compound	3 5-Dinitrobenzoate	Miscellaneous
56	**Anisil** (4,4'-Dimethoxybenzil)	133, yel										Monoxime, 133, *syn*-Dioxime, 217, *anti*-Dioxime, 195, bz , Disemicarbazone, 254 5, dil ac a , Dihydrazone, 118
57	**Antiarol** (5-Hydroxy-1,2,3-trimethoxybenzene)	148, w										Acetyl, 74, al , Methyl ether, 47, b p 271
58	**Anhalamine** (6,7-Dimethoxy-8-hydroxy-1,2,3,4-tetrahydroisoquinoline)	187-8, al				234-6						Dibenzoyl, 128-9, N-Benzoyl, 167 8
59	**7-Methoxyquinoline**	210	287^{758}			229						

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES IX AND X

Phenylhydrazone *

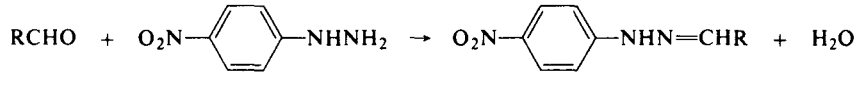
$$RCHO + H_2NNHC_6H_5 \rightarrow RCH{=}NNHC_6H_5 + H_2O$$

$$RR'CO + H_2NNHC_6H_5 \rightarrow RR'C{=}NNHC_6H_5 + H_2O$$

Phenylhydrazone

From the carbonyl compound with phenylhydrazine in methanol or ethanol
For directions and examples see Cheronis pp 497 8 Shriner, p 131
From the carbonyl compound with phenylhydrazine in aqueous acetic acid
See Wild, p 111
From the carbonyl compound with phenylhydrazine in methanol in the presence of acetic acid
See Cheronis, p 511
From the carbonyl compound in alcohol with phenylhydrazine hydrochloride and sodium acetate in water
See Vogel, p 721

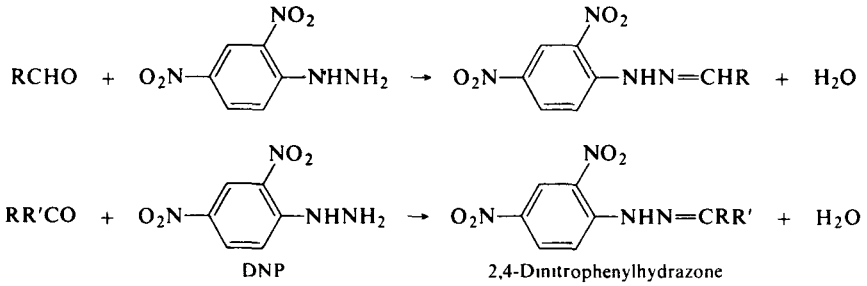
p-Nitrophenylhydrazone *



p Nitrophenylhydrazone

From the carbonyl compound with *p*-nitrophenylhydrazine and a catalytic amount of acetic acid in alcohol
For directions and examples see Shriner, pp 131, 219, Vogel, p 722, Wild, p 112
From the carbonyl compound in alcohol or water with *p*-nitrophenylhydrazine in aqueous acetic-hydrochloric acids
See G Petit, *Bull Soc Chim France*, 141 (1948)

2 4-Dinitrophenylhydrazone (DNP-derivative) *



DNP 2,4-Dinitrophenylhydrazone

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in methanol or ethanol
For directions and examples see Linstead, p 26, Shriner, p 219, Vogel, p 344, Wild, pp 114-5, O L Brady and G V Elsmie, *Analyst*, **51**, 77 (1926), O L Brady, *J Chem Soc*, 756 (1931), H H Strain, *J Amer Chem Soc*, **57**, 758 (1935), O L Brady and S G Jarret, *J Chem Soc*, 1021 (1950)
From the carbonyl compound with 2,4-dinitrophenylhydrazine and 1% hydrochloric acid in methanol or ethanol
See Cheronis, pp 499-501, 511, Vogel, p 722, Wild, pp 112-4, C F H Allen, *J Amer Chem Soc*, **52**, 2955 (1930), C F H Allen and J H Richmond, *J Org Chem*, **2**, 222 (1937)
From the carbonyl compound with 2,4-dinitrophenylhydrazine and acetic acid in diglyme (diethylene glycol dimethyl ether)
See H J Shine, *J Org Chem*, **24**, 1790 (1959)
From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated hydrochloric acid in diglyme (diethylene glycol dimethyl ether)
See Cheronis, p 501, H J Shine, *J Org Chem*, **24**, 252 (1959), *J Chem Ed*, **36**, 575 (1959)

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid
See Vogel, p 344, G D Johnson, *J Amer Chem Soc*, **73**, 5888 (1951), **75**, 2720 (1953)
From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol
See N R Campbell, *Analyst*, **61**, 391 (1936)
From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine
See E A Braude and C J Timmons, *J Chem Soc*, 3131 (1953)

Semicarbazone *

$$RCHO + H_2NNHCONH_2 \rightarrow RCH{=}NNHCONH_2 + H_2O$$

$$RR'CO + H_2NNHCONH_2 \rightarrow RR'C{=}NNHCONH_2 + H_2O$$

$$RR'CO + (CH_3)_2C{=}NNHCONH_2 \rightarrow RR'C{=}NNHCONH_2 + (CH_3)_2CO$$

Semicarbazone

From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate
For directions and examples see Cheronis, pp 503–504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, *J Amer Chem Soc*, **41**, 417 (1919)
From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate
See Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, **52**, 1267 (1930)
From the carbonyl compound and acetone semicarbazone in acetic acid
See B Angla, *Ann Chim Anal Chim Appl*, **22**, 10 (1940)

Thiosemicarbazone *

$$RCHO + H_2NNHCSNH_2 \rightarrow RCH{=}NNHCSNH_2 + H_2O$$

$$RR'CO + H_2NNHCSNH_2 \rightarrow RR'C{=}NNHCSNH_2 + H_2O$$

Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid
For directions and examples see Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, *J Chem Soc*, **121**, 873 (1922), W Baird, R Burns and F J Wilson, *J Chem Soc*, 2527 (1927), M Busch, *J prakt Chem*, **124**, 301 (1930), P P T Sah and T C Daniels, *Rec Trav Chim*, **69**, 1545 (1950)

Phenylsemicarbazone *

$$RCHO + H_2NNHCONHC_6H_5 \rightarrow RCH{=}NNHCONHC_6H_5 + H_2O$$

$$RR'CO + H_2NNHCONHC_6H_5 \rightarrow RR'C{=}NNHCONHC_6H_5 + H_2O$$

Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid
For directions and examples see P P T Sah and T -S Ma, *J Chinese Chem Soc*, **2**, 32 (1934), *C A*, **28**, 3713 (1934)

Oxime *

$$RCHO + NH_2OH \rightarrow RCH{=}NOH + H_2O$$

$$RR'CO + NH_2OH \rightarrow RR'C{=}NOH + H_2O$$

Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent
For directions and examples see Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, *J Amer Chem Soc*, **53**, 1536 (1931), W E Bachmann and C H Boatner, *J Amer Chem Soc*, **58**, 2097 (1936), W E Bachmann and M X Barton, *J Org Chem*, **3**, 300 (1938)
For a modification of the above method in aqueous alcohol
See W M D Bryant and D M Smith, *J Amer Chem Soc*, **57**, 57 (1935)
From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

See: Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

See: Shriner, p. 255.

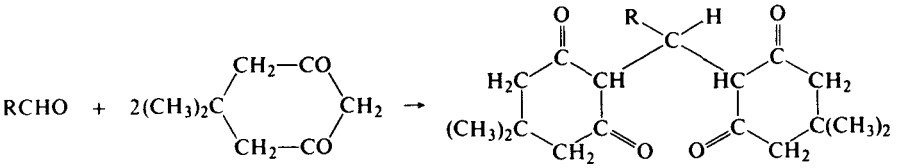
From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

See: Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, *J. Amer. Chem. Soc.*, **53**, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

See: Wild, p. 120.

*Dimethone derivative (Methone derivative).**



This derivative is specific for aldehydes only.

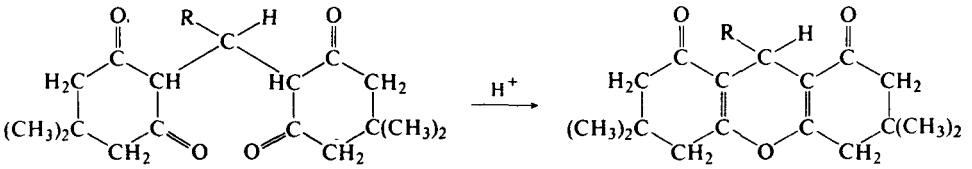
From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

For directions and examples see: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136–7; D. Vorlander, *Z. Anal. Chem.*, **77**, 241 (1929); *Z. Angew. Chem.*, **42**, 46 (1929); W. Weinberger, *Ind. Eng. Chem., Anal. Ed.*, **3**, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

See: E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*Anhydride of dimethone derivative (substituted octahydroxanthene).**



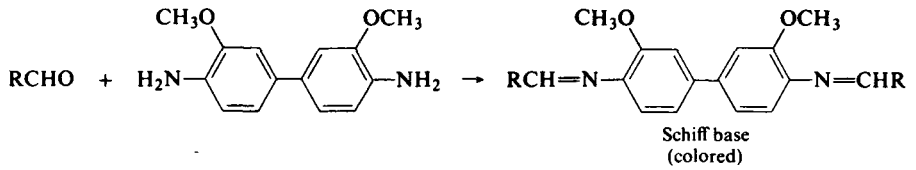
From the dimethone derivative with acetic anhydride.

For directions and examples see: Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

See: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

o-Dianisidine spot test.



This test is usually applicable to aldehydes only.

From the aldehyde and a saturated solution of *o*-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

For directions and examples see: F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, *Mikrochim. Acta*, **1**, 55 (1927).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.*

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	Semi carbazone	2 4-Di nitrophenyl hydrazone	*p*-Nitro phenylhydra zone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv)	Dimethone anhydride	Miscellaneous	*o*-Dianisidine spot test		
													Cold	Hot	Limit γ
1	**Formaldehyde** (Methanal)	−21	−91		169	167, yel al	181 2, yel , bz	145	oil	189, al , 191 4			pa yel	or br	50
2	**Trifluoroacetaldehyde**	−20				151									
3	**Acetaldehyde** (Ethanal)	20 2	−123 5	1 3392[18], 1 3316	162 3	stable 168, al unstable 157, mixture 148	128 5	57, 99	47	139, al	175-6, al	Thiosemicarbazone, 146	or	dk br	30
4	**Propionaldehyde** (Propanal)	48 9	−81	1 364	89, bz - lgr , 154, w	148, or , 150, red, 155	125, yel , 50% al	oil	40	154 6, al	143	Picrate, 156-7	dk ol gn	red	20
5	**Glyoxal**	50	15		270	328	311	180	178	*mono* 186, *di* 228	*mono* 224	Phenylosazone, 169-70			
6	**Acrolein** (Acraldehyde)	52 4	−87 7	1 4025	171, w	165	150-1	50 1, hot lgr , pyrazoline		192, 50% al	163, al		red br	vlt br	0 1
7	**Propynal** (Propargyl aldehyde)	55										Cu deriv , 160			
8	**2,2,2-Trifluoropropionaldehyde**	56[745]			,	151									
9	**Isobutyraldehyde**	64	−65 9	1 3730	125 6	187, or - yel , al , 182	130 1, or - yel , al	oil	oil	154	144				
10	**2-Methyl-2-propenal** (Methacrolein)	73 5		1 4191	198	206		74, pyrazoline							
11	***n*-Butyraldehyde** (Butanal)	74 7	−97 1	1 38433	95 5, lgr , 106	123, al	87, yel , al , 93 5, red	93 5	b p 152[715]	134, 142	141				
12	**Trimethylacetaldehyde** (Pivaldehyde)	75	3, 6	1 3791	190	210, yel			41						
13	**Chloroacetaldehyde**	85-6			134-5d, 148, al				oil						
14	**2-Chloropropionaldehyde**	86		1 431[17]								Hydrate, b p 80 5-81			
15	**Dichloroacetaldehyde**	89 5-90 5			155-6, using only 1 equivalent of reagent				b p 67-9[17], using only 1 equivalent of reagent						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv.)	Dimethone anhydride	Miscellaneous	*o*-Dianisidine spot test		
													Cold	Hot	Limit, γ
16	**Methoxyacetaldehyde**	92		1.3950		124-5	115								
17	**3-Methylbutanal** (Isovaleraldehyde)	92.5	−51	1.39225	107	123, yel-or., al	110.1, al	oil	48.5	154-5, al	173 (cor.)	Thiosemicarbazone, 52.3			
18	**2-Methyl-1-butanal** (α-Methylbutyraldehyde)	92-3	20, tri-	1.3942	103.5, bz-pet eth	120									
19	**Trichloroethanal** (Chloral, Trichloroacetaldehyde)	98	−57.5	1.45572	90d	131	131, yel		56			Hydrate, 51.7			
20	**Pentanal** (Valeraldehyde)	103.4	−91.5	1.3947		98, yel., al., 107			52, pet eth	104.5	113	Thiosemicarbazone, 65			
21	***tert*-Butylacetaldehyde**	103		1.4150		147									
22	**2-Butenal** (Crotonaldehyde)	104	−69	$1.4362^{20.5}$	199	190, crim., bz-lt pet	184.5	56	119	183	163, sint., 167	Phenylsemicarbazone, 126-7	dk red	dk br-red	2
23	**Dimethylethylacetaldehyde**	104													
24	**Ethoxyacetaldehyde**	106		1.3956		116.7 me al	113.4, al								
25	**2-Isopropylacrolein**	107.9		1.4223		165									
26	**2-Butynal**	105 110^{755}		1.446^{19}		136									
27	**Methylisopropylacetaldehyde**	114		1.3998^{25}		124									
28	**2-Bromoisobutyraldehyde**	115		1.4518^{25}								Decomposes in w			
29	**Diethylacetaldehyde** (2-Ethylbutyraldehyde)	116 117		1.4025	99, bz-lt pet	95, pa-or., lt pet., 129 30, al				102, me al					
30	**Methyl-*n*-propylacetaldehyde**	116^{737}			102	103									
31	**2-Methyl-2-butenal**	116.9			216										
32	***n*-Propoxyacetaldehyde**	119^{748}				86									
33	**Isobutylacetaldehyde** (Isocaproaldehyde)	121^{743}			127	99			b.p. 103^{35}						
34	**Paraldehyde** (Acetaldehyde trimer)	124.4^{752}	12.6	1.4049								Dilute acid → Acetaldehyde, b.p. 20.2	dk ol grn	dk red br	4
35	**2-Pentenal**	125			180		123								
36	**3-Methoxyisobutyraldehyde**	129		1.4030^{27}		102									

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	Semi carba zone	2 4-Di nitro phenyl hydra zone	*p* Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Dimeth one deriv (Dime done deriv)	Dimeth one anhy dride	Miscel laneous	*o*-Dianisidine spot test		
													Cold	Hot	Limit γ
37	**3-Chloropropion-aldehyde**	130–1		1 475[15]								Trimer 35 5, dil HCl-abs al b p 170 5[12–5]			
38	**Hexanal** (Capro-aldehyde)	131		1 4068	106, bz - pet eth	104, or - yel			51, pet eth me al	108 5, dil al		Phenyl-semicar-bazone, 135–6			
39	**Ethylisopropylacet-aldehyde**	133 5		1 4086[25]		121									
40	**3,3-Dimethyl-pentanal**	134		1 4292		102									
41	**3-Methyl-2-butenal** (3-Methylcroton-aldehyde)	135		1 4526	223	182									
42	**Cyclopentanecar-boxaldehyde**	136			124										
43	**2-Methylpenten-2-al-1** (3-Ethyl-2-methylacrolein)	136 8		1 4488	207	159, red al		58–60	48–48 8						
44	**Tetrahydrofurfural**	142–3[779]		1 4473 1 43658	166	134						Conc HCl → brt red col α Benzyl-α phenyl hydra zone 67 me al			
45	**5-Methylhexanal**	144[750]		1 4114	117	117									
46	**3-Furaldehyde**	144[732]		1 4945	211			149 5							
47	**1-Cyclopentenyl-formaldehyde**	146		1 4828[21]	208		188								
49	**2-Chloro-2-butenal** (2-Chlorocroton-aldehyde)	147–50		1 478[23]								Cyano-hydrin b p 137 8[26], n_D^{17} 1 4762			
50	**2-Hexenal**	150		1 4470[13]	176		139								
51	**3-Hexenal**	150			147										
52	**Heptanal** (Enanth-aldehyde)	155	−45	1 4125	109, al	108, yel , al	73		57	135	112		red-br	red	9
53	**Ethylisobutylacet-aldehyde**	155			98										
54	**Di-*n*-propylacetal-dehyde**	161		1 4142[15]	101				b p 126[47]						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	Semicarbazone	2,4-Dinitrophenylhydrazone	*p* Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv.)	Dimethone anhydride	Miscellaneous	*o*-Dianisidine spot test		
													Cold	Hot	Limit, γ
55	**2-Furancarboxaldehyde** (Furfural)	161.7	−36.5	1.52608	202	212.4, yel., 230 (cor.), red, mixture 185	54	97	α 75-6, pet. eth., β 91.2, al.	160d	162.5	Phenylsemicarbazone, 180.1	dk. red-vlt.	dk. bl.-vlt.	0.02
56	**Hexahydrobenzaldehyde**	162		1.4495[19]	173, 176, w.	172			90-1, pet. eth			Oxime-HCl, 107-8d			
57	**2-Ethylhexanal-1** (*n*-Butylethylacetaldehyde)	163		1.4150	254d	114.5, dil. al., 120.1, yel., al.									
58	**2,2,3-Trichloro-*n*-butyraldehyde** (*n*-Butylchloral, Crotonchloral)	164.5 5.5		1.47554					65			NH_3 → Butylchloral ammonia, 62			
59	**Butanedial** (Succinaldehyde)	169-70d		1.4254		280			*di* 172			Polymer, 65			
60	**Octanal** (*n*-Octaldehyde Caprylaldehyde)	171		1.42167	98, dil. me. al. 101	106, yel., al., 96	80, brt. yel.		60, me. al.	90, dil. al.	101	Thiosemicarbazone, 94-94.5			
61	**2-Ethyl-3-*n*-propylacrolein**	173		1.4518[22]	150.1, 153 -	124.5 122									
62	**3-Fluorobenzaldehyde**	173					202	114	63						
63	**2,2,2-Tribromoethanal** (Bromal)	174, yel.							115			Monohydrate, 53.5	no reac.	dk. grn.	40
64	**4-Fluorobenzaldehyde**	174.5[52]					212	147	*syn* 116.7, *anti* 86						
65	**2-Fluorobenzaldehyde**	175	−44.5				205	90	63						
66	**Benzaldehyde**	179	−26, f.p. −55.6	1.5446	222, 233-5, r. htng.	237, or. al.	190, red. al. 234.6, 262	158, 154.5	α 35 (stable) β 130, eth.	193	200	Phenylsemicarbazone, 180.1	or.	red-or.	3
67	**Nonanal** (Pelargonaldehyde)	185		1.4273	100.84, me. al.	100 (cor.), yel., al.			64, pet. eth.	86		Phenylsemicarbazone, 131.2			
68	**5-Methylfurfural**	187		1.5147[25]	211*	212 (cor.)	130, red.	147-8	*syn* 112, *anti* 51-2						
69	**Glutaraldehyde**	187-9d		1.4330[25]			169		*di* 175, 178, w.						
70	**Phenylethanal** (Phenylacetaldehyde)	194	33	1.53191	153, dil. al., 156	121, grn.-yel., al., 110		58, lgr., 62-3	97-8, eth., 100	165	126		dk. br.-red	dk. br.	polym.

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	Semi carba zone	2 4-Di nitro phenyl hydra-zone	*p* Nitro-phenyl hydra zone	Phenyl hydra zone	Oxime	Dimeth-one deriv (Dime done deriv)	Dimeth one anhy dride	Miscel-laneous	*o*-Dianisidine spot test		
													Cold	Hot	Limit, γ
71	**2-Hydroxybenz-aldehyde** (Salicyl-aldehyde)	197 (cor)	−7, f p 1 6	1 574	231	248, red, abs al 252d , lt red, ac a	227, red-br , al	142	57, 63		208, 70% al	*p*-Nitro-benzo-ate, 128	or	or	5
72	**2-Thiophenecarbox-aldehyde**	198		1 5950[16]		242		119 139							
73	**3-Methylbenz-aldehyde** (3-Tolu-aldehyde)	199		1 5413[21]	204 223 4	212, 194	157	91, lgr , 84	60, lgr	172	206		dk or - red	ch red	5
74	**2-Methylbenz-aldehyde** (2-Tolu-aldehyde)	200		1 5481	209 al , 212, 218	193 4, red, ac a	222, red, al	101, 105 6, 111	49	167	215		dk or - red	ch red	5
75	**4-Methylbenz-aldehyde** (4-Tolu-aldehyde)	204 5		1 5454	234, al , 215	232 5 4 5 (cor) or - yel al $PhNO_2$	200 5 (cor), dk red, ac a	112-3, al , 121	79-80, 110				dk or - red	ch red	5
76	***d*-Citronellal** (*d*-Rhodinal)	207		1 4485	83-4, chl , ppt by lgr 91 2	78, yel , al			oil	77 9, dil al	173		dk grn	brt red	10
77	**Decanal** (Capralde-hyde)	207-9		1 4287	102	104, yel			69, dil me al	91 7, dil al		Thio-semicar-bazone, 99-100	pa ol	dk br	200
78	**2-Chlorobenz-aldehyde**	213-4	11	1 56708	146, yel , 225, pyr , 229-30, me al	213 6 (cor), 209, or red, xyl	237 8, red, al , 241, br - red, 249, or	86	α 75-6, al , β 101 3	205d , al	224 6 (cor), al				
79	**Phenoxyethanal** (Phenoxyacetalde-hyde, Glycolalde-hyde phenyl ether)	215d		1 5380[21]	145			86, pa yel , al	95, pet eth						
80	**3,5-Dimethylbenz-aldehyde**	220-2	9	1 5385	201 2							Oxid → acid, 170, al			
81	**3-Phenylpropion-aldehyde** (Hydro-cinnamaldehyde)	224			127, al	149, yel , al	122 3, yel , dil al		93-4 5, dil al 97 (cor)						
82	**Citral a.** (Geranial)	228d		1 48752	164, me al	108-10, red-or al , 116			143 5				dk red	red blk	0 1
83	**Citral b.** (Neral)	228d		1 4900	HCl 171, mix-ture 132, NaOAc	96, red-or , al							dk red	red blk	0 1

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 1) Listed in order of increasing atmospheric b.p.* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	Semi carba zone	2 4 Di nitro phenyl-hydra-zone	*p* Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Dimeth-one deriv (Dime-done deriv)	Dimeth one anhy dride	Miscel laneous	*o* Dianisidine spot test		
													Cold	Hot	Limit γ
84	**2,6-Dimethylbenz-aldehyde**	228^{742}	11		158										
85	**3-Methoxybenz-aldehyde** (3-Anis-aldehyde)	230	3 4	1 5538	233d		171	76	39 40 pet eth , 112			Phenyl-thio-semicar-bazone, 153	dk or	red br	0 4
86	**3-Bromobenz-aldehyde**	234–6			205		220	141	72						
87	**4-Isopropylbenz-aldehyde** (Cumal-dehyde)	236		1 5301	211, me al	241, red bz , 243, red, ac a , 244 5, al -chl	190, al	129, al	α 52, al β 111	170–1, al	172 3		dk red	ol yel	3
88	**3-Ethoxybenz-aldehyde**	245 5		1 5408											
89	**4-Methoxybenz-aldehyde** (4-Anisal-dehyde)	248	2 5	1 5731	210, 203	253 4d , red, ac a , 250, red, xyl	160, red-vlt	120 1, wh , dil al	α' 64-5, bz α 4 5 (from α' on fu-sion) β 133, bz	144 5 (cor), al	243 (cor), al		dk or	red-br	0 4
90	**3-Phenylpropenal** (Cinnamaldehyde)	252d	−7 5	1 61949	215 6 w	255d , red, ac a	195, red, al	168, yel , dil al	α 64-5, lgr , β 138 5, bz	213 (cor), al 161, al	175, al		dk ch red	ch red	0 05
91	**4-Ethoxybenz-aldehyde**	255, 249	13–4		202d , al , 208				*syn* 157 *anti* 118						
92	**3,4-Diethoxybenz-aldehyde** (Proto-catechualdehyde diethyl ether)	277–80							98			Oxid → acid, 165			
93	**Diphenylacetalde-hyde**	315–6d			162				α 120, β 106			Oxid → Benzo-phenone 48			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)*

No	Name	Boiling point °C	Melting point °C	n_D^{20}	Semi carba zone	2 4 Di nitro phenyl hydra zone	*p* Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	Di meth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	*o* Dianisidine spot test		
													Cold	Hot	Limit γ
1	**7-Methyloctanal**	94^{120}			80	100									
2	**3-(2-Furyl)propionaldehyde**	70^{14}		1 4470	80										
3	**2-Methyloctanal**	83^{20}			80										
4	**2,3-Dichloro-*n*-butyraldehyde**	58 60^{20}		1 4618[21]	96 7				oil						
5	**Octanal** (*n* Octalde hyde)	81^{32}		1 4217	98 101	106 yel	80		59 60	89 8					
6	**Undecanal** (Hen decanal)	120^{20}	−4	1 4324[23]	103 me al	104 yel			72 wh me al			Trimer 47 8			
7	**Tridecanal** (*n* Tridecyl aldehyde)	136^{8}	15		106 al	108			80 5 dil al			Trimer 61 5 eth			
8	**2-Hydroxypropionaldehyde**	114^{9}			114 w		127								
9	**2-*n*-Amylcinnamaldehyde** (2 *n* Pentyl cinnamaldehyde Jasminaldehyde)	161 3^{13}		1 5381	118	164 red al			74 al w						
10	**2-Methyl-3-phenylpropionaldehyde**	90^{6}			123										
11	**2-Hydroxy-2-methyl hexanal** (*n* Butyl methylglycolalde hyde)	87 8^{3}			143										
12	**Phenoxyacetaldehyde**	83		1 5360	146	138			95						
13	**2-Ethyl-2-hexenal**	73^{20}			152	125									
14	**2-Ethyl-3-hexenal**	84^{52}			156										
15	**Cyclohexylacetaldehyde**	58^{10}		1 4509[25]	159	125									
16	**2-Nonenal**	126^{21}		1 4426	165	126	113								
17	**2-Heptenal**	85^{14}		1 4314	169		116								
18	**2,3,6-Trimethylbenzaldehyde**	114^{10}			169				126						
19	**3,5-Dimethylhexahydrobenzaldehyde**	71^{14}			171										
20	**2-Hydroxy-2-phenylpropionaldehyde** (Methylphenylglycol aldehyde)	101^{4}			182 3										
21	**2,4,6-Trimethylbenzaldehyde**	98^{6} 128^{15}		1 5524	188										
22	**2-Hydroxy-2-phenylbutyraldehyde** (Ethyl phenylglycolaldehyde)	110 11			188										
23	**2-Hydroxybutyraldehyde** (Aldol)	83^{4}			194		109 11 red yel dil al		*syn* 112 *anti* 51 2	146 8 30^{9} me al	126	4 Bromo phenylhydrazone 127 8			
24	**1,2,3,4-Tetrahydro-2-naphthaldehyde**	92^{1}			197										
25	**2-(1-Naphthyl)-propionaldehyde**	132^{2}			204										

* Derivative data given in order m p crystal color solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	Semi carba zone	2 4 Di nitro phenyl hydra zone	*p* Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	Di meth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	*o* Dianisidine spot test		
													Cold	Hot	Limit γ
26	**1,6-Hexanedial** (Adipic dialdehyde)	94[12], 70[3]		1 4350	*di* 206				*di* 185 6 w						
27	**2-Methylcinnamaldehyde**	124[14]		1 6057[17]	208, al - w										
28	**Phenylglyoxal**	108[15]			*mono* 208 9d yel al *bis* 229d		309					91 (mono hyd) w 2 Thio semicarba zone, 170 yel al			
30	**Cyclohexenecarboxaldehyde**	70[13]		1 4921[1]	213				99						
31	**2-Phenoxybenzaldehyde**	153[1]			215										

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 3) Miscellaneous; reduced pressure b.p. only (listed alphabetically)*

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	Semi carba zone	2,4 Di nitro phenyl-hydra-zone	*p*-Nitro-phenyl hydra-zone	Phenyl-hydra-zone	Oxime	Di meth one deriv (Dime done deriv)	Di meth-one anhy-dride	Miscellaneous	*o* Dianisidine spot test		
													Cold	Hot	Limit γ
1	**2-Chloroacrolein**	29 31^{17}		1 463								Diethylacetal, b p 158 60			
2	**4-Chloro-*n*-butyraldehyde**	50 1^{11}		1 44662[8.5]		134 5	110		74 5						
3	***d,l*-2,3-Dichloropropion-aldehyde**	48^{14}		1 4762								Dimethylacetal, b p 78-82^{14}, n_D^{18} 1 144			
4	**2-Heptynal**	54^{13}		1 4521[17]		74									
5	**2,4-Hexadienal** (Sorbalde-hyde)	65^{11}		1 5372[22]				102	160						
6	**4-Hydroxy-*n*-butyr-aldehyde**	68^{8}		1 4403		118									
7	**3-Hydroxy-2-isopropyl-propionaldehyde**	84^{10}				126									
8	**3-Hydroxy-3-methyl-*n*-butyraldehyde**	$67^{1.5}$					142								
9	**4-Methoxy-2-methyl-*n*-butyraldehyde**	66^{55}		1 4280[25]		88									
10	**5-Methyl-2-thiophene-carboxaldehyde**	114^{25}		1 5782[29]				126							
11	**3-Methyl-2-thiophene-carboxyaldehyde**	114^{25}		1 5833[25]				149							
12	**4-Octenal**	84^{13}		1 4463[25]		108									
13	**Phenylpropargyl alde-hyde**	116 7^{17}		1 6032[25]					108, lgr						
14	**2-Phenylpropionaldehyde**	76^{4}				135									
15	**3-Pyridinecarboxaldehyde** (Nicotinaldehyde)	99^{20}						158							
16	**2,2,4-Trichloro-*n*-butyr-aldehyde**		f p -78									HNO_3 → acid, 73 5			
17	**2,4,6-Trihydroxybenzalde-hyde** (Phloroglucinalde-hyde)		d						195d , (hyd), w			2,4,6 Triacetate 156 7, al 2-Benzoate 198 200, chl			
18	**4-Vinylbenzaldehyde** (4-Formylstyrene)	93^{14}		1 5960[25]				131							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point °C	Semi carba zone	2 4-Di-nitro phenyl hydra zone	*p* Nitro phenyl-hydrazone	Phenyl hydra zone	Oxime	Dimeth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	*o* Dianisidine spot test		
												Cold	Hot	Limit γ
1	**3-Chlorobenzaldehyde**	17 8	213 4	228, pyr 230, me al	248, dk red, xyl , 256, or - yel	216, dil al	134 5, abs al	*α, anti* 70 1, al *β, syn* 118			$n_D^{20.2}$ 1 55908			
2	**2,3,5,6-Tetramethyl-benzaldehyde**	20	135[11]	270d				125						
3	**2-Ethoxybenzaldehyde** (Salicylaldehyde ethyl ether)	20 2 6-7	247 9	219, al				57 9, pet *eth*			Diacetate 88 9, ac *anh*			
4	**Tetradecanal** (Myristaldehyde)	23 3 5	166[24]	106 5, dil al	108	95 brt yel		82 5 3 5, dil al			Trimer, 65			
5	**Pentadecanal**	24 5	160[14]	106 5, al	106 7, yel , pyr -al	94 5, yel , al		86, dil al			Trimer, 69 70			
6	**Hexadecanal** (Palmitaldehyde)	34		107, dil al , 108-9	108	96 5, yel , eth		88, yel			Trimer, 73 Thiosemicarbazone, 106 9			
7	**1-Naphthaldehyde**	34	292 162[18]	221		224	80	98 90						
8	**Phenylacetaldehyde**	34	195	156, 163	121	151	*mono* 63, 58, *di* 101-2	99, 103	165					
9	**4-Methoxy-1-naphthaldehyde**	34, wh	200[11]				113				Azine 185, yel , al			
10	**(5-Hydroxymethyl) furfural**	35 6	115 $20^{0.5}$	195d al, recr tol - lgr	184 red	185 dk red, al	140 1, tol	77 8, 108						
11	**Heptadecanal** (Margaric aldehyde)	35-6, 63						89 5, et ac			Trimer, 77-8, lt pet			
12	**3,4-Methylenedioxybenzaldehyde** (Piperonal)	37	263	230, 234, 237	265d , xyl , 266d , red, ac a	199 200, red	102 3, yel , al , 99, 106	*syn* 146, me al , *anti* 112, w	177 8, 193, yel , al	220 (cor)		brt red	dk red	4
13	**2-Iodobenzaldehyde**	37	129[14]	206			79	108						
14	**Octadecanal** (Stearaldehyde)	38		108-9	101, 110	101, yel , me al		89			Thiosemicarbazone, 111			
15	**2-Methoxybenzaldehyde** (*o*-Anisaldehyde, Salicylaldehyde methyl ether)	38-9	243-6 (cor)	215d , al	253 5 (cor), red, xyl	204-5, br red		92, dil al			n_D^{20} 1 5598			
16	**2-Aminobenzaldehyde**	40				220	221	135						
17	**4-Diethylaminobenzaldehyde**	41	172[7]	241d , al			103, yel - br	93						
18	**Dodecanal** (Lauraldehyde)	2 forms a) 42-3 b) 11	238	103, 106	106, yel	90		76-7, eth , 77-8, me al			Thiosemicarbazone, 100			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Semi carbazone	2 4 Di nitrophenyl hydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv)	Di methone anhydride	Miscellaneous	*o* Dianisidine spot test		
												Cold	Hot	Limit, γ
19	**3,4-Dichlorobenzaldehyde**	43 4	247 8			276 7, or		*syn* 120 al , on fusing → *anti* 114 5 118-9						
20	**3-Phenylcinnamaldehyde**	44	210[14]	214 5	196		173, yel							
21	**2,4,5-Trimethylbenzaldehyde**	44	120[10]	243			127							
22	**2-Nitrobenzaldehyde**	44		256	265	263	156	*anti* 102 *syn* 154, bz				grn br	red br	5
23	**3,4-Dimethoxybenzaldehyde** (Veratraldehyde)	44, 58	285	177	261 3 (cor), or , $PhNO_2$ 264 5		121, al	94 5, lgr	173					
24	**4-Chlorobenzaldehyde**	48	214 5 6 5	230, pyr 233, me al	254 (cor), or	237, dk br , al	127 7 5, lt yel , dil al	α 110, β 146						
25	**2-Pyrrolecarboxaldehyde**	50	217 9	183 5, w		182 3, red, xyl	139, lgr	164, bz			n_D^{15} 1 5939			
26	**Benzylglycolaldehyde**	52	121[4]	137							Benzoate, 70			
27	**Furfural diacetate**	52, eth	220											
28	**4-Chloro-2-hydroxybenzaldehyde**	52 5		212 pa yel , ac a		257, or , ac a		155, col , al						
29	**Quinoline-4-carboxaldehyde**	51 3, tol (anh), 84 4 5 (monohyd)	123[4]			261 2 yel al		181 2 me al			Picrate, 179			
30	**2-Ethyl-4-hydroxybenzaldehyde**	53	145[1]											
31	**2-(2-Furyl)-acrolein**	54, lgr	95[9]	219 5			132, pet eth	110 1						
32	**2,3-Dimethoxybenzaldehyde** (*o*-Veratraldehyde)	54	137[12]	231d			138	99, al -w						
33	**9-Hydroxynonanal**	54	120[0 1]											
34	**2,3-Diphenylpropionaldehyde**	54	170[11]	125										
35	**3-Benzyloxybenzaldehyde**	54	218[20]											

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitro phenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv)	Dimethone anhydride	Miscellaneous	*o*-Dianisidine spot test		
												Cold	Hot	Limit, γ
36	**3-Chloro-2-hydroxybenzaldehyde** (3-Chlorosalicylaldehyde)	54 5 5 5		240-3, 50% ac a				167-8, dil al			5 Nitro deriv, 129, yel, dil al			
37	**Octatrienal**	55												
38	**Isoquinoline-1-carboxaldehyde**	55 5		197			171 2							
39	**Phthalaldehyde**	56					*di* 191					brt yel ppt	brt yel ppt	
40	**2,3,5-Trichlorobenzaldehyde**	56 col, dil al									Oxid $\xrightarrow{KMnO_4}$ acid, 162 3			
41	**2-Hydroxy-5-methylbenzaldehyde** (5-Methylsalicylaldehyde)	56 dil al	217 8				149 yel, al	105, w			Diacetate, 94, al			
42	**3-Iodobenzaldehyde**	57		226		212	155	62						
43	**4-Bromobenzaldehyde**	57		228, 229	128, 257	207 8	113	*syn* 157, *anti* 111						
44	**3-Nitrobenzaldehyde**	58		246	293d	247	120, 124	120 122						
45	**2,5-Dichlorobenzaldehyde**	58	231-3				104-5, al	127 5-8, dil al						
46	**2,4,6-Trichlorobenzaldehyde**	58-9												
47	**2-Phenanthraldehyde**	59, 59 5		282				175						
48	***Paraisobutyraldehyde*** (2,4,6-Tri-isopropyl-1,3,5-trioxan)	59 60	195 (cor), sl depolym								See Isobutyraldehyde b p 64			
49	**1-Hydroxy-2-naphthaldehyde**	59 60, gm-yel, al-w						145, bz						
50	**2-Naphthaldehyde**	60, w	150^{15}	245, al	270	230	205 6 d, al, 217 8	156, dil al						
51	**4-Phenylbenzaldehyde**	60		243d, al	239d, scar, xyl		189d	149-50						
52	**3-Methoxy-1-naphthaldehyde**	60, pet eth		200, al-w		197, red, ac a		102, al-w						
53	**4-Ethoxy-3-methoxybenzaldehyde**	64												
54	**3,5-Dichlorobenzaldehyde**	65	235 40^{748}				106 5, yel, pet eth	112						
55	**2,3-Dichlorobenzaldehyde**	65 7												
56	**5-Methoxy-1-naphthaldehyde**	66, yel, pet eth		246, ac a-w		246, red, ac a-w		104, w						

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv)	Dimethone anhydride	Miscellaneous	*o*-Dianisidine spot test		
												Cold	Hot	Limit, γ
57	**Dibenzofuran-2-carboxaldehyde**	68					162							
58	**2,6-Dichlorobenzaldehyde**	70–1									*o*-Nitrophenylhydrazone, 154, *p*-Bromophenylhydrazone, 142			
59	**2,4-Dimethoxybenzaldehyde** (β-Resorcylaldehyde dimethyl ether)	71, dil al, 69	165[10]					106, w			5-Nitro deriv 188 9, me al			
60	**Quinoline-2-carboxaldehyde**	71, pet eth (anh), 51 (monohyd), w				250, yel, 225, subl	204, yel, al	188						
61	**4-Ethoxy-1-naphthaldehyde**	72									Hydrazone, 160 182, dk red, Azine, 209, yel, $PhNO_2$			
62	**4-Aminobenzaldehyde**	72		153			156	124				or br	red br	0 4
63	**2,4-Dichlorobenzaldehyde**	72, 74 5						136 7			Oxime HCl, 133 5			
64	**4-Dimethylaminobenzaldehyde**	74		222	325	182	148	185						
65	**4-Methylthiazole-5-carboxaldehyde**	75, 72 5	118[21]				159, 161							
66	**Quinoline-6-carboxaldehyde**	75 6 (anh), 55 (hyd)		239, yel, al			185, red, al	191, yel, al			Methiodide, 218, yel, al			
67	**3,4,5-Trimethoxybenzaldehyde** (Gallaldehyde trimethyl ether)	78, 75	163–5[10]	219–20		201–2		83 4						
68	**4-Iodobenzaldehyde**	78		224	257	201	121							
69	**3-Phenanthraldehyde**	80		275				145						
70	**4-Hydroxy-3-methoxybenzaldehyde** (Vanillin)	80 1, w	285d	230, 240d.	271d (cor), red, ac ac, 268	227, ac a, 223	105, bz	117, w, 122	196–8 (cor), al	228	2,4-Dinitrophenyl ether, 131	brt or red	ch red	3
71	**2-Hydroxy-1-naphthaldehyde**	82, al	192[27]	240, yel, me al				157			Picrate, 120	or	brk red	10
72	**Stilbene-2-carboxaldehyde**	83												
73	**2-Methoxy-1-naphthaldehyde**	84, al	200–1[11]								Azine, 255–6, yel, $PhNO_2$			

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv)	Dimethone anhydride	Miscellaneous	*o*-Dianisidine spot test		
												Cold	Hot	Limit, γ
74	**2,3,6-Trichlorobenzaldehyde**	86 7									Ac anh + ac a + NaOAc → 2,3,6-trichlorocinnamic acid, 189, ac a			
75	**Isophthalaldehyde**	89					242	180						
76	**3,4,5-Trichlorobenzaldehyde**	90 1, al		252-4, al		342d, or, $PhNO_2$	147				2-Nitro deriv, 118 5 9 0 Oxid alk $KMnO_4$ → 3,4,5-trichlorobenzoic acid, 210			
77	**Phenylglyoxal hydrate**	91		α 217d		309	*dl* 152	α 129, *dl* 168						
78	**2,3,4-Trichlorobenzaldehyde**	91									Ac anh + ac a + NaOAc → 2,3,4-trichlorocinnamic acid, 185			
79	**Quinoline-8-carboxaldehyde**	94 5, dil al		238 9, bz			176, yel, al	115, dil al						
80	**2-Phenylcinnamaldehyde**	94, al, 95	195 200[1]	188-9, al, 195			125 6, yel, ac a, 141	165-6, al						
81	**3,5-Dichloro-2-hydroxybenzaldehyde** (3 5-Dichlorosalicylaldehyde)	95 6		227d, ac a			153, pa yel, al	195-6, al-w (4 1)			Ac anh + ac a + NaOAc → dichlorocoumarin, 160, bz			
82	**Hydroxyacetaldehyde** (Glycolaldehyde)	96 7					162				Phenylosazone, 178 9, yel, eth, *p*-Nitrophenylosazone, 311			
83	**3-Chloro-*n*-butyraldehyde** (Trimer)	96 7	28-33[13]											
84	**2,2-Dimethyl-3-hydroxypropionaldehyde**	97	85[15]											
85	**2,3,4,6-Tetrachlorobenzaldehyde**	97 8												
86	**Benzaldehyde-2-carboxylic acid** (2-Formylbenzoic acid, Phthalaldehydic acid)	98 9 (hyd), 240-50 (anh)		202				120, w						
87	**3-Hydroxy-2-naphthaldehyde**	99-100		>270, me al			246-8	207d						

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Semi carbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dimedone deriv)	Dimethone anhydride	Miscellaneous	*o* Dianisidine spot test		
												Cold	Hot	Limit, γ
88	**5-Chloro-2-hydroxybenzaldehyde**	99 100	105[12]	286-7, ac a			150 2	128 w 123 4						
89	**9-Phenanthraldehyde**	101		223		265		157						
90	**3-Hydroxybenzaldehyde**	104 108 (cor), w	240	198, 199	259, scar, xyl 260d, red, al	221 2, dil ac a	130 1 5, tol, 147, recr bz	90, 88				dk br red	dk ch red	4
91	**9-Anthraldehyde**	105		219, yel, al			207, or, al	187						
92	**4-Nitrobenzaldehyde**	106		221, 211	320	249	159, 153	*anti* 133, 129, *syn* 182 4				or br	red br	1
93	**2,3,4,5-Tetrachlorobenzaldehyde**	106 6 5												
94	**2,3-Dihydroxybenzaldehyde**	108		226d			167							
95	**2-Chloro-5-hydroxybenzaldehyde**	110 5-1 5, ac a		236, pa yel			250 1, red, dil al		146 7, abs al					
96	**1-Phenanthraldehyde**	111 5						189						
98	**2,4,5-Trichlorobenzaldehyde**	112-3, al									Ac anh + ac a + NaOAc → 2,4,5-trichlorocinnamic acid, 200 1			
99	**3-Hydroxy-2,4,6-trichlorobenzaldehyde**	113-6 5, 50% ac a				272-3d, yel or	,	170-2, dil al						
100	**2-Ethoxy-1-naphthaldehyde**	115, al		214-5, yel, al			91				Azine, 184, yel, $PhNO_2$-al			
101	**Metaldehyde**	115, 246, (polymers)									Dil a → acetaldehyde, b p 20 2			
102	**4-Hydroxybenzaldehyde**	116-7, w		224, 280d	280d, purp, ac a, 260 (monohyd), red, w	266	177 8, al, 184, slow htng	72, 112 (anh)	188-90 (cor), 184	246		dk or red	ch red	5
103	**Terephthalaldehyde**	116, 118	245			*di* 281	*di* 278d, 154	*di* 200						
104	**2,4,6-Trimethoxybenzaldehyde**	118						201-3, me al						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Semi carba zone	2 4 Di-nitro phenyl hydra zone	*p* Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	*Dimeth* one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	*o* Dianisidine spot test		
												Cold	Hot	Limit γ
105	**1-Bromo-2-naphthaldehyde**	118									Oxid → acid 186			
106	**4-Chloro-3-hydroxybenzaldehyde**	121		238 9, pa yel		226 7 vlt red dil al		126 (anh) 106 10d (monohyd)						
107	**Pyrene-3-carboxaldehyde**	126												
108	**1,2,3,4-Tetrahydrophenanthrene-9-carboxaldehyde**	129												
109	**4,6-Dichloro-3-hydroxybenzaldehyde**	129 30									2 Nitro deriv 157			
110	**2,4-Dihydroxybenzaldehyde** (β-Resorcylaldehyde)	135-6, yel , w		260d	286d brt red AmOH		156 60d	191, w						
111	**3-Chloro-4-hydroxybenzaldehyde**	139 (cor)		210d , yel , v dil ac a				144 5, w						
112	**2-Chloro-3-hydroxybenzaldehyde**	139 9 5		236 7, pa yel		244 5 or red, al		149 dil al						
113	**2,6-Dichloro-3-hydroxybenzaldehyde**	140 2						174 5 dil al						
114	**2,4-Dichloro-3-hydroxybenzaldehyde**	141, ac a				277 8, or red		188, al						
115	*d,l*-**Glyceraldehyde** (dimer)	142, 40% me al		160d	166 7 (cor), 50% me al			117 8	197 (cor) 50% al 203	172 50% al				
116	**2-Chloro-4-hydroxybenzaldehyde**	147 8 w		214, yel al		284d dk red al		194 al						
117	**3,4-Dihydroxybenzaldehyde** (Protocatechualdehyde)	153 4, w		230d	275d , dk red, me al		175 6d , w 121 8	157, xyl	145d , al		Dibenzoate 96 7, al			
118	**3,5-Dihydroxybenzaldehyde** (α-Resorcylic aldehyde)	156 7		223 4										
119	**3,5-Dichloro-4-hydroxybenzaldehyde**	158 9 (cor), 156, dil al		236 7d (cor), grn-yel , ac a				185, dil al						
120	**Hydroxypyruvic aldehyde**	160						135						
121	**Diphenylglycolaldehyde**	163		242				124						
122	**Benzaldehyde-3-carboxylic acid** (3-Formylbenzoic acid)	175, w		265			164	188d						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi carba zone	2 4 Di nitro-phenyl-hydra-zone	*p* Nitro phenyl-hydrazone	Phenyl-hydra-zone	Oxime	Dimeth one deriv (Dime-done deriv)	Di-meth one anhy dride	Miscellaneous	*o*-Dianisidine spot test		
												Cold	Hot	Limit γ
123	**2-Hydroxybenzalde-hyde-3-carboxylic acid** (3-Formyl-salicylic acid)	179					188, al	193, yel , w						
124	**4-Hydroxy-1-naphthal-dehyde**	181, yel , w		224							Hydrazone, 220-36, dk red Azine, 236, yel , $PhNO_2$			
125	**Indole-3-carboxalde-hyde**	195, 198					198							
126	**Pentachlorobenz-aldehyde**	202 5					152 5 (cor), yel , al	201 (cor), bz						
127	**3,4-Benzypyrene-5-carboxaldehyde**	203												
128	**3,4,5-Trihydroxybenz-aldehyde** (Gallalde-hyde)	212d , (mono-hyd)				226, 234-6d		195-200d						
129	**4-Hydroxybenzalde-hyde-3-carboxylic acid** (5-Formyl-salicylic acid)	248-9					219, al	179						
130	**Benzaldehyde-4-carboxylic acid** (4-Formylbenzoic acid)	256, w , subl					226	208-10						

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES IX AND X

Phenylhydrazone *

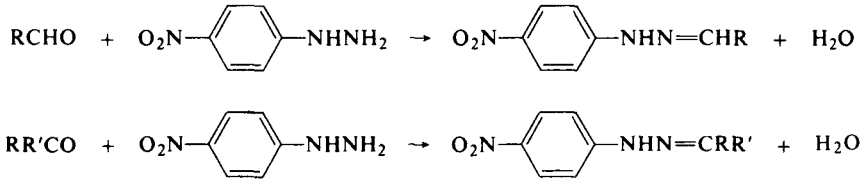
$$RCHO + H_2NNHC_6H_5 \rightarrow RCH{=}NNHC_6H_5 + H_2O$$

$$RR'CO + H_2NNHC_6H_5 \rightarrow RR'C{=}NNHC_6H_5 + H_2O$$

Phenylhydrazone

From the carbonyl compound with phenylhydrazine in methanol or ethanol
For directions and examples see Cheronis pp 497 8 Shriner, p 131
From the carbonyl compound with phenylhydrazine in aqueous acetic acid
See Wild, p 111
From the carbonyl compound with phenylhydrazine in methanol in the presence of acetic acid
See Cheronis, p 511
From the carbonyl compound in alcohol with phenylhydrazine hydrochloride and sodium acetate in water
See Vogel, p 721

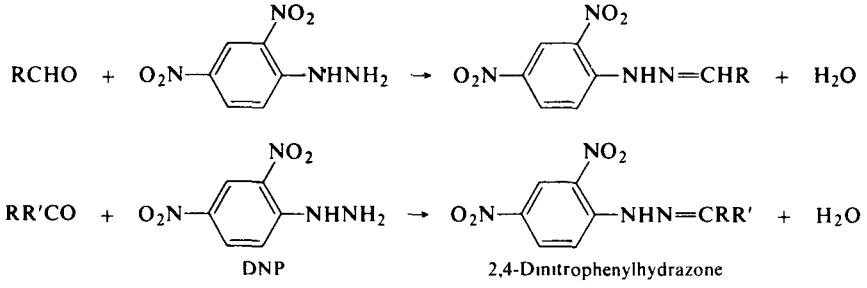
p-Nitrophenylhydrazone *



p Nitrophenylhydrazone

From the carbonyl compound with *p*-nitrophenylhydrazine and a catalytic amount of acetic acid in alcohol
For directions and examples see Shriner, pp 131, 219, Vogel, p 722, Wild, p 112
From the carbonyl compound in alcohol or water with *p*-nitrophenylhydrazine in aqueous acetic-hydrochloric acids
See G Petit, *Bull Soc Chim France*, 141 (1948)

2 4-Dinitrophenylhydrazone (DNP-derivative) *



DNP 2,4-Dinitrophenylhydrazone

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in methanol or ethanol
For directions and examples see Linstead, p 26, Shriner, p 219, Vogel, p 344, Wild, pp 114-5, O L Brady and G V Elsmie, *Analyst*, **51**, 77 (1926), O L Brady, *J Chem Soc*, 756 (1931), H H Strain, *J Amer Chem Soc*, **57**, 758 (1935), O L Brady and S G Jarret, *J Chem Soc*, 1021 (1950)
From the carbonyl compound with 2,4-dinitrophenylhydrazine and 1% hydrochloric acid in methanol or ethanol
See Cheronis, pp 499-501, 511, Vogel, p 722, Wild, pp 112-4, C F H Allen, *J Amer Chem Soc*, **52**, 2955 (1930), C F H Allen and J H Richmond, *J Org Chem*, **2**, 222 (1937)
From the carbonyl compound with 2,4-dinitrophenylhydrazine and acetic acid in diglyme (diethylene glycol dimethyl ether)
See H J Shine, *J Org Chem*, **24**, 1790 (1959)
From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated hydrochloric acid in diglyme (diethylene glycol dimethyl ether)
See Cheronis, p 501, H J Shine, *J Org Chem*, **24**, 252 (1959), *J Chem Ed*, **36**, 575 (1959)

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid
See Vogel, p 344, G D Johnson, *J Amer Chem Soc*, **73**, 5888 (1951), **75**, 2720 (1953)
From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol
See N R Campbell, *Analyst*, **61**, 391 (1936)
From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine
See E A Braude and C J Timmons, *J Chem Soc*, 3131 (1953)

Semicarbazone *

$$RCHO + H_2NNHCONH_2 \rightarrow RCH{=}NNHCONH_2 + H_2O$$

$$RR'CO + H_2NNHCONH_2 \rightarrow RR'C{=}NNHCONH_2 + H_2O$$

$$RR'CO + (CH_3)_2C{=}NNHCONH_2 \rightarrow RR'C{=}NNHCONH_2 + (CH_3)_2CO$$

Semicarbazone

From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate
For directions and examples see Cheronis, pp 503–504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, *J Amer Chem Soc*, **41**, 417 (1919)
From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate
See Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, **52**, 1267 (1930)
From the carbonyl compound and acetone semicarbazone in acetic acid
See B Angla, *Ann Chim Anal Chim Appl*, **22**, 10 (1940)

Thiosemicarbazone *

$$RCHO + H_2NNHCSNH_2 \rightarrow RCH{=}NNHCSNH_2 + H_2O$$

$$RR'CO + H_2NNHCSNH_2 \rightarrow RR'C{=}NNHCSNH_2 + H_2O$$

Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid
For directions and examples see Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, *J Chem Soc*, **121**, 873 (1922), W Baird, R Burns and F J Wilson, *J Chem Soc*, 2527 (1927), M Busch, *J prakt Chem*, **124**, 301 (1930), P P T Sah and T C Daniels, *Rec Trav Chim*, **69**, 1545 (1950)

Phenylsemicarbazone *

$$RCHO + H_2NNHCONHC_6H_5 \rightarrow RCH{=}NNHCONHC_6H_5 + H_2O$$

$$RR'CO + H_2NNHCONHC_6H_5 \rightarrow RR'C{=}NNHCONHC_6H_5 + H_2O$$

Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid
For directions and examples see P P T Sah and T -S Ma, *J Chinese Chem Soc*, **2**, 32 (1934), *C A*, **28**, 3713 (1934)

Oxime *

$$RCHO + NH_2OH \rightarrow RCH{=}NOH + H_2O$$

$$RR'CO + NH_2OH \rightarrow RR'C{=}NOH + H_2O$$

Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent
For directions and examples see Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, *J Amer Chem Soc*, **53**, 1536 (1931), W E Bachmann and C H Boatner, *J Amer Chem Soc*, **58**, 2097 (1936), W E Bachmann and M X Barton, *J Org Chem*, **3**, 300 (1938)
For a modification of the above method in aqueous alcohol
See W M D Bryant and D M Smith, *J Amer Chem Soc*, **57**, 57 (1935)
From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

See: Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

See: Shriner, p. 255.

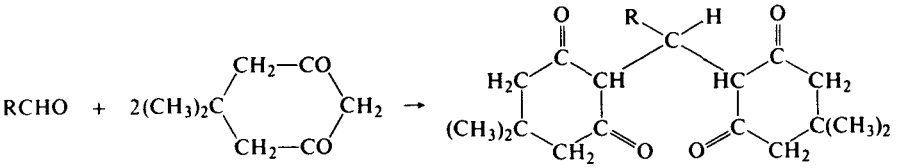
From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

See: Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, *J. Amer. Chem. Soc.*, **53**, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

See: Wild, p. 120.

*Dimethone derivative (Methone derivative).**



This derivative is specific for aldehydes only.

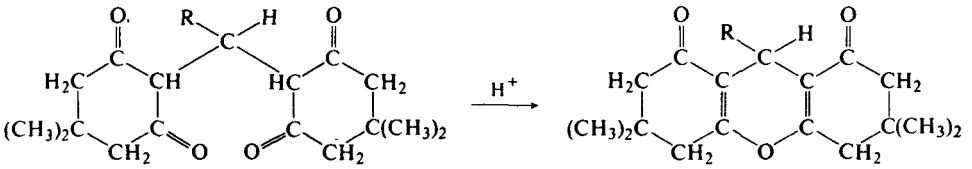
From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

For directions and examples see: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136–7; D. Vorlander, *Z. Anal. Chem.*, **77**, 241 (1929); *Z. Angew. Chem.*, **42**, 46 (1929); W. Weinberger, *Ind. Eng. Chem., Anal. Ed.*, **3**, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

See: E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*Anhydride of dimethone derivative (substituted octahydroxanthene).**



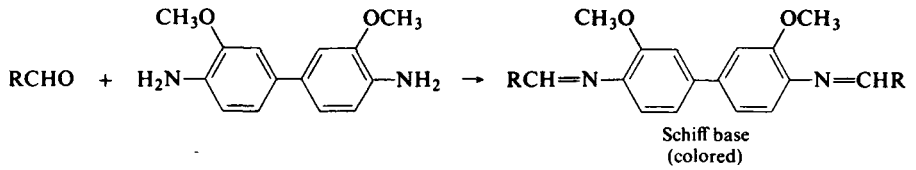
From the dimethone derivative with acetic anhydride.

For directions and examples see: Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

See: Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

o-Dianisidine spot test.



This test is usually applicable to aldehydes only.

From the aldehyde and a saturated solution of *o*-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

For directions and examples see: F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, *Mikrochim. Acta*, **1**, 55 (1927).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

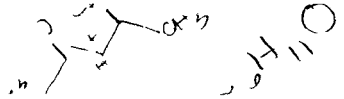


TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	Melting point °C	n_D^t	D_4^t	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
1	**Acetone** (2-Propanone)	56	−95	1.3592		190 w	126-128 yel al	148-9 yel al	42	59	Thiosemicarbazone 179
2	**3-Buten-2-one** (Methyl vinyl ketone)	81		1.4095[2]		141-140					
3	**2-Butanone** (Ethyl methyl ketone)	80-82	86.4	1.3791	0.804	146	116-7 115 yel al	128-9 yel w al	oil	b.p. 152	Phenylsemicarbazone 168
4	**3-Butyn-2-one** (Ethynyl methyl ketone)	86					181	143			
5	**2,3-Butanedione** (Biacetyl)	88 gr yel	f.p. 2.4	1.3927		*mono* 235 (cor.) w *di* 278-9 c.a.	*di* 314-5 (cor.) red or PhNO	*mono* 230 or yel	*mono* 134 yel dil al *di* 243d yel bz	*mono* 76 *di* 245-6 (cor.) 234-5 subl dil al	
6	**2-Methyl-3-butanone** (Isopropyl methyl ketone)	94.3		1.3879	0.8046	113.4-112.3 al	120-117 or yel al chl	108-9 or yel al	oil	oil	
7	**2-Methyl-1-buten-3-one** (Isopropenyl methyl ketone)	97[1]		1.4232-1.4235		173	181				
8	**Cyclobutanone**	100		1.4189			146				
9	**3-Pentanone** (Diethyl ketone)	102	39.8	1.3922		138-9	156 pr or al	144 or yel 50 al	oil	b.p. 165	
10	**2-Pentanone** (Methyl *n*-propyl ketone)	102.3		1.3902-1.39012	0.80639	112-106	143-4 yel or al	117	oil	b.p. 167	
11	**1-Penten-3-one** (Ethyl vinyl ketone)	102[1]		1.4192			129				
12	**3,3-Dimethyl-2-butanone** (*tert*-Butyl methyl ketone, Pinacolone)	106	49.8	1.3960-1.3956	0.8114	157.8	125 or yel al fusion[2] 131		oil	75-79	
13	**1-Methoxy-2-propanone** (Methoxymethyl methyl ketone)	115		1.3981			163-159	111-109			
14	**1-Methoxy-3-butanone** (1-Methoxyethyl methyl ketone)	116		1.3936		141					
15	**4-Methyl-2-pentanone** (Isobutyl methyl ketone)	116.8		1.3956	0.8008	132-130	95 or red al			b.p. 176	
16	**3-Methyl-2-pentanone** (*sec*-Butyl methyl ketone)	118		1.3990		94-5 pet eth	71.2			oil b.p. 89[20]	
17	**1-Chloro-2-propanone** (Chloroacetone)	119				150-164d	125			b.p. 171[73]	
18	**2-Methyl-1-penten-3-one** (Ethyl isopropenyl ketone)	119		1.4270[1]		161					
19	**1,1-Dichloro-2-propanone** (1,1-Dichloroacetone)	120			1.305[5]	163					
20	**2,4-Dimethyl-3-pentanone** (Di-isopropyl ketone)	124		1.4001	0.8108	160 (cor.) 149	88-85-6 or 94-8				
21	**Methyl neopentyl ketone**	125-122		1.4018[25]			100				
22	**3-Hexanone** (Ethyl *n*-propyl ketone)	125		1.4007	0.81491[4]	113	130			b.p. 86[17]	
23	**2,2-Dimethyl-3-pentanone** (*tert*-Butyl ethyl ketone)	125[23]		1.4052			144				
24	**2-Hexanone** (*n*-Butyl methyl ketone)	128		1.40069	0.81127	125 (cor.) 121 rapid htng	106 red or al 110	88	oil	49	Thiosemicarbazone 110

* Derivative data given in order: m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Semi carbazone	2 4-Di-nitrophenyl hydrazone	*p*-Nitro-phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
25	**4-Methyl-3-penten-2-one** (Iso-propylideneacetone Mesityl oxide)	130		1 44397	0 86532	α 164 β 133 4, bz	200, red, al , 203, red, ac a	132 4, or -yel , al	142	β 48–9, me al	
26	**3,3-Dimethyl-2-pentanone** (*tert*-Amyl methyl ketone)	130[733]		1 4100			112				
27	**Cyclopentanone**	130 7	−51 3	1 4366 1 4370	0 94869	210 203, 216–7, rapid htng	146, or ac a , 142, or - yel , al	154	55, lt pet	56 5, pet eth	
28	**5-Hexen-2-one** (Allylacetone)	132		1 4174[25]		102	108				
29	**1-Methoxy-2-butanone** (Ethyl methoxymethyl ketone)	133[757]		1 4063			198				
30	**2,2,4-Trimethyl-3-pentanone** (*tert*-Butyl isopropyl ketone)	135		1 4065		132				144	
31	**5-Methyl-3-hexanone** (Ethyl isobutyl ketone)	135[735]		1 407		152					
32	**2-Methyl-1-penten-4-one**	135 45d				192					
33	**1-Bromo-2-propanone** (Bromo-acetone)	136				135d				36	
34	**2-Methyl-3-hexanone** (Isopropyl *n*-propyl ketone)	136		1 4075		119					
35	**4-Methyl-3-hexanone** (*sec*-Butyl ethyl ketone)	136		1 402		137	78				
36	**2-Methoxy-3-pentanone** (Ethyl 1-methoxyethyl ketone)	136[750]		1 4019		120					
37	**Cyclobutyl methyl ketone**	136		1 4283[28]		149					
38	**3-Methyl-2-hexanone**	137				70					
39	**3-Methyl-1-hexen-5-one**	138		1 4197[25]		112					
40	**1-Chloro-2-butanone** (Chloro-methyl ethyl ketone)	138		1 4372							
41	**3-Methyl-1-penten-4-one**	138				201				75 6	
42	**3,4-Dimethyl-2-pentanone**	138		1 4094		113					
43	**4-Hexen-3-one**	139		1 4388		157					
44	**2,4-Pentanedione** (Acetylacetone)	139	−30	1 4465[25 6]	0 976	*mono* 122, *di* 209	209, yel , al			*di* 149, al	
45	**2-Methylcyclopentanone**	139		1 4364		184, 182				b p 103[22]	
46	**3-Ethyl-2-pentanone**	139[746]		1 4073		99					
47	**3-Hydroxy-3-methyl-2-butanone** (Acetyl diethyl carbinol)	140				165				87	
48	**4-Methyl-2-hexanone**	142, 139		1 4057[25]		120, 128					
49	**1-Propoxy-2-propanone** (Iso-propoxymethyl methyl ketone)	142		1 4004			142 144				
50	***d*-3-Methylcyclopentanone**	143		1 4340[19]		184 5				α 91–2, β 67–9	$[\alpha]_D^{12}$ + 132 9
51	**3,4-Dimethyl-4-penten-2-one**	144				114					
52	**4-Heptanone** (Di-*n*-propyl ketone)	144	−34 0	1 4069	0 8175	132, pet eth	75, yel - or , al			b p 193	
53	**2,4-Dimethyl-3-hexanone** (*sec*-Butyl isopropyl ketone)	145		1 4059, 1 4080		71					
54	**3-Hydroxy-2-butanone** (*d l*-Acetoin)	145, 148	−72, 15	1 4178	0 9861[30]	185, al , 202	*di* 318, or , $PhNO_2$ tol				Phenylosazone, 243d , yel , bz
55	*d l*-3-Methylcyclopentanone	145[755]		1 4329		185					
56	**1-Methoxy-3-methyl-2-butanone** (Isopropyl methoxymethyl ketone)	145[748]		1 4078			163				

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Semi-carbazone	2 4-Di nitrophenyl hydrazone	*p*-Nitro phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
57	**2,2-Dimethyl-3-hexanone** (*tert*-Butyl *n*-propyl ketone)	145[738]		1 4107			124 116				
58	**1-Hydroxy-2-propanone** (Acetol)	146	−17	1 4295		196, al	128 5 (cor), or , al	173			
59	**4-Chloro-3-methyl-2-butanone** (α-Chloroisopropyl methyl ketone)	146		1 4390			116				
60	**1-Hepten-4-one**	146 7				110, w -al				b p 92 3[13]	
61	**3,4-Dimethyl-3-penten-2-one**	147		1 4506[14]		200					
62	**1-Ethoxy-2-butanone** (Ethoxy-methyl ethyl ketone)	147[752]		1 4068							
63	**2,5-Dimethyl-3,4-hexanedione** (Di-isobutyryl)	148		1 42057						*mono* 125, *di* 172	
64	**3-Heptanone** (*n*-Butyl ethyl ketone)	148		1 4092		101, 103, 152					
65	**5-Methyl-4-hexen-3-one**	148		1 4496[15]		163					
66	**5-Methyl-5-hexen-2-one** (Meth-allylacetone)	149		1 4285[25]		137					
67	**2-Methyl-4-heptanone** (Isobutyl *n* propyl ketone)	150[750]				124					
68	**4,4-Dimethyl-3-hexanone** (*tert* Amyl ethyl ketone)	150 2				98					
69	**2-Heptanone** (*n*-Amyl methyl ketone)	151 2	−35 5	1 40069		123, al , 127	89, yel or , al 74		207		
70	**3-Ethyl-5-hexen-2-one**	152		1 4260[25]			53				
71	**5-Hepten-2-one** (Crotylacetone)	153		1 4280[25]	0 8446	105 97					
72	**1-Methoxy-2-pentanone** (Meth oxymethyl *n*-propyl ketone)	153[745]		1 4119							
73	**3,3-Dimethylcyclopentanone**	153[748]				178					
74	**2,2,4,4-Tetramethyl-3-pentanone** (Di-*tert*-butyl ketone)	154		1 4392, 1 4194							
75	**1-Bromo-2-butanone** (Bromo-methyl ethyl ketone)	155, 50[12]		1 4670							
76	**Cyclopentyl methyl ketone**	155				143					
77	**2,2,5,5-Tetramethylcyclo-pentanone**	155		1 4280							
78	**1-Methoxy-3-hexanone** (1-Meth-oxyethyl *n*-propyl ketone)	155[746]		1 4091		169, 170					
79	**Cyclohexanone**	156	−16 4	1 4507		166–7	160, 162, yel al	146 7, 90% al	81 2, 50% al	91, lgr	
80	**4-Methyl-6-hepten-3-one**	156					80				
81	**2-Hepten-4-one**	156 7				147, w - me al					
82	**2,3-Hexanedione**	158								*di* 175	
83	**3,4-Dimethyl-2-hexanone**	158, 155				120, 118, 126					
84	**3,4-Dimethyl-3-hexen-2-one**	158		1 4476[15]		142					
85	**2,2,4-Trimethyl-3-hexanone** (*tert*-Butyl isobutyl ketone)	158				145					
86	**2-Ethyl-1-hexen-3-one**	158[742]		1 4408[18]		119					
87	**3,3-Dimethyl-1-methoxy-2-butanone** (*tert* Butyl methoxy-methyl ketone)	159[743]		1 4193							
88	**1-Isopropoxy-3-methyl-2-butanone**	160					88				
89	**2-Methyl-3-cyclopentenone**	161		1 4771		220				127	

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Semi carbazone	2 4-Di-nitrophenyl-hydrazone	*p*-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
90	**1-Ethylcyclopentanone**	161[755]				189					
91	**3-Methyl-2-heptanone**	162		1 415		82					
92	**4,5-Dimethyl-5-hexen-3-one**	162[750]				110					
93	**3,5-Dimethyl-4-heptanone** (Di-*sec*-butyl ketone)	162, 170-3				83-4					
94	**6-Methyl-3-heptanone** (Ethyl isoamyl ketone)	163, 160				132					
95	**2-Methoxy-3-methyl-2-pentanone** (*sec*-Butyl methoxymethyl ketone)	164[757]		1 4162							
96	**1-Methoxy-4-methyl-2-pentanone** (Isobutyl methoxymethyl ketone)	164[751]		1 4140							
97	**2-Methylcyclohexanone**	165 1, 166	−14 0	1 4885	0 92500	191 197d, al, rapid htng	135 5 7 0, al 137 (cor)	132	b p 220[35-41]	43, eth	
98	**4-Hydroxy-4-methyl-2-pentanone** (Diacetone alcohol)	166, 164					202 3			58	3,5-Dinitro-benzoate, 55
99	**4,5-Dimethyl-4-hexen-3-one**	166[750]				209					
100	**2,2-Dimethyl-3-heptanone** (*n*-Butyl *tert*-butyl ketone)	166[745]		1 4167		145					
101	**2,6-Dimethyl-4-heptanone** (Di-isobutyl ketone, Isovalerone)	168 0		1 4173[25]		122, 126	66, or-red 92				
102	**2-Methyl-4-octanone** (*n*-Butyl isobutyl ketone)	168				132					
103	**2,5-Dimethyl-4-heptanone** (*sec*-Butyl isobutyl ketone)	169, 167				133					
104	***d*-3-Methylcyclohexanone**	169		1 4456[21]		180, me al				43	$[\alpha]_D^{25}$ +13 38
105	***d l*-3-Methylcyclohexanone**	168, 169 6	−73 5	1 4430 1 4463	0 91535	179, me al 191 4d, rapid htng	155 yel	119	94, w -al		
106	**1-Methoxy-2-hexanone** (*n*-Butyl methoxymethyl ketone)	169[744]		1 4173							
107	**4-Octanone** (*n*-Butyl *n*-propyl ketone)	170				96					
108	**Methyl acetoacetate**	170	−40 6	1 41964	1 0765	152					
109	**2,2-Dimethylcyclohexanone**	170 171		1 4482		201 193	140-2				
110	**6-Methyl-2-heptanone** (Isohexyl methyl ketone)	171		1 4146		154	77				
111	***trans*-2,4-Dimethylcyclohexanone**	171		1 4429[16]		136					
112	**4-Methylcyclohexanone**	171 25	−40 6	1 4445	0 91562	199, me al, 203 5d, rapid htng		128 5, yel, al	109 10, al	37 9	
113	***d,l*-2,5-Dimethylcyclohexanone**	171-3		1 4446		α 122, β 173				111, al	
114	**2-Octanone** (Hexyl methyl ketone)	173	−21 5	1 41518, 1 4154	0 81853	122 3 (cor), pet eth -al	58, or, al	92 3, yel, al			
115	**5-Ethyl-3-heptanone**	173				134					
116	***d*-2,5-Dimethylcyclohexanone**	173-4				176 7				97 8	$[\alpha]_D^{20}$ +11 6
117	**3-Ethyl-2-methylcyclopentanone**	174				170, al					

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) *Liquids* 1) (*Listed in order of increasing atmospheric b.p.*)* (*Continued*)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
118	**2,6-Dimethylcyclohexanone**	174		1 4500, 1 4470							
119	**2-Isopropylcyclopentanone**	174		1 4395[29]		202					
120	**Acetoxyacetone**	174–5, 74[18]		1 4150	1 0749	145 me al		144, yel , bz	60d , eth	b p 144[20]	
121	**2,4-Heptanedione** (*n*-Butyrylacetone)	174 5									Cu salt, 165 161, pa bl
122	**3-Methyl-3-hepten-2-one**	175				164					
123	*cis*-**2,4-Dimethylcyclohexanone**	176		1 4430[25]		200, 190				98 9	
124	**4-Ethyl-4-hydroxy-3-hexanone**	178[742]				177					
125	**2,3-Dimethylcyclohexanone**	178–9		1 4505		203–4					
126	**2,2,6-Trimethylcyclohexanone**	179[767]		1 4480		209	141				
127	**3,3-Dimethylcyclohexanone**	179[748]		1 4482[17]		219					
128	**5-Ethyl-4-hepten-3-one**	179[740]				105					
129	**3-Ethyl-4-methylcyclopentanone**	180				208–9 w -al				oil, b p 117[11]	
130	**Cyclohexyl methyl ketone**	180		1 4514		177		154		60	
131	*trans*-**3,5-Dimethylcyclohexanone**	*d l* 180 1		1 4475[21]	*d l* 0 897 *d* 0 9083 *l* 0 9074	*d l* 193–4, *d* 193–4, *l* 189				*d l* oil, b p 116–8[14]	*d* $[\alpha]_D^{20}$ +4 65 *l* $[\alpha]_D^{20}$ −7 91
132	**5-Hydroxy-4-octanone** (Butyroin)	180–90					99				
133	**Ethyl acetoacetate**	181				133, 129d	93				
134	**Cycloheptanone**	181, 182				163	148	137		23	
136	*cis*-**3,5-Dimethylcyclohexanone**	182–3		1 4407	0 890	202 3				74	
137	**2-Propylcyclopentanone**	183		1 4429		214d , al				oil, b p 109–11[9]	
138	**2,2,6,6-Tetramethylcyclohexanone**	184[772]	15	1 4473							
139	**3-Methyl-2,4-hexanedione**	184 183									Cu salt, 177
140	**5-Nonanone** (Di-*n*-butyl ketone)	186–7	f p -5 9	1 421[15]	0 8222	90, al					
141	**3,4-Dimethylcyclohexanone**	187		1 4520 1 4507	0 906	189					
142	**3-Nonanone** (Ethyl *n*-hexyl ketone)	187[751]				112					
143	**2,5-Dimethylcyclohexen-3-one**	189 90		1 4753[22]		165, me al				92 3, me al 169, al	
144	**Methyl 2-pyridyl ketone** (2-Acetylpyridine)	190								121	
145	**3-Propylcyclopentanone**	190–1		1 4456[12]		178 9, me al				oil, b p 121 2[12]	
146	**3-Ethylcyclohexanone**	192		1 4537, 1 4511		182, 175					
147	**1,5-Dimethylcyclohexen-4-one**	192–3, 194								102	
148	**2,5-Hexanedione** (Acetonylacetone)	194	−9	1 428, 1 449	0 97370	*mono* 185d , *di* 224	*di* 257 pyr	*di* 210 2 red al	*di* 120, dil al	*mono* b p 130[11], *di* 137	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
149	***d*-Fenchone**	195–6		1 46355[18]	0 947[19]	184, 172	140		b p 202–3[18]	*d* or *l* α+ 165 β+ 123, *d l* α+ 159 β+ 129	Hydrazone 56 7
150	**2-Nonanone** (*n*-Heptyl methyl ketone)	195 3	−8	1 42072	0 82133 0 82217	118 9 al					
151	**1-Acetyl-4-methylcyclohexanone**	195–7		1 4509[18]		α 159, me al β 175				57 9	
152	**Methyl levulinate**	196 0		1 42333	1 04945	143	142, al		96 105, al		
153	**4-Fluoroacetophenone**	196		1 5081[25]		219					
154	***d l*-2-Ethyl-5-methylcyclohexanone**	197		1 4485		178–81				80, w -al	
155	**1-Acetyl-2-methylcyclohexanone**	197 200				172 3					
156	**2-*n*-Propylcyclohexanone**	198–9[748]		1 4558[13]		133d , w -al				67 8	
157	**1-Acetylcyclohexene**	200		1 4892		220				59	
158	**3-(Trifluoromethyl)acetophenone**	202									
159	**β-Thujone**	202, 76[10]				174	114				
160	**Acetophenone** (Methyl phenyl ketone)	205, 202	20	1 541 1 5339	1 02810	198–9 (cor), 50% al , 203	238–40, al , 249–50, or -red , ac a	184–5, or -red	105, wh , al , → dk	60	
161	**2-Ethyl-4-methylcyclohexanone**	205[747]		1 4452							
162	**Ethyl levulinate**	206		1 42288	1 01114	148 51 2	102		104		
163	**4-Decanone**	206 7									
164	**1,5-Dimethylcyclohexen-3-one**	208–9		1 4819[22]		179–80, yel , al , 168 71			76 8		Thiosemicarbazone, 195d
165	***l*-Menthone**	209, 207	−6 6	1 4505		189, 187, 184	146, or , al		53	59, eth	
166	**2-Decanone** (Methyl *n*-octyl ketone)	211, 215 5	14, f p 3 1	1 42523	0 82370	124, 126, pet eth					
167	**Methyl 4-pyridyl ketone**	212								142	
168	**4-*n*-Propylcyclohexanone**	212[740]		1 4514[25]		180					
169	**2-Acetylthiophene** (Methyl 2-thienyl ketone)	213	10 5	1 5666		190, bz		181	96	81	
170	**2-Methylacetophenone** (Methyl 2-tolyl ketone)	214, 216		1 5320		205, al , 210	159, yel , al 161			61	
171	**6-Bromo-2-hexanone**	214[720]		1 4713			81				
172	**1,5,5-Trimethylcyclohexen-3-one** (Isophorone)	215		1 4789[21 5]	0 9255[20 5]	199 5d , al , 191			68, dil al	79 5, pet eth , 76	
173	***n*-Propyl 2-pyridyl ketone**	217–8							82	48	Picrate, 75
174	**Propiophenone** (Ethyl phenyl ketone)	218, 220	20, 18 6	1 5270	1 0105	173 4 (cor), al , 182, rapid htng	190 1, red, bz , 189			54, 53, pet eth	
175	**Methyl 3-pyridyl ketone**	220, 218							137	113	
176	**3-Methylacetophenone** (Methyl 3-tolyl ketone)	220		1 5306	1 007	198, 203	207			55, 57, al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Semicarbazone	2,4 Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
177	**Isobutyrophenone** (Isopropyl phenyl ketone)	222 217		1 5190	$0\ 9863_4^{16.9}$	181, al	163, or-red, dil ac a		73	94, lt pet	
178	**Acetyl benzoyl ketone**	222, yel		$1\ 537^{19}$		*di* 229 32		*di* 256	*α* 143	*α*, *mono* 166, *β*, *mono* 114 *di* 240	
179	**5-Ethyl-1-methylcyclohexene-3-one**	223 7				162 8d, al					Thiosemicarbazone, 150 1
180	**4[8]-*p*-Menthen-3-one** (Pulegone)	224, 221 2		$1\ 48705^{18}$		174 175 6	142			119	
181	**Pivalophenone** (*tert* Butyl phenyl ketone)	224^{754}		1 5082 1 5102		150	194 5			167	
182	**1-Phenyl-2-butanone** (Benzyl ethyl ketone)	226				135 146					
183	**6-Undecanone** (6-Hendecanone Di-*n*-amyl ketone)	228 (cor)	15	1 42875	0 82471	oil				oil	
184	**3-Chloroacetophenone**	228				232		176		88	
185	**Ethyl 1-thienyl ketone**	228				167				55-6	
186	**2-Undecanone** (2-Hendecanone Methyl *n*-nonyl ketone)	228	12 1 12 7	1 42899	0 82564	122 0 5	63, al	90 1, yel, al		44 5	
187	**2,4-Dimethylacetophenone**	228 234 5		1 5381 1 5340		185 7				63 4, pet eth	
188	**2-Chloroacetophenone**	229		$1\ 685^{25}$		160				113	
189	**1-Phenoxy-2-propanone** (Phenoxyacetone)	229 30 120^{19}		1 5228	1 0903	173, 176 (cor), 50% al					
190	***n*-Propyl 4-pyridyl ketone**	229 31									Picrate, 96
191	***n*-Butyrophenone** (Phenyl *n*-propyl ketone)	230, 218 21	11 5 13 0	1 5196 1 5203		187 8, al, 191	190, or-red, dil ac a			50, abs eth	
192	***d*-Carvone**	230		1 49952	0 9608	162-3, 142 3, *d l* 154 6	191, red, ac a	174 5, red-br		*d α* 72-3, al *d*, *β* 56-7, *l*, *α*, (−) 72, *l*, *β*, (+) 57-8, *d*, *l* 93-4	$[\alpha]_D^{20}$ +62 9
193	**2,5-Dimethylacetophenone**	230		1 5291 1 5306		168 9					
194	**4-Chloroacetophenone**	232 236	12			204 160, 146	231	239	114	95	
196	**4-Phenyl-2-butanone** (Methyl-*β*-phenylethyl ketone)	235				142				87	
197	**Isovalerophenone** (Isobutyl phenyl ketone)	236				210				76, 64 5	
198	**3,5-Dimethylacetophenone**	236 7		$1\ 5276^{25}$				179 80, yel, ac a		114, me al	
199	**2-Methoxyacetophenone** (2-Acetylanisole)	239, 245		1 5395	1 089	183			114, al	83, 96 0 5, pet	
200	**3-Methoxyacetophenone** (3-Acetylanisole)	240, 252		$1\ 5583^{15.4}$	$1\ 0993_4^{15.4}$	196					
201	**5-Phenyl-3-pentanone**	244		1 5125		80					
202	**5-Isopropyl-2-methylacetophenone** (2-Acetyl-*p*-cymene)	245		1 51849	$0\ 9654_{20}^{20}$	147	140 2, clearing at 160			91-2 5	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Semi carbazone	2,4-Di nitrophenyl-hydrazone	*p*-Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
203	**α-Bromopropiophenone**	245 50		1 5686^{25}							
204	**3,4-Dimethylacetophenone**	246 7, 251		1 5400		233 4				85	
205	**2,4,5-Trimethylacetophenone**	246 7				204				85 6	
206	***n*-Propyl 3-pyridyl ketone**	246 52		1 5128		169 70			182		Picrate, 104
207	***n*-Valerophenone** (*n*-Butyl phenyl ketone)	248 5 242		1 5150	0 988$_{20}^{20}$	160, w -al	166, brt red, ac a	161 5 2 5, or - red, al	162	52 0- 5, pet eth	
208	**2-Aminoacetophenone**	250 2d	20			290d , al			108, al	109, subl , w	
209	**2,5-Dichloroacetophenone**	251	14							130	
210	**4-Isopropylacetophenone**	252 4									
211	**1,1,1-Tribromoacetone**	255d									
212	**Ethyl benzoylacetate**	265				125					
213	***n*-Enanthophenone** (*n*-Hexyl phenyl ketone)	283 3	16 4	1 50760$_{He}^{t}$	0 95155	119, dil al		127 8		55	
214	**3-Phenylcyclohexanone**	287 8^{736}				167, al				128 9, al	
215	**1-Acetylnaphthalene** (Methyl 1-naphthyl ketone)	302		1 629		288 5-9 5, 232-3			146	140, 137 5	
216	**Ethyl 1-naphthyl ketone**	305 7		1 6109						58	Picrate, 77-8, al , 79
217	**2-Benzoylpyridine** (Phenyl 2-pyridyl ketone)	317		1 6056			199		136, yel , al	150 165	Picrate, 130, al
218	**2,4,5-Trimethylbenzophenone**	328			1 0332$_{4}^{18}$						
219	**2,4,4'-Trimethylbenzophenone**	340								132, al	
220	**α-Methylstyryl phenyl ketone** (Dypnone)	340 5 sl d			1 108$_{0}^{20}$	151, bz				*syn* 134, al , *anti* 78	
221	**1,5-Diphenyl-3-pentanone** (Dibenzylacetone)	352, 348	13 4							95 6	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)*

No	Name	Semi-carbazone	Boiling point, °C	n_D^{20}	D_4^{20}	Miscellaneous
1	**1-Chloro-2-methyl-3-pentanone**	70	64[9]			
2	**4-Methyl-2-octanone**	70	94[40]			
3	**1-*Hepten*-5-*one***	82 3, w al	46 7[12]	1 4254[18 3]	0 8487[18 3]	
4	**3-Dodecanone**	89 w -al	134[18]			m p 19
5	**1,3-Diethoxy-2-propanone** (*sym*-Diethoxyacetone)	91	105[35]	1 4202		
6	**1-Ethoxy-2-propanone** (Ethoxyacetone)	96	36[28]	1 4000		
7	**3-Cyclopentyl-2-butanone** (α-Cyclopentyl-α-methylacetone)	98	79[17]	1 4470		
8	**7-Methyl-1-octen-5-one**	101 2	62 3[14]	1 4288[12 5]		
9	**Cyclohexyl methoxymethyl ketone**	102	111[21]	1 4552[25]		
10	**1-Phenoxy-2-butanone** (Ethyl phenoxymethyl ketone)	102	100[5]	1 5201		
11	**1-Naphthoxyacetone**	103	205 8[14]			
12	**1-Hepten-6-one**	108 w -al	41 3[10]	1 4350[18]	0 8673[18]	
13	**1-Phenoxy-2-pentanone** (Phenoxymethyl *n*-propyl ketone)	108	112[4]	1 5148		
14	**3-Octyn-2-one**	109	76[15]	1 4446[25]		2 4 Dinitrophenylhydrazone 88
15	**3-Hepten-6-one**	109 10 wh	61 2[20]	1 4290[21]	0 8618[21]	
16	**3-Methyl-4-phenyl-2-butanone**	112 114	130[17]	1 5090[19]		
17	**3-Methyl-3-hepten-5-one**	114	82 6[42]	1 4488[25]		
18	**1-Chloro-2-ethyl-3-hexanone**	115	92[12]			
19	**1,3-Dimethoxy-2-propanone** (*sym*-Dimethoxyacetone)	120	78[18]	1 4174		
21	***trans*-3-Hepten-2-one**	125 128	60[16]	1 4421 1 4430	0 8445	
22	**5-Hydroxy-5-methyl-3-heptanone**	125	86[14]	1 4386[14]		
23	**α-Ethoxyacetophenone**	128	122[15]	1 5250		
24	**3-Propylpropiophenone** (Ethyl 3-propylphenyl ketone)	128	145[20]			
25	**α-Methoxyacetophenone**	129	126[19]			
26	**1-Phenyl-4-hexen-1-one**	130	97[1]	1 5270[25]		
27	**5-Phenyl-2-*pentanone***	130	122[6]			
28	**2-Methyl-3-octen-6-one**	131 2	73 7[11]	1 44533		
29	**1-Phenyl-1-hexen-5-one**	132 et ac	153 5[10]	1 5458[25]		
30	**3-Phenyl-1-hexen-5-one**	132	153 5[10]	1 5193[25]		2 4 Dinitrophenylhydrazone, 103
31	**4-Phenyl-2-pentanone**	137	115[13]	1 5124		
32	**3-Propyl-3-hexen-2-one**	142	72[9]			
33	**3-Acetylfuran**	150	84[21]			
34	**3-Hydroxy-3-methyl-2-pentanone**	150	73[50]	1 4200		
35	**1-Cyclopentyl-2-propanone** (1-Cyclopentylacetone)	150	67[12]			
37	***cis*-3-Hepten-2-one**	152	70[15]	1 4505[22]	0 8555[22]	
38	**3-Hydroxy-3-methyl-2-heptanone**	152	84[19]			
39	***d*-2-Ethyl-5-methylcyclohexanone**	152 4	83 4[18]		0 9016$_4^{15}$	$[\alpha]_D$ +8 5
40	**5-Hydroxy-2-pentanone**	155	86[10]	1 4350[25]		
41	**3-Phenyl-2-butanone**	158	107[22]	1 5092		
42	**3-Phenyl-3-hexen-5-one**	158	138[14]			
43	**Dicyclopentyl ketone**	162	112[12]			
44	**2-Ethylcyclohexanone**	162 163	76[20]	1 4522		2,4-Dinitrophenylhydrazone 162
45	**2,3-Dimethyl-2-hepten-6-one**	163	76[13]			
46	**3-*n*-Propylcyclohexanone**	169	42[0 7]	1 4530		
48	**2-Cyclohexenone**	172, 168	68[22]	1 4879		2,4-Dinitrophenylhydrazone, 163 117
49	**2-Chloropropiophenone** (2-Chlorophenyl ethyl ketone)	173	106[12]			
50	***d,l*-1-Acetyl-3-methylcyclohexanone**	174-5	99 100[38]			
51	**3-*n*-Propyl-2-cyclohexenone**	175	60[0 4]	1 4876[25]		2,4-Dinitrophenylhydrazone, 156
52	**2-Bromoacetophenone**	177	112[10]			2,4-Dinitrophenylhydrazone, 189

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)* (Continued)

No	Name	Semi-carbazone	Boiling point °C	n_D^{20}	D_4^{20}	Miscellaneous
53	**2-Methyl-3-butenyl phenyl ketone**	177	100[2 1]	1 5223[25]		
54	**4-Methoxycyclohexanone**	178	85[14]	1 4560		2,4-Dinitrophenylhydrazone, 150
55	**5,5-Dimethyl-3-hexen-2-one**	178	79[40]	1 4430		
56	**Ethyl 2-methylstyryl ketone**	178	152[14]			
57	**2-*Bromopropiophenone*** (2-Bromophenyl ethyl ketone)	179	118[11]			
58	**3-Isopropyl-2-cyclohexenone**	179	60[0 3]	1 4842		2,4 Dinitrophenylhydrazone, 155
59	**2-Ethylacetophenone**	180	118[29]	1 5249		
60	**3-Pyridylacetone**	185	123[1]			
61	**/-6-Isopropyl-3-cyclohexenone**	185	98 100[10]	1 484		$[\alpha]_D^{18}$ −64 5 2,4-Dinitrophenyl-hydrazone, 137-8 *p*-Nitro-phenylhydrazone, 168-9
62	**4-*n*-Butylacetophenone**	185	141[14]			
63	**3-Phenyl-2-hexen-5-one**	185	138[14]			
64	**3-Ethyl-2-cyclohexenone**	186	57[0 9]	1 4913		
65	**3-Methyl-3-phenyl-2-butanone**	186	77[15]	1 5083		
66	**2-Methyl-3-octen-5-one**	187-8	68 78[24]	1 4748		
67	**4-Isopropylcyclohexanone**	188, 188-9	91[13]	1 4560		*p*-Nitrophenylhydrazone, 123-4
68	**4,4,6-Trimethyl-2-cyclohexen-1-one**	188, 185-7	73-5[13]			
69	**2-Acetyl-5-methylfuran**	191	73[8]			
71	**3-Phenyl-2-pentanone**		110[18]	1 5051		
72	**4-Phenylhexahydroacetophenone** (Methyl 4-phenylcyclohexyl ketone)	191	121[1 2]			
73	**2,6,6-Trimethylcycloheptanone**	191-2	85 5[12]	1 4568[18]	0 9095[18]	
74	**Acetyl phenyl carbinol**	194	137			2,4-Dinitrophenylhydrazone, 170 126 Oxime 113
75	**2-Tetralone**	194	131[11]	1 5555[25]		m p 18, Oxime, 88
76	**3-Isopropylcyclohexanone**	195	51[1]	1 4540		
77	**1-Propionylcyclohexene**	195, 189	102[14]			Oxime, 78
78	**α-Thienylacetone** (1-(α-Thienyl)-2-propanone)	195	106[12]	1 5366[14]		
79	**5,5-Dimethyl cyclohexen-3-one**	195	88 5[32]			H_2SO_4 → red → vlt → col
80	**2-Acetylbiphenyl**	197	105[1]			
81	**3-Methyl-2-cyclohexen-1-one**	199, 201	78[14]	1 4945		2,4-Dinitrophenylhydrazone, 176 178
82	**1-Acetyl-2,2-dimethylcyclohexene**	201	118[49]	1 4810[25]		
83	**1,1-Dimethyl-2-tetralone**	204	96[0 5]	1 538		
84	**2-Methyl-1-tetralone**	205, 195	138[16]	1 5447		
85	**6-Propionyltetralin**	209	163[11]	1 5508[29]		
86	**3-Methyl-2-*n*-propylcyclopentanone**	210	58[2]	1 4778		
87	**4-Methyl-1-tetralone**	211	111[1]			
88	**1-Acetylcyclopentene**	211	74[12]			
89	**2-Acetyl-5-methylthiophene**	217	83[2]	1 5622		
90	**1-Tetralone**	217, yel , al	170[49]			Oxime, 102, prisms, 88 9, needles, me al
91	**Neopentyl phenyl ketone**	218	116[11]	1 5078		Oxime, 114
92	**3-Methyl-2,5-hexanedione**	220	71[10]	1 4260		
93	***cis*-1-Decalone**	220d	116[18]	1 4939		
94	**3-Acetylbiphenyl**	223	138[1]	1 6140[25]		
95	**1,2-Dimethyl cyclohexen-3-one**	225d	118-9[12]			
96	**3-*Chloroacetophenone***	232	113[11]	1 5494		
97	**3-Bromoacetophenone**	233	132[17]	1 5755		
99	**6-Acetyltetralin**	234	156[10]	1 5591[25]		
100	**2,3-Dimethyl-2-cyclopentenone**	250	92[25]	1 4830		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)* (Continued)

No	Name	Semi carbazone	Boiling point °C	n_D^{20}	D_4^{20}	Miscellaneous
101	**1-Ethyl-2-methyl-3-cyclohexenone**	250	105^{19}			
102	**3-Acetylthianaphthene**	250	137^{3}			
103	**2-Oxopropionaldehyde** (Methylglyoxal, Pyruvic aldehyde)	*di* 254	52^{12}			*bis*-2,4-Dinitrophenylhydrazone 299 300, red, $PhNO_2$, Dioxime 157, al

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point °C	Semi-carbazone	2,4 Di-nitrophenyl-hydrazone	*p*-Nitro-phenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	**2-Aminoacetophenone**	20	250 2d	290d, al			108, al	109, subl, w	
2	**2-Dodecanone** (*n*-Decyl methyl ketone)	20 5	246 7	122 3 dil al					n_D^{30} 1 42855, D_4^{30} 0 81982
3	***n*-Amyl phenyl ketone** (*n*-Pentyl phenyl ketone)	24 7	265 2	131 5, 50% al 133 (cor)	168 (cor), ac a				n_D^{25} 1 50272
4	**3,5-Dichloroacetophenone**	26	134 6[17]					138	
5	**Benzyl methyl ketone** (Phenyl-acetone)	27	216 5 (cor)	199 9 5, al, 188	156	145	86 7 lgr 83	68 70	n_D^{20} 1 5168
6	**4-Methylacetophenone**	28	226	204 5, al, 197	260 4 (cor), scar, ac a	198	97, al	87-8, pet eth	n_D^{20} 1 5348, D_4^{20} 1 003
7	**2-Hydroxyacetophenone**	28	215	210	210 12 212 3		110	118	
8	**Phorone** (Di-isopropylidene-acetone)	28, yel -gr	198	221, w 186	118			48	Tetrabromide, 88 9, al
9	**2-Tridecanone** (Methyl *n*-undecyl ketone *n*-Hendecyl methyl ketone)	28	263	123, al, 126, 117	69, or -yel	101-2		56 7, al - pet eth	n_D^{30} 1 43175
10	**Furfuralacetophenone**	29, yel - red	317d		169, scar				
11	**Ethyl 2-furyl ketone**	30, 28	183	189					
12	**4-Cyclohexylcyclohexanone**	30 31 29 2	100[0 1]	216	137			101 2, 104 5	
13	**2-(1'-Hydroxycyclopentyl)-cyclo-pentanone**	31	99[3]					78	
14	**7-Tridecanone** (Di-*n*-hexyl ketone)	31 2	255, 264			96			
15	**2-Acetylfuran** (2-Furyl methyl ketone)	32, 33	169-73	150, me al, 148	220	185 6, red, w - al	86, yel, w -al	104, eth - pet eth, 92	n_D^{20} 1 5017, D^{20} 1 098
16	**Levulinic acid** (3-Acetyl propionic acid)	33	245 6		206 (cor), or -yel, ac a	174 5	108, bz	45-6	
17	**2-Tetradecanone** (*n*-Dodecyl methyl ketone)	33-4, dil al		115 6, al					
18	**Methyl 1-naphthyl ketone** (1 Acetylnaphthalene)	34	302	222 5 4			146	136	n_D^{20} 1 6257, Picrate, 116, yel
19	**1,3-Diphenyl-2-propanone** (1 3 Diphenylacetone Dibenzyl ketone)	34, 35, 30	330	145 6, abs al, 125-6, dil al	100		121, al, 128 9	125, 123	
20	**2,2,6,6-Tetramethyl-4-piperidone**	34 9, red, dry eth, 58 (mono-hyd), eth	205-6	219 20, al				153 al	
21	**4-Chloropropiophenone**	36 35	118[2]	177, 175 6				62-3	
22	**2-Phenylcyclopentanone**	37	126-7[10]	218d					
23	**Furfuralacetone**	38, 39	116[10]		241 (cor)		131-2, al		
24	**4-Methoxyacetophenone**	38, 37	258	197 8, dil al	220 (cor), red, 231 8 (cor)	195-5 5, or, al	142, yel, al	86-7, wh, pet eth	
25	**1-Phenyl-1-hepten-3-one** (*n*-Butyl styryl ketone)	38 9, 40	159-67[11]				98, yel		Dimer, 175-6

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semicarbazone	2 4-Di nitrophenylhydrazone	*p* Nitro phenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
26	**4,4-Dimethylcyclohexanone**	38 41	73^{14}	204			106 7		n_D^{24} 1 4537 D_4^{20} 0 932
27	**3,4-Methylenedioxypropiophenone** (Propiopiperone)	39		187 8			97	104	
28	**2-Hydroxybenzophenone**	39, w -al 153	250^{560}				155, al	*syn* 141, bz *anti* 143, bz	
29	**2-Methoxybenzophenone** (2-Anisyl phenyl ketone)	39						145 8, dil al fu sion → 130	
30	**3-Bromopropiophenone**	40		183					
31	**Benzalacetone**	41	212	187	227, 223	166	157	115	Thiosemicarbazone, 148
32	**1-Indanone** (α-Hydrindone)	42, 38	$241\ 2^{739}$	233 239	258	234 5, ac a	130 1 134 5 me al 124 8	146 144 bz pet eth	
33	**2,4-Dichloroacetophenone**	42	235 40	208				152	n_D^{20} 1 5640
34	**3-Aminopropiophenone**	42, yel	$168\ 9^{15}$	196 7				112 112 3	N-*p* Toluenesulfonyl deriv 97 al
35	**2-Bromobenzophenone**	42	345					133	
36	**8-Pentadecanone** (Di-*n*-heptyl ketone)	42	178					120	
37	**4-Phenyl-3-buten-2-one** (Methyl styryl ketone)	42	262	186, al , 198, 142	227, red, ac a 223, or - red, al	165 7, red, al	156 7 yel , al , 159	115 6, 60% al 87	H_2SO_4 → or -red
38	**3-Chlorobenzyl phenyl ketone**	43						102	
39	**8-Acetylguanine**	43 5	116°		253				
40	**2-Benzoylfuran** (2-Furyl phenyl ketone)	44	150^{3}					122	
41	**1,3-Dichloro-2-propanone** (1,3-Dichloroacetone)	45	175, 173						n_D^{16} 1 47144, D_4^{16} 1 3826
42	**2-Acetylquinoline**	46					54		
43	**3-Chloropropiophenone**	46		179-80					
44	**4-Bromopropiophenone**	46	140^{2}	171				90 1	
45	**Phenyl *n*-undecyl ketone** (*n*-Hendecyl phenyl ketone Laurophenone)	47, 44		94 5 95				63 63 5	
46	**2-Aminopropiophenone**	47, pet eth		190d , al				88 9, w	Hydrochloride, 184 5 N-Acetyl 70 1
47	**Benzophenone**	48, 49	306 (cor)	164-5, al , 167	238 9, or - yel , ac a , 229	154 5, yel , al , 144, red, al	137 8, al	142 3, me al , 144 140	D_{50}^{50} 1 0976
48	**2,4,6-Heptanetrione** (Diacetylacetone)	49	121^{10}	*mono* 203			*di* 142	2,6-*di* 68 5	n_D^{20} 1 4930, D_{40}^{40} 1 0681
49	**5-Phenoxy-2-pentanone** (Methyl 3-phenoxypropyl ketone)	50	121^{2}	108 10	110				
50	**9-Heptadecanone** (Di-*n*-octyl ketone)	50-50 5	250-3			54		111 2	
51	**Phenacyl bromide** (ω-Bromoacetophenone)	50, 51		146	212-3, yel , or			89 5, 97	
52	**4-Bromoacetophenone**	51, 50 5	225	208	230, 237 (cor)		126	128, 129	
53	**3-Bromophenacyl bromide**	51, lgr	174^{14}	163-4d , al					
54	**Ethynyl phenyl ketone**	51			214				

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
55	**3,4-Dimethoxyacetophenone** (Acetoveratrone)	51, w -al	286–8	218, w al	206–7	227	131	140, w -al	
56	**Diphenylacetoin**	52		169					4-Nitrobenzoate 84
57	**Methyl 2-naphthyl ketone** (2-Acetylnaphthalene)	53 4, al , 56	301	234 5 237	262d , red, ac a		176–7, 171	149, 145 6	Picrate, 82
58	**Chloromethyl 2-phenylethyl ketone**	54	244 5	156	147, 146			89	
59	**2-Furyl-2-thenoylmethane**	55 5	195[6]						Cu salt, 274
60	**Phenyl 2-thienyl ketone** (2-Benzoylthiophene)	56	300	195–7				93	
61	**2-Nonadecanone** (*n*-Heptadecyl methyl ketone)	56		124–5 125 5 6				77	
62	**4-*n*-Caproylresorcinol** (2 4-Di hydroxy-*n*-caproylbenzene)	56 7	243 5d					190–1d , 50% al	
63	**2,2 -Dichlorobenzoin**	57							
64	**3-Propionylphenanthrene**	57						53 6 4 7	Picrate, 113
65	**9-Propionylphenanthrene**	57							Picrate, 107
66	**Benzalacetophenone** (Phenyl styryl ketone Chalcone)	58, pa yel al 57 8	345	α 168, β 170, yel , γ 179–80d	244d , or -red, ac a , 245 (cor)		120	140 68	Picrate, 93 7, Dimers, 124, 178, 195, 225 6
67	**2-Indanone**	58 58 9		218, 212–15 (dec)		232 (dec)		155	
68	**Phenacyl chloride** (ω-Chloroacetophenone)	59	244	156, 149	213 4d 214 5d			89	
69	**3-Phenyl-2,4-pentanedione**	60	134[20]						Cu salt, 224
70	**Mesitylacetone**	60	130[10]	205, 197					
71	**Ethyl 2-naphthyl ketone**	60	312 4	202				133, w -al	
72	**Difurfuralacetone**	60, yel					121–2		
73	**Desoxybenzoin** (Benzyl phenyl ketone)	60, al	321 (cor)	148, dil al	204 (cor), or	163, red-br , 160	116, yel , al	98, al	
74	**4-Methylbenzophenone** (Phenyl 4-tolyl ketone)	60, 55	326 (cor)	121–2, al	202 4 (cor), 199–200, or		109, wh , ac a	154, less soluble in w -ac a , 115, more soluble in w -ac a	
75	**1-Phenyl-1,3-butanedione** (Benzoylacetone Methyl phenacyl ketone)	61	261–2		151, pa yel , al	100–1, me al	150–3		
76	**1,1-Diphenylacetone**	61, al		170			131, bz	165	
77	**2,4′-Dibromobenzophenone**	62, pet eth	381–4 sl d					141–2	
78	**5-Isopropyl-1,3-cyclohexanedione**	62							
79	***Benzyl 3-chlorophenyl ketone***	62						120	
80	**4-Methoxybenzophenone** (4-Anisyl phenyl ketone)	62 4 al	354		180, dk or	198–9, al	132, 90	α 140 1, 137–8, β 115 6	
81	**2-Phenylcyclohexanone**	63, al , 60	160[15]	190	139			169	
82	**4-Methoxybenzil**	63						124	
83	**1-Acetyl-2-hydroxynaphthalene**	64							Benzoate, 85 6, pyr
84	**11-Henelcosanone** (Di-*n*-decyl ketone)	64, w -al						27 5	
85	**Benzoylformic acid** (Phenylglyoxylic acid)	66	147 51[12]		196 7d (cor), yel			α 127, eth , β 145d , w	Thiosemicarbazone, 188 9 (cor), yel
86	**2,2 -Dimethylbenzophenone** (Di-2-tolyl ketone)	67			190			105	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
87	**1,5-Diphenyl-1,5-pentanedione** (1,3-Dibenzoylpropane)	67 5, 62–3						*di* 165 6d	
88	**3,5-Dibromoacetophenone**	68, al , 65	198[15]	268d , w - ac a			109–10, yel,, al		
89	**Cinnamalacetone**	68, eth		186, yel , al	222 3, vlt -red, ac a , 218–20, br -red, chl -me al		180, yel , al	153, al , 152	
90	**Benzoyl-2-furoylmethane**	68	169[3]						Cu salt, 248
91	**12-Tricosanone** (Di-*n*-undecyl ketone Di *n*-hendecyl ketone, Laurone)	69 5		179				39 40, al	
92	**Diphenyl triketone**	70, 69, yel , lgr							Heating with excess phenylhydrazine → 4 Benzene-azo-1,3,5 triphenylpyrazole, 156 7 yel -red, al
93	**2-Chlorobenzyl phenyl ketone**	71						86	
94	**Dihydroxyacetone**	72			277 8	160		84	Diacetate, 48 Dibenzoate, 120 5, Dimer 78 81
95	**3-Acetylphenanthrene**	72		230				193 4	Picrate, 125 6
96	**4-Methoxybenzalacetone** (Anisalacetone)	73, me al			229 (cor), red, ac a			119 20	
97	**Benzylacetophenone**	73		144				87	
98	**Phenoxymethyl phenyl ketone** (α Phenoxyacetophenone)	74	187[8]	187					
99	**9-Acetylphenanthrene**	74	170[1]	201				154-5	Picrate, 107 8
100	**1-Naphthyl phenyl ketone**	75 5–6 0	225[15]	385	α 246 7, red, β 243 4, or , mixt 220			161	
101	**9-Acetylfluorene**	75 5					139		
102	**2-Benzofuryl methyl ketone**	76, 72	136[11]	207			154		
103	**Benzyl 4-methoxyphenyl ketone**	77						118	
104	**4-Methoxybenzalacetophenone** (Anisalacetophenone 4-Methoxychalcone)	77, yel , al		α 168, al , β 190, al					Picrate, 87, or
105	**2-Naphthoxyacetone**	78, 77		203			154	123	
106	**4-Phenylcyclohexanone**	78		212, 229d , al				110	
107	**Benzoyl-2-thenoylmethane**	78	201[4]						Cu salt, 278
108	**4-Chlorobenzophenone**	78			185		106	β 105–6	
109	**1,4-Cyclohexanedione**	79	132[20]	*mono* 221 2, *di* 231	240			188	
110	**Di-*n*-tridecyl ketone** (Myristone)	79						57	
111	**Phenacyl phenyl ketone** (Dibenzoylmethane, ω-Benzoylacetophenone)	keto 81, enol 78, al		205			*mono* 105	*mono* 165	Dibromo deriv , 94–5, eth
112	**3-Nitroacetophenone**	81		257	228		128, 135	132	
113	**4-Bromobenzophenone**	82		350	230		126	α 116–7, β 110–1	
114	**1-Benzoylpropionic acid**	82–3d					100–4, br , bz		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2,4 Di-nitrophenyl-hydrazone	*p*-Nitro phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
115	**Fluorenone**	83, yel, bz	341 5		283 4	269	151 2, yel, al	195 6 (cor)	
116	**4-Iodoacetophenone**	85, eth	153[18]						
117	**Di-*n*-Heptadecyl ketone**	88 5, lgr, 89						67, 62 3	
118	**4,4'-Dimethylbenzophenone** (Di 4-tolyl ketone)	95, al	335	143 4	218 9		100, yel, al	163, al	Hydrazone, 108 10
119	**Benzil** (Dibenzoyl)	95, yel	347	*mono* 174-5 d, *di* 243 4d, al	*di* 189, yel, al, 185	*mono*· 192 3, dk or, ac a, *di* 290, yel, pyr -eth	*mono* 134, yel, al, *di* 235, chl rapid htng	*α mono* 137 8, 140, bz, *di* 237	
120	**β,β-Diphenylpropiophenone**	96 92						133	
121	**3-Hydroxyacetophenone**	96, 95	296	189 91	261				
122	**4-Chlorophenacyl bromide**	96-8							Acetate, 72
123	**2,3-Dihydroxyacetophenone** (3-Acetylcatechol)	97 8, dk yel, bz -lgr		166 7				96 7	Diacetate 109, bz Di-Me eth, b p 143 4[14] 143 4[14]
124	**2-Naphthylglyoxal**	98, (hyd), w 109	183[20]						Diacetate, 150, bz -pet eth osazone 184
125	**3-Aminoacetophenone**	98-9, pa yel, al		196d, w				192 4, w -al	Hydrazone, 98, al
126	**2-Benzoylacrylic acid**	99 (anh) 64 (mono hyd)		190			197	168d	Hydrazone, 185 6, al
127	**Di-2-thenoylmethane**	100							Cu salt, 263
128	**Di-1-naphthyl ketone**	100						200	Picrate 121 5 2 0
129	**1,3-Dibenzoylbenzene**	101 2, al						*mono* 201, *di* 70-3	
130	**2-Acetyl-1-hydroxynaphthalene**	102, gr -yel, al, 98, yel, bz	325 sl d	245 50, pa yel			136 7, wh, dil al	168 9	Acetate, 107 5, Benzoate, 128, al
131	**Cinnamacetophenone**	102, yel, al			222, red, ac a, 218 9d	*α* 135, al			
132	**1,3-Cyclohexanedione**	104						156	
133	**4-Tolil** (4,4'-Dimethylbenzil)	104 5						225	
134	**2-Propionylphenanthrene**	105, 104							Picrate, 107
135	**2-Aminobenzophenone**	105-6, pa yel, al						156, alk -stab, 127, a -stab	
136	**Benzoylnitromethane**	106					105 5 5, yel, al	96, w	
137	**4-Aminoacetophenone**	106, w	294	250, yel al	266 7, 263			147 8, al	4 Toluenesulfonamide, 203
138	**Benzalacenaphthenone**	107, yel, w -al						48	
139	**Benzyl 4-chlorophenyl ketone**	108						123	
140	**4-Bromophenacyl bromide**	108 9						115	Acetate, 72
141	**4-Hydroxyacetophenone** (4-Acetylphenol)	109		199	210, br, al		151, wh → yel	145, 143 4, bz	Acetate, 54, Benzoate, 134 5, al
142	***trans*-1,2-Dibenzoylethylene**	110						211	
143	**Piperonalacetone**	110-1, pa yel		*α* 217, al, *β* 168, bz			163	186, al	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semicarbazone	2,4-Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
144	**2-Acetyldibenzothiophene**	112		235					
145	**1,5-Diphenyl-3-pentadienone** (Dibenzalacetone)	112, 111		187-90, al	180, red, ac a	173, yel, bz	152 3, 147 8, yel, al	142 4	Picrate, 114
146	**4,4'-Dimethoxybenzoin** (Anisoin)	113, dil al		185 (cor), w -al					Acetate, 94-5, al -pet eth
147	**1,4-Diacetylbenzene**	114	130[3]					240	
148	**3,4-Dihydroxyacetophenone** (4-Acetylcatechol)	116, w	127 33[11]					184d, et ac	3 4-Diacetate, 91
149	**3-Hydroxybenzophenone**	116, al						*syn* 76, *anti* 126, bz	
150	**α-Hydroxyacetophenone** (Phenacyl alcohol, Benzoyl carbinol)	117 8	118[11]	146 6 5, al			112, lgr -eth	70	Acetate, 49, eth, Benzoate, 118, dil al
151	**7-Acenaphthenone**	121 (cor), al					90, dk, al	175, al, 183 4, bz, *di* 222d	Picrate, 113
152	**4-Phenylacetophenone** (4-Acetylbiphenyl, Methyl 4-xenyl ketone)	121, al	325-7		241 5-2, red-or			186-7, al	
153	**Piperonalacetophenone** (3,4-Methylenedioxychalcone)	122, yel, al		α 203-5, abs al					Dibromide, 152, bz -lgr (1 1), Picrate, 126-8
154	**9-Hydroxyxanthene** (Xanthydrol)	122-4d							Heat → Dixanthyl ether, 219, Dixanthyl, 204, lgr
155	**4-Aminobenzophenone**	124, w -al						168, al, 127, w -al	Hydrazone, 139-40, yel, al
156	**4-Phenylphenacyl bromide**	124 5							Acetate, 111
157	**2-Naphthoin**	126						172	
158	**4-Phenylphenacyl chloride**	126-7							Acetate, 111
159	**Vanillalacetone** (4-Hydroxy-3-methoxystyryl methyl ketone)	129, yel, al			230 (cor), red		127-8, yel		
160	**Dianisalacetone**	129, yel, bz -pet eth			82-3			147 8	
161	**4,4'-Dimethoxybenzil** (Anisil)	133, yel		*di* 254 5, dil ac a				*mono* 133 *syn di* 217, *anti, di* 195, bz	Dihydrazone, 118
162	***d,l*-Benzoin**	133, al, 129	344	α 205-6, w	245, yel, al, 234		α 158-9, bz -lgr, β 106	α 151 2, bz, β 99	Acetate, 83, al, Benzoate, 124 5, 75% al
163	***cis*-1,2-Dibenzoylethylene**	134						*di* 210 1d	
164	**3,4,5-Tribromoacetophenone**	134 5, al		265d, ac a			129-34d, yel, pet eth		
165	**4-Hydroxybenzophenone** (4-Benzoylphenol)	134 5, w		194, bz	242 4 (cor), or		144, pet eth	81, Heat → 152	Acetate, 81, al Benzoate, 94 5, 115
166	**1-Furoin**	135, 138-9 (cor)			216 7, or -red, al		79-81, lgr -bz	α 161, al, β 102, pa yel, eth	Acetate, 76-7, Benzoate, 92 3
167	**Mesityl phenyl ketone**	137			232				
168	**4-Chlorobenzyl phenyl ketone**	138						96	

* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Semi carbazone	2,4-Di nitrophenyl-hydrazone	*p*-Nitro-phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
169	**α-Anisal-α′-cinnamalacetone**	139, red, al					Pyrazo-line, 155 6, yel , al		Dibromide, 139-40, CS_2, Tetrabromide, 155 6, CS_2
170	**4-Aminopropiophenone**	140, w						153, al	N-Acetyl deriv 161, w
171	**3,3′-Dibromobenzophenone**	141						181 2d	
172	**2-Acetylphenanthrene**	143		260			187 8		
173	**Dicinnamalacetone**	144, yel , abs al			195 7 (cor), dk red		166, yel , al		Light → d
174	**1,2-Dibenzoylethane**	147			*di* 265		*mono* 116, *di* 179	204	
175	**2,4-Dihydroxyacetophenone** (Resacetophenone)	147, 144		218, 214 20d	206 8		156 8	202 3	2,4-Diacetate, 38 2,4 Dibenzoate, 81
176	**3,5-Dihydroxyacetophenone**	147 8, w		205 6, al		236 7, red, w -ac a			3,5-Diacetate, 91-2, lgr
177	**4,4′-Dichlorobenzophenone**	147-8			238-40			135	
178	**1,2-Dibenzoylbenzene**	148						*mono* 150	
179	**9-Benzoylanthracene** (9-Anthra-phenone)	148, yel , bz							H_2SO_4 → brief blue color
180	**4-Hydroxypropiophenone**	148			229				
181	**5,5-Dimethyl-1,3-cyclo-hexanedione** (Methone Dimedone)	148 9						*mono* 115 *di* 176	
182	**2,3,4,2′-Tetrahydroxybenzo-phenone**	149 (anh), 100 (hyd), yel , w							2,3,4,2′-Tetraacetate, 118, al
183	**Anthrone**	154, ac a							Al sol → bl fluorescence
184	**1,4-Dibenzoylbenzene**	161, al						*mono* 212-3, *di* 235	
185	**Furil** (2,2′-Bifuroyl)	165, yel , bz					*mono* 82 3, yel , *di* 184, yel , lgr	α, *mono* 106, β, *mono* 97-8, α, *di* 100, 166, β, *di* 188 90	
186	**Benzanthrone**	170, yel , al							H_2SO_4 → or -red sol , gr fluorescence
187	**Quinhydrone**	171, dk gr , subl					152	161	
188	**2,3,4-Trihydroxyacetophenone** (Gallacetophenone)	172, w		225, rapid htng				162 3	2,3,4-Triacetate, 85 Picrate, 133
189	**Xanthone** (Diphenylene ketone oxide)	174	350				152	161	
190	**4,4′-Bis(dimethylamino)benzo-phenone**	174					174 5	233	Hydrazone, 150, Picrate, 156
191	**4,4′-Dibromobenzophenone**	177	395					150-2	Hydrazone, 92-4
192	***d,l*-Camphor**	*d l* 178, *d* 179	209, 205	247-8d (cor), 236-7, al	*d, l* 164, *d* 177, or , al	217	233	*d* 118 9	*d* $[\alpha]_D^{20}$ + 44, Hydrazone, 55
193	**3-Acetylindazole**	182, yel , ac a			>320, red, $PhNO_2$			222, bz -al	N-Acetyl deriv , 123, ac a
194	**3,4,5-Trihydroxyacetophenone**	187-8, w		216-7, al		260d , red, w -ac a			3,4,5-Triacetate, 111-2, lgr

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Semi carbazone	2 4-Di nitrophenyl hydrazone	*p* Nitro phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
195	**3-Acetylindole**	190 1, bz						144 7, w	N-Acetyl deriv , 151, subl , pet eth -bz , Picrate, 183, yel , pet eth Diacetyl deriv , 165 6, bz
196	**2,5,2′,6′-Tetrahydroxybenzo-phenone**	200 2d w							2,5,2′,6′-Tetraacetate, 118 9, al
197	**2,5-Dihydroxyacetophenone** (Quinacetophenone)	202, yel gr , w				215 6		149 50, tol	2 5-Diacetate, 68, ac a
198	**2,4,5-Trihydroxyacetophenone**	206 7 red							2 4 5-Triacetate 165 6, bz
199	**2,3,5-Trihydroxyacetophenone**	206-7, yel , ac a				241 2d , w -al			2 3 5-Triacetate, 106 7, lgr
200	**2,4,6-Trihydroxyacetophenone** (Phloracetophenone)	219, anh , w							2,4 6-Triacetate, 103, 2,4,6-Tribenzoate, 117 8
201	**2,3-(3′,4′,5′-Triphenylcyclo-pentadieno)-indone**	222					246-7		
202	**3,4,3′4′-Tetrahydroxybenzo-phenone**	227 8, w						145, al	
203	**Ninhydrin** (Triketohydrindene hydrate)	243, 241d					*di* 207 8, or -red, al	201	Warm aqueous sol of α-amino acids → intense bl , vlt , etc At 125-30, loses w , turns red
204	**Phenacridone**	304 5, yel , ac a							N-Benzyl deriv , 188 9, yel , al

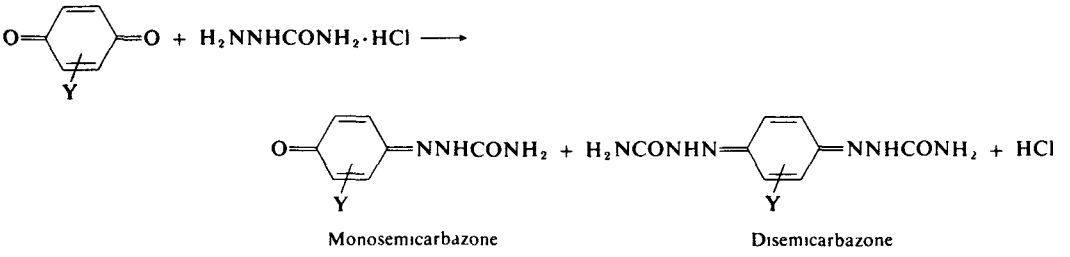
*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XI

The derivatives of quinones are usually similar to those of ketones Therefore, for directions and examples for their preparation see explanations and references to Tables 9 and 10, pages 141, 142, 143

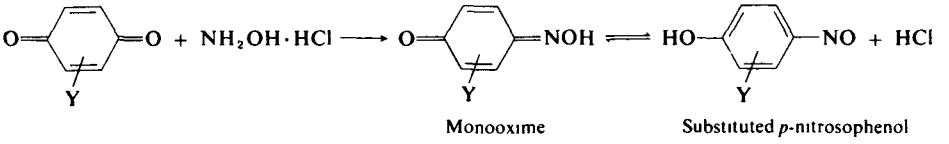
The derivatives listed as *phenylhydrazones*, *p-nitrophenylhydrazones* and *2,4-dinitrophenylhydrazones* of quinones in most cases are not real substituted phenylhydrazones, but either addition compounds or hydroxy derivatives of variously substituted aromatic azo compounds

Semicarbazone *



From the quinone with semicarbazide hydrochloride in water
For directions and examples see Linstead, p 30, Vogel, p 749

Oxime *



From the quinone with hydroxylamine hydrochloride in water
For directions and examples see Linstead, p 30

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XI. ORGANIC DERIVATIVES OF QUINONES
(Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2,4 Di nitrophenyl hydrazone	*p*-Nitro-phenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	**2,3,5-Trimethyl-1,4-benzoquinone**	32, yel , eth		252 3 d , yel				1-*mono* 181 2, yel , al 4-*mono* 134, yel	
2	**2-Isopropyl-5-methyl-1,4-benzoquinone** (Thymoquinone)	45 5, or - yel	232	*mono* 201 2d , yel , al , *di* 237, yel	*mono* 179 80, dk red, al		93	1-*mono* 160 2, pa yel chl	
3	**2,3-Dimethyl-1,4-benzoquinone** (*o*-Xylo-*p* quinone)	55 (subl), yel						*mono* 166, yel	
4	**2-Bromo-1,4-benzoquinone**	56						1-*mono* 184, or 4-*mono* 196	
5	**2-Chloro-1,4-benzoquinone**	57, yel - red		4-*mono* 185d				1-*mono* 184, pa grn -yel , 4-*mono* 148d	
6	**2-Methyl-1,4-benzoquinone** (*p*-Toluquinone)	67 6 68 4		4-*mono* 178 9, yel , al *di* 240d , or -red	*di* 269, $PhNO_2$		130	*mono* 134 5d w , *di* 220d , yel -wh	
7	**2,6-Dimethyl-1,4-benzoquinone** (*m*-Xylo-*p*-quinone)	68 71, yel						1-*mono* 175, yel , al -w 4 *mono* 170 1, yel bz	
8	**4-Chloro-1,2-benzoquinone**	78 pa yel -red, hexane						*di* 128, br	
9	**2,5-Dimethyl-1,4-naphthoquinone**	94 yel me al					*mono* 226, red, ac a		
10	**Dunnione**	98 9, or - red, w		*mono* 232 3, w -me al	266 8, or				$[\alpha]_D^{18}$ +310° in chl
11	**2-Methyl-1,4-naphthoquinone**	106, yel , me al			4-*mono* 299d			*mono* 160, *di* 166-8	Benzoyl chloride + Zn dust → 1 4-dibenzyloxy-2-methylnaphthalene, 180 0-0 5, col , al
12	**Quinone** (1,4-Benzoquinone)	116, yel 113		*mono* 166, yel , 165-6d , red, 178, *di* 243d , red	*mono* 185 6, br , al , *di* 231		152	240	Picrate, 79, Quinhydrone, 171
13	**2-Chloro-1,4-naphthoquinone**	117, yel , w						4-*mono* 200d 198, pa yel , bz	
14	**1,4-Naphthoquinone** (α-Naphtho-quinone)	117 8, yel , al		*mono* 247, grn -yel , ac a	*mono* 278, yel , pyr	*mono* 277 9, or -red, $PhNO_2$	*mono* 205-6d , dk vlt , bz		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XI. ORGANIC DERIVATIVES OF QUINONES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Semicarbazone	2,4 Dinitrophenylhydrazone	*p*-Nitrophenylhydrazone	Phenyl hydrazone	Oxime	Miscellaneous
15	**2,5-Dimethyl-1,4-benzoquinone** (*p*-Xylo-*p*-quinone)	125, yel, al					122 4, yel, 154 5, or	*mono* 168, yel, w, *di* 272, yel, al, 254	Monobenzoylphenylhydrazone, 122 4, yel, lgr
16	**2,6-Dibromo-1,4-benzoquinone**	131, yel, al		4-*mono* 225d, yel, al				4-*mono* 170d, br	
17	**2,6-Diphenyl-1,4-benzoquinone**	137 8, red						242-4d	
18	**2,5-Dihydroxy-3-*n*-dodecyl-1,4-benzoquinone** (Embelin)	143, or-red, eth-bz		*di* 236			*di* 189 90	*tetra* 175	Diacetate, 54 Dibenzoate, 97-8
19	**1,2-Naphthoquinone** (β-Naphthoquinone)	145 7d, red, eth, 120		1-*mono* 184d, yel, al		1-*mono* 250 1, 2-*mono* 236, dk red, ac a	2-*mono* 138, dk red, al	1-*mono* 109 5, 2-*mono* 162-4d, *di* 169, yel, al	
20	**3,7-Dimethyl-1,2-naphthoquinone**	151 2, red, al						2-*mono* 222d, or	
21	**5-Hydroxy-1,4-naphthoquinone** (Juglone)	153 4, or, bz						*mono* 167 0 7 5, red, ac a, *di* 225 (exp), dk br, ac a	Acetate, 154-5
22	**3-Chloro-1,2-naphthoquinone**	172, red, chl						1-*mono* 167 8, or	
23	**1,8-Dihydroxy-2-methyl-9,10-anthraquinone** (2-Methylchrysazin)	175							Diacetate, 205
24	**2-Methyl-9,10-anthraquinone**	177 9, 177, pa yel							Diacetate, 217, pa yel, ac a
25	**3,5-Dihydroxy-2-methyl-1,4-naphthoquinone** (Droserone)	181, pa yel, al						*di* 151	Diacetate, 119, me al
26	**2,3,4-Trihydroxy-9,10-phenanthraquinone**	185d, br-red		*mono* 270d, br-red, al					Phenazine, 255d, br, al
27	**6-Bromo-1,4-dihydroxy-9,10-anthraquinone** (6-Bromoquinizarin)	185 5, red-br, bz							Di Me eth, 176 5, or-yel, al, Diacetate, 220 5, yel, al
28	**1,2-Anthraquinone**	185 90d, or-br						1-*mono* 188d, or-br, 2-*mono* 200d, or-br	
29	**4-Chloro-1,2-naphthoquinone**	188, red br, bz						2-*mono* 157, pa yel	
30	**7-Isopropyl-1-methyl-9,10-phenanthraquinone** (Retenequinone)	197, or, al		*mono* 200, yel, pyr		*mono* 222 3, red, ac a	*mono* 160, or, bz-al	*mono* 128 5, 130 1 (cor), yel, al	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XI. ORGANIC DERIVATIVES OF QUINONES
(*Listed in order of increasing m.p.*)* (*Continued*)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4 Dinitro-phenyl-hydrazone	*p*-Nitro-phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
31	**Camphorquinone**	199, yel, dil al		3 *mono* (α) 236d, al	*mono* 36, *di* 190	239	183 90, pa yel, al, 170	*mono* α 153 β 114 5, *di* (four forms) α 201d, β 248d, γ 136 δ 194d	3-*p*-Bromophenylhydrazone, 215 6, ac a, Hydrazone, 182
32	**1-Hydroxy-9,10-anthraquinone**	200, or-red, al, 193	subl						Acetate, 176 9, yel, al
33	**1,4-Dihydroxy-9,10-anthraquinone** (Quinizarin)	200 2 (cor), red, ac a, 195							Diacetate, 207 8, yel, pyr, 200-1, yel, ac anh
34	**9,10-Phenanthraquinone**	206 7 5, or-yel, 208, or	>360, subl → or-red	*mono* 220d	*mono* 312-3d, dk red	*mono* 245, red, xyl	*mono* 165, dk red, al	*mono* 158, grn-yel, al, *di* 202d	Conc H_2SO_4 → dull grn
35	**1,4-Anthraquinone**	218d, yel, turns dark at 200 10						233 br, turns dark at 205	
36	**4-Chloro-1,2,3-trihydroxy-9,10-anthraquinone**	233, yel							Triacetate, 187, yel, Conc H_2SO_4 → red
37	**2-Bromo-9,10-phenanthraquinone**	233 4, red-yel, ac a						*mono* 163 4, or	
38	**1-Bromo-9,10-phenanthraquinone**	233-4, yel						*mono* 213d	
39	**Chrysoquinone** (Chrysenequinone)	239 5, red						*mono* 161, or	Conc H_2SO_4 → bl
40	**1,2,8-Trihydroxy-9,10-anthraquinone** (2-Hydroxychrysazin)	239 40, red, ac a							Triacetate, 224, yel 2-Me eth, 220 or, chl-me al, 2,8-Di-Me eth, 193, br-yel, chl-me al, 1,2,8-Tri-Me eth, 157, yel, me al
41	**1-Amino-9,10-anthraquinone**	251, or-red							N-Acetyl, 218, or-red, N-Benzoyl, 255, grn, N-*p*-Toluenesulfonyl, 228 9
42	**3-Amino-9,10-phenanthraquinone**	254, dk red-br, al						*mono* 247d, red-br	
43	**1,2,4-Trihydroxy-9,10-anthraquinone**	259, dk red, abs al							2-Me eth 232 3, red, bz, 2,4-Di-Me eth 186-9, or, 2-Acetate, 179 80, or, al Triacetate, 198-200 (sinters 193), pa yel
44	**Acenaphthenequinone**	261 (cor), yel, ac a		*mono* 192-3, ac a, *di* 271, al		*mono* 247, or-red, ac a	*mono* 179, or-red, al, *di* 219, dk yel, al	*mono* 230, dil al, 220d	

* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XI. ORGANIC DERIVATIVES OF QUINONES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2 4-Dinitro-phenyl hydrazone	*p*-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
45	**1,3-Dihydroxy-4-methyl-9,10-anthraquinone** (4-Methylpur-puroxanthin)	265 6, or , bz							Di-Me eth , 162, yel , chl , Diacetate, 181-2, yel , ac a
46	**2-Bromo-1,4-dihydroxy-9,10-anthraquinone** (2-Bromo-quinizarin)	265 8, br - red							Diacetate, 226-9, yel
47	**3-Bromo-9,10-phenanthraquinone**	268 dk - yel , ac a		*mono* 242d			*mono* 177, red	*mono* 198, *di* 212d , grn	
48	**Aceanthrenequinone** (3,4-Benzacenaphthenequinone)	270, red, bz					*mono* 203, or , bz	*mono* 251d , yel , ac a	subl
49	**1,2,5-Trihydroxy-9,10-anthra-quinone** (Hydroxyanthrarufin)	273 4, red, ac a							2-Me eth , 229, yel , al , 1 2-Di-Me eth , 231, or , al , 1,2,5-Tri-Me eth , 203 4, yel , al , Triacetate, 228 9, yel al
50	**1,5-Dihydroxy-9,10-anthra-quinone** (Anthrarufin)	280 (subl), pa yel	379-81						Diacetate, 245d , pa yel , ac a
51	**Chloranilic acid** (2 5-Dichloro-3,6-dihydroxy-1,4-benzo-quinone)	283 4, red, w (+2H_2O)							Di-Me eth , 141 2, red, Di-Et eth , 107, red, Di-acetate, 182 5, yel
52	**9,10-Anthraquinone**	286	382, 376 8 (cor)					*mono* 224, pa yel , (rapid htng)	Diacetate, 260, col , ac a
53	**Chloranil** (2,3,5,6-Tetrachloro-1,4-benzoquinone)	290, yel , ac a , (slow htng , sealed tube)	subl						SO_2—Tetrachlorohydro-quinone, In w -alkali sol → alkali salts of chloranilic acid
54	**Alizarin** (1,2-Dihydroxy-9,10-anthraquinone)	290, or , al	430						2-Benzoate, 214 6, al , 2-*p*-Bromobenzoate, 195, yel , Diacetate, 184, yel , al , Di-Me eth , 215
55	**2-Amino-9,10-phenanthraquinone**	>300, dk vlt , w , sinters at 205-10							N-Acetyl, 324, dk red-vlt , $PhNO_2$, N-Benzoyl, 297-8, br -red, $PhNO_2$
56	**3-Aminoalizarin** (3-Amino-1,2-dihydroxy-9,10-anthraquinone)	>300, dk red, ac a							N-Acetyl, 238-40, yel -br , Monobenzoyl, 275, dk yel , Dibenzoyl, 252, yel
57	**1,4-Diamino-5,8-dihydroxy-9,10-anthraquinone** (5,8-Diamino-quinizarin)	>300, br - vlt , $PhNO_2$							N,N'-Dibenzoyl, 284-5, br -vlt , xyl , N,N'-Di-phenyl, 258-60, dk bl , bz -lgr , 1,4-Di-Me eth , 250d , vlt -blk , ac a
58	**Dianthraquinone** (9,9'-Di-anthranyl-10,10'-quinone)	>300, yel							Conc H_2SO_4 → vlt -red, CrO_3 → Anthraquinone, Zn dust + ac a → di-anthranol, 230 (enol), 250 (keto)

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XI. ORGANIC DERIVATIVES OF QUINONES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi carbazone	2 4-Dinitro-phenyl-hydrazone	*p*-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
59	**2-Amino-9,10-anthraquinone**	306, 303 6, red, al							N-Acetyl, 262, yel , N,N-Diacetyl, 258, yel , ac a N-Benzoyl, 227 8, yel , ac a
60	**2-Hydroxy-9,10-anthraquinone**	305, yel , al	306						Acetate, 159 60, al , Benzoate, 202 4, ac a
61	**1,2,3-Trihydroxy-9,10-anthra-quinone** (Anthragallol)	313 4d , br -or (290, subl)							Triacetate, 181 2, yel , al 188 9, pyr 2,3-Di-*p*-toluenesulfonate 196 8, yel , pyr , Tri-Me eth , 167 9, grn -yel , bz -pet , Triacetate, 181-2, yel , ac a , Tribenzoate, 213 5, pa yel , al bz
62	**1,2,6-Trihydroxy-9,10-anthra-quinone** (Flavopurpurin)	>330, (>160, subl)							2,6-Di-Me eth , 239, yel , 1,2,6-Tri-Me eth , 225-6, yel Diacetate 238 Tri acetate 202 3
63	**1,2,7-Trihydroxy-9,10-anthra-quinone** (Anthrapurpurin)	369, or , al							2-Acetate, 296-8 yel , al , 2,7-Diacetate, 192 3, yel , al -ac a Triacetate, 223, pa yel , ac a Tri-Me eth , 201, yel , al

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide All of them appear therefore under the same title

Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid

$$RCOCl + H_2O \longrightarrow \underset{\text{Acid}}{RCOOH} + HCl$$

$$(RCO)_2O + H_2O \xrightarrow{NaOH} 2RCOONa \xrightarrow{H^+} \underset{\text{Acid}}{RCOOH}$$

From the acyl halide in water
For directions and examples see Wild, p 180
From the acyl halide with aqueous sodium hydroxide
See Vogel, p 369, Wild, p 180
From the acid anhydride with water
See Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, **97**, 1677 (1910)
From the acid anhydride with aqueous sodium hydroxide
See Linstead, pp 16 7 Wild, p 184

Amide *

$$RCOOH \xrightarrow{SOCl_2} \underset{\substack{\text{Acid}\\\text{chloride}}}{RCOCl} \xrightarrow{NH_3} RCONH_2 + NH_4Cl$$

$$RCOOH + NH_3 \longrightarrow RCONH_2$$

$$(RCO)_2O + NH_3 \longrightarrow \underset{\text{Amide}}{RCONH_2}$$

Acid chloride is prepared from the acid and thionyl chloride Amide is formed on addition of aqueous ammonia
For directions and examples see Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181
From the acid chloride in benzene with aqueous ammonia
See D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, **71**, 3017 (1942)
By passing gaseous ammonia through a benzene or ether solution of the acyl chloride
See Linstead, p 14, Wild, p 182
From the neat acid with gaseous ammonia
See J A Mitchell and E E Reid, *J Amer Chem Soc*, **53**, 1879 (1931)
From the acid anhydride with aqueous ammonia
See Wild, p 184, 185

Anilide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{C_6H_5NH_2} RCONHC_6H_5 + C_6H_5NH_3^+Cl^-$$

$$RCOOH + C_6H_5NH_2 \longrightarrow RCONHC_6H_5 + H_2O$$

$$(RCO)_2O + C_6H_5NH_2 \longrightarrow \underset{\text{Anilide}}{RCONHC_6H_5} + C_6H_5NH_3^+RCOO^-$$

From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether
For directions and examples see Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200–1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)
From the acid chloride with aniline in aqueous sodium hydroxide
See Wild, pp 181, 219
From the acid and aniline at high temperatures
See Vogel, p 362

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the sodium salt of the acid with aniline and concentrated hydrochloric acid
See Shriner, p 201, Wild, p 154
From the acid anhydride with aniline without solvent
See Linstead, p 17, Vogel, p 377, Wild, p 185
From the acid anhydride with aniline in benzene
See Linstead, p 15, Wild, p 185

p-Toluidide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{p\text{-}CH_3C_6H_4NH_2} RCONHC_6H_4CH_3\text{-}p + p\text{-}CH_3C_6H_4NH_3^+Cl^-$$

$$RCOOH + p\text{-}CH_3C_6H_4NH_2 \longrightarrow RCONHC_6H_4CH_3\text{-}p + H_2O$$

$$(RCO)_2O + p\text{-}CH_3C_6H_4NH_2 \longrightarrow RCONHC_6H_4CH_3\text{-}p + p\text{-}CH_3C_6H_4NH_3^+RCOO^-$$

From the acid chloride with *p*-toluidine in ether or benzene
For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361
From the acid and *p*-toluidine at high temperatures
See Cheronis, pp 441, 442-3, Vogel, p 362
From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid
See Shriner, p 201, Wild, p 154
From the acid anhydride with *p*-toluidine without solvent
See Cheronis, p 459, Linstead, p 17
From the acid anhydride with *p*-toluidine in benzene
See Wild, p 185

1- and 2-Naphthylamide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{1\text{- or }2\ C_{10}H_7NH_2} \underset{\text{Naphthylamide (1 or 2-)}}{RCONHC_{10}H_7} + C_{10}H_7NH_3^+Cl^-$$

From the acid chloride with the naphthylamine
For directions and examples see Cheronis, p 446, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)

p-Nitrobenzyl ester *

$$RCOONa + p\text{-}NO_2C_6H_4CH_2X \rightarrow \underset{p\text{-Nitrobenzyl ester}}{RCOOCH_2C_6H_4NO_2\text{-}p} + NaX \quad (X = Cl, Br, I)$$

From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol
For directions and examples see Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, pp 144 5
From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone
See F F Blicke and F D Smith, *J Amer Chem Soc*, **51**, 1947 (1929)
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1 2 water-ethanol
See E E Reid, *J Amer Chem Soc*, **39**, 124 (1917)
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1 2 water-ethanol
See J A Lyman and E E Reid, *J Amer Chem Soc*, **39**, 701 (1917)

p-Bromophenacyl ester *

$$RCOONa + \underset{\text{bromide}}{\underset{p\text{-Bromophenacyl}}{p\text{-}BrC_6H_4COCH_2Br}} \longrightarrow RCOOCH_2COC_6H_4Br\text{-}p + NaCl$$

$$RCOOH + \underset{\text{phenone}}{\underset{p\text{ Bromodiazoaceto-}}{p\text{-}BrC_6H_4\,COCHN_2}} \xrightarrow{CuCl_2} \underset{p\text{-Bromophenacyl ester}}{RCOOCH_2COC_6H_4Br\text{-}p} + N_2$$

From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with *p*-bromophenacyl halide in 1 2 water-ethanol

See W L Judefind and E E Reid, *J Amer Chem Soc*, **41**, 1043 (1920)

From the sodium salt of the acid (neutralization with sodium hydroxide) with *p*-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, *J Amer Chem Soc*, **52**, 818 (1930), C G Moses and E E Reid, *J Amer Chem Soc*, **54**, 2101 (1930)

From the acid and *p*-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

p-Phenylphenacyl ester *

$$RCOONa + \underset{\text{p Phenylphenacyl bromide}}{p\text{-}C_6H_5C_6H_4COCH_2Br} \longrightarrow RCOOCH_2COC_6H_4C_6H_5\text{-}p + NaBr$$

$$RCOOH + \underset{\substack{\text{p Phenyldiazoaceto}\\\text{phenone}}}{p\text{-}C_6H_5C_6H_4COCHN_2} \xrightarrow{CuCl_2} \underset{\text{p Phenylphenacyl ester}}{RCOOCH_2COC_6H_4C_6H_5\text{-}p} + N_2$$

From the sodium salt of the acid (neutralization with sodium carbonate) and *p*-phenylphenacyl bromide in aqueous alcohol

For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, *J Amer Chem Soc*, **52**, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and *p*-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

For dibasic acids from the acid, ethylamine and *p*-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

From the acid and *p*-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

Methyl ester

$$RCOOH + CH_3OH \xrightarrow{H_2SO_4} RCOOCH_3 + H_2O$$

$$RCOOH + CH_2N_2 \longrightarrow \underset{\text{Methyl ester}}{RCOOCH_3} + N_2$$

From the acid with methanol and a catalytic amount of sulfuric acid

For directions and examples see Linstead, p 16, Vogel, p 383

From the acid and diazomethane in ether

See B Eistert, in *Newer Methods of Preparative Organic Chemistry*, Interscience, New York, 1948, p 513

Ethyl ester

$$RCOOH + C_2H_5OH \longrightarrow RCOOC_2H_5 + H_2O$$

$$RCOOAg + C_2H_5I \longrightarrow RCOOC_2H_5 + AgI$$

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{C_2H_5OH} \underset{\text{Ethyl ester}}{RCOOC_2H_5} + HCl$$

From the acid and ethanol in the presence of a catalytic amount of sulfuric acid

For directions and examples see Vogel, pp 383, 385, 386, 387

From the silver salt of the acid with ethyl iodide

See Vogel, p 388

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

*S-Benzylthiuronium salt.**

$$\underset{}{RCOONa} + \underset{\text{S-Benzylthiuronium chloride}}{[C_6H_5CH_2SC(NH_2)_2]^+Cl^-} \rightarrow \underset{\text{S-Benzylthiuronium salt}}{[C_6H_5CH_2SC(NH_2)_2]^+RCOO^-} + NaCl$$

From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim.* [5], **5**, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* **6**, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, **58**, 1004 (1936).

Phenylhydrazide.

$$RCOOH + H_2NNHC_6H_5 \rightarrow \underset{\text{Phenylhydrazide}}{RCONHNHC_6H_5} + H_2O$$

From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, **64**, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	*p*-Toluidide	Anilide	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	**Thioacetic acid**	93			$1\ 074_4^{10}$	130	76		108			
2	**Formic acid**	100 7	8 4	1 37137	1 22026	53	50	140 135				*p* Nitrobenzyl ester, 31
3	**Acetic acid** (Ethanoic acid)	118 2	16 6	1 36976 1 3721	1 04926	153 147	114	86 0	82			*p*-Nitrobenzyl ester, 78
4	**Difluoroacetic acid**	134 5							52			
5	**Acrylic acid**	141, 140	13	1 4224	$1\ 0621_4^{16}$	141	104 5, w		84-5, pet eth			
6	**Propionic acid** (Propanoic acid)	141	−20 8	1 3868	0 99336	126, 123	106	63 4	81			*p*-Nitrobenzyl ester 31
7	**Propiolic acid**	144d	18		$1\ 1391_4^{15}$		87		61 2			
8	**Isobutyric acid** (Isobutanoic acid)	154 7	−46 1	1 3920	0 94791	108 5 9 5	105	76 8	128 129			
9	**Methacrylic acid**	161	16	1 429	1 015				102 6			*p*-Bromoanilide, 116
10	***n*-Butyric acid** (*n*-Butanoic acid)	162 5 164	−5 5 −8	1 3983 1 3979	0 95790	75	96 97	63	115 6			*p* Nitrobenzyl ester, 35
11	**Pyruvic acid** (α-Oxopropionic acid)	165d 80^{23}	13 6	1 4138	$1\ 2668_4^{15}$	109 130	104, subl		124 5, 145			2,4-Dinitrophenylhydrazone 218, yel, al
12	**Vinylacetic acid** (3-Butenoic acid)	169 163	−35	1 4221	1 0094		58		73			
13	**Isocrotonic acid** (*cis*-(β)-Crotonic acid *cis*-2-Butenoic acid)	169	15	1 4456	1 0265	132	101 2	81	101 2			
14	***d l*-2-Methylbutanoic acid** (Ethylmethylacetic acid)	176 7 174		1 4052	$0\ 938_{20}^{20}$	92 5 3 0	110	55	112			
15	**Isovaleric acid** (3-Methylbutanoic acid)	176 5	−30 0	1 4043	0 92623	106 7	109 5 (cor)	68 0	135 137			
16	***n*-Amylpropiolic acid** (1-Heptyne-1-carboxylic acid)	180 220d	f p 2 5			68, bz			91			Nitrile, b p 194 6 *o*-Toluidide, 60, pet eth
17	**3,3-Dimethylbutanoic acid** (*tert*-Butylacetic acid)	184, 96^{26}	6 7	1 4096	0 9124	134	132, et ac - pet eth		132	b p 126		
18	***d l*-α-Chloropropionic acid**	186				124	92		80			
19	**Cyclopropanecarboxylic acid**	186, 182 4	17, 18-9	1 43901	1 0885				125		b p 134, n_D^{20} 1 41902, D_4^{15} 0 96078	
20	***n*-Pentanoic acid** (*n*-Valeric acid)	186 4	−34 5	1 4086	0 93922	74	63	75	106			
21	**2,2-Dimethylbutanoic acid** (Dimethylethylacetic acid)	187, 190	−15 0	1 4141, 1 4145	0 9276	83 0 5	92, 90-1		103			*p*-Phenylphenacyl ester, 86
22	**Allylacetic acid** (4-Pentenoic acid)	188 9		1 4341 1 4283	$0\ 9843_4^{18}$				94, b p 230		b p 144 6	
23	**Cyclopropylacetic acid**	190^{750}		$1\ 4320^{25}$								*p*-Phenylphenacyl ester, 83
24	***d l*-2,3-Dimethylbutanoic acid** (Isopropylmethylacetic acid)	191 7	−1 5	1 4146	0 9275	112 6	78 4		132			*p*-Phenylphenacyl ester, 74
25	**Dichloroacetic acid**	194	5-6	1 4659	1 5634	153	118	99	98, subl			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	*p*-Toluidide	Anilide	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
26	**Cyclobutanecarboxylic acid**	195	1 4403[25]	1 0599					152 3	b p 136 0 – 5	b p 159 62	
27	**2-Ethylbutanoic acid** (Diethylacetic acid)	195	–31 8	1 4132	0 9239	116 2	127 5		112 107			
28	***d l*-2-Methylpentanoic acid** (Methyl-*n*-propylacetic acid)	195 6		1 4136	0 9230	81	95		79 6			
29	***d,l*-3-Methylpentanoic acid**	197 5	–41 6	1 4159	0 9262	74 8	87, 88		124 9			
30	**4-Methylpentanoic acid** (Isocaproic acid, Isobutylacetic acid)	199 1[752]	–33	1 4144	0 9225	63 0	112 0, 110 5 111 5	77 3	120 1			
31	**Methoxyacetic acid** (Glycolic acid methyl ether)	204, 203		1 41677	1 1768		58, pet eth		96 5 7 0, 92–4			
32	**2-Ethyl-2-methylbutanoic acid** (Diethylmethylacetic acid)	204		1 4256					78			
33	**Hexanoic acid** (*n*-Caproic acid)	205 35	–3 9, f p –1 5– –2	1 41635	0 93568	74 5	94 5	72 0	100, 101		b p 166–7	
34	**Ethoxyacetic acid** (Glycolic acid ethyl ether)	206 7		1 41937	1 1021	32, eth	95 92	104 8	80–2			
35	**5-Methylhexanoic acid**	207[752]		1 4220			75		103			
36	**2-Ethylpentanoic acid** (Ethyl-*n*-propylacetic acid)	209				129	94		104 5			
37	**2-Methylhexanoic acid** (*n*-Butylmethylacetic acid)	209 6		1 4189[25]		85	98		73 70–2 5			
38	**α-Chloroisovaleric acid**	20–2									b p 178 9	Nitrile b p 154 5 Chloride, b p 149
39	**α-Bromobutanoic acid**	217d				92	98		112, 108			
40	**4-Methylhexanoic acid**	217 8[754]		1 4211	0 9194		76 5		98			
41	**2,2-Dimethylhexanoic acid**	218							89			
42	**4-Ethyl-4-methylbutanoic acid** (*active*-Amylacetic acid)	221			0 9149					b p 158 64	b p 173 9	$[\alpha]_D^5$ +7 6 in me al
43	**2-Chloro-*n*-valeric acid** (2-Chloropentanoic acid)	222								b p 160	b p 185–6	Nitrile, b p 160
44	***n*-Heptanoic acid** (*n*-Heptoic acid)	223 0	–7 46	1 4234	0 91808	81	70, 65	72 0	96, 96 5			
45	**2-Ethylhexanoic acid** (α-Ethylcaproic acid)	228							102			*p*-Phenylphenacyl ester, 53 4, 49 5 50
46	**Cyclohexylacetic acid**	237							172			
47	***n*-Caprylic acid** (*n*-Octanoic acid)	237, 239 3	16 3	1 4268	0 90884	70	57	67 4	110, 106		b p 207 8[754]	
48	**Pelargonic acid** (*n*-Nonanoic acid)	254 4	12 3	1 43446[15] He, yel	0 90552	84	57	68 5	99			
49	***d*-Citronellic acid** (2,6-Dimethyl-1-octene-8-carboxylic acid)	257			0 9308				84 5		b p 113 5[12], $[\alpha]_D^{26}$ +0 3	$[\alpha]_D$ +21, Nitrile, b p 230, D^{20} 0 8645
50	**2-Phenylpropionic acid**	265							92			
51	**4-Acetylbutanoic acid** (γ-Acetobutyric acid)	275d, 195–200[65]	13–4			123, w			114, chl			Semicarbazone 175d (+1 H_2O), w, Oxime, 104 5 bz

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing amide m.p.)*

No	Name	Amide	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	*p*-Toluidide	Anilide	*p*-Bromophenacyl ester	Methyl ester	Ethyl ester	Miscellaneous
1	**3-Ethoxypropionic acid**	51	120[17]		1 4216							
2	**3-Heptynoic acid**	67	102[2]	14	1 4635[25]							
3	**2-Heptynoic acid**	68 9, al	135[20]		1 4619	0 978				b p 91-3[19], n_D^{20} 1 4455, D_4^{20} 0 937		
4	*trans*-**Oleic acid**	75-6	216[5], 250 (superheated steam)	*α* 13 36, *β* 16 25	1 4597		42 5	41	40, 46			
5	**2-Fluoropropionic acid**	76	60[8]									
6	**2-Azidoisovaleric acid** (2-Triazoisovaleric acid)	78 9, bz	82[0 1]			$1\ 0638_{33}^{33}$					b p 82[16], D_{20}^{20} 1 0295	
7	***d,l*-Lactic acid**	78 5 9 0 (cor), bz -al (3 1)	122[15]	18			107	58 5-9 0, w	112 8	144 8	154	
8	***d l*-2-Azidopropionic acid** (*d,l*-2-Triazopropionic acid)	80, bz	121 5[20]								b p 70[16] n_D^{25} 1 428 57, D_{23}^{23} 1 065	Explodes on heating
9	**2-Ethyl-3-Hexenoic acid**	80	132[19]									
10	**4-Phenoxybutanoic acid**	80	197[18]									
11	**2-Methoxypropionic acid**	81	89[10]									
12	***l*-Citronellic acid** (2,6-Dimethyl-1-octen-8-carboxylic acid)	84-5	117 9[0 6]		1 4563[24]	$0\ 9274_{25}^{25}$	93-4	76		b p 86[1 1]		$[\alpha]_D^{24}$ -6 6
13	**2-Ethyl-4-methylpentanoic acid** (Ethylisobutylacetic acid)	89	115[20]									
14	**2-Octynoic acid**	90	133[10]		1 4595			60				
15	**6-Methyloctanoic acid**	91	149[23]		1 4337							
17	**3-Methylhexanoic acid**	98	112[16]		1 4222							
18	**2,3-Dimethylpentanoic acid**	102	92[15]									
19	**2-Cyanopropionic acid**	105, 81	142-5[11]								b p 192-3	
20	**7-Methyloctanoic acid**	106	105[2]									
21	**1-Chlorocyclohexane carboxylic acid**	110, me al -w	138-40[13]									Ethylamide, 53
22	**2-Cyanobutanoic acid**	113	153-5[15]								b p 207-9	
23	**Methylneopentylacetic acid**	123	108[14]									
24	**2-Isopropylbutanoic acid** (2-Ethyl-3-methylbutanoic acid)	135	105[15]									
25	**5-Cyclopentylpentanoic acid**	136	123[4 5]									
26	**2-Methylcyclopentanecarboxylic acid**	148	107[9]		1 4504[22]							
27	**3,4,4-Trimethylpentanoic acid**	167	98[4]		1 4320[21]							
28	*cis*-**4-Methylcyclohexanecarboxylic acid**	175	130[13]									
29	**Cyclopentanecarboxylic acid**	179	123[27]									

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	**β-Bromobutyric acid** (β-Bromobutanoic acid)	20	122[16]					92 3		b p 183 4	
2	***trans*-β-Ethyl-α-methylacrylic acid**	24	112[12] *cis* 94[10]				91, *cis* 46	80			n_D^{20} 1 4578 *cis* n_D^{25} 1 4485
3	***d l*-α-Azidobutyric acid** (*d l*-α-Triazobutyric acid)	24	81[0 2]					38 9, bz - pet eth		b p 64[7], D_{20}^{20} 1 038	
4	**Undecylenic acid** (10-Undecen-1-oic acid 10-Hendecen-1-oic acid)	24 5	275					87			Cu salt, 232-4, Pb salt, 80
5	**2-Ethoxybenzoic acid** (Salicylic acid ethyl ether)	24 5 5 5	300d					132			
6	***d l*-α-Bromopropionic acid**	25 7	203 5	125	99, 100			123	b p 145-50	b p 159-60d	
7	***n*-Undecylic acid** (*n*-Undecanoic acid, *n*-Hendecanoic acid)	28 5, α 13 4, β 16 3	280, 284	80	71		68 2	103			
8	**α-Chloroisobutyric acid** (α-Chloroisobutanoic acid)	31	118[50]		69 70, al				b p 133 5	b p 148 9	
9	**α-Azidoisobutyric acid** (α-Azidoisobutanoic acid α-Triazoisobutyric acid)	31	75[0 2]					93-4		b p 71[16], D_{20}^{20} 1 0344	D_{33}^{33} 1 1433
10	**Cyclohexanecarboxylic acid** (Hexahydrobenzoic acid)	31, 30 1	233		146 (cor)			185 6			
11	**α-Ketobutyric acid** (2 Oxobutanoic acid)	31	78[25]					117			n_D^{20} 1 3975, *p*-Nitrophenylhydrazone, 194
12	**Fluoroacetic acid**	31-2	167-9					108			
13	**Capric acid** (*n*-Decanoic acid)	31 5	268 70	78	70		67, al , 66	108, 100 1, 98, 99	b p 224	b p 243-5	n_D^{40} 1 42855
14	**Bromochloroacetic acid**	31 5	215 sl d					126, 117		b p 174d	Phenyl ester, 46 5, b p 266
15	**2-Hexenoic acid**	32	-		110						
16	***n*-Butylmethylglycolic acid**	33						58			
17	***cis*-13-Docosenoic acid** (Erucic acid)	33-4	264[15]	75-8	55		62 5, 61 0	84			D 0 860[55]
18	**Levulinic acid** (γ-Ketovaleric acid, β-Acetylpropionic acid)	33-5 deliq	245-6	108 9, w	102, w	61	84	107-8d			Oxime, 96
19	**Pivalic acid** (Trimethylacetic acid)	35 5	163-4	119-20	132-3, 128 (cor)		75 6	155 7, 153-4, et ac -pet eth			
20	***d,l*-α-Methylhydrocinnamic acid** (α-Benzylpropionic acid)	36 5	272	130, *d* 115-6				107 8, *d* 113-4			
21	**1-Cyclohexenylcarboxylic acid**	38	107[3]					128			
22	***n*-Hexylmethylglycolic acid**	40						59			
23	**5-Acetyl-*n*-valeric acid** (δ-Acetylpentanoic acid)	40 2, 31-2	250 3[280]								Semicarbazone, 144-6, ac a
24	***d, l*-α-Campholytic acid** (1,5,5-Trimethylcyclopenten-4-carboxylic acid)	40 5	162-5[45], *l* 240-3					103, w	b p 200		Nitrile, b p 200-5
25	**β-Chloropropionic acid**	41, w , 39, lgr	204						b p 155-7, D^0 1 198	b p 162, D_4^{20} 1 1086, n_D^{20} 1 42537	Nitrile, b p 175-6, $D^{18\,5}$ 1 1443
26	***d,l*-α-Ethylphenylacetic acid** (*d,l*-α-Phenylbutanoic acid)	42	270					85-7, 83			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	*p* Toluidide	Anilide	*p* Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
27	**α-Ethylpimelic acid**	43	223[17]		145						
28	**Tridecylic acid** (*n*-Tridecanoic acid)	43, 41 6	312, 177[10]	88	80		75 0	100			
29	**Lauric acid** (*n*-Dodecanoic acid)	44, 42	299	87	78		76	100, 99			
30	***d,l*-α-Bromoisovaleric acid**	44	230d	124	116			133, bz	b p 174	b p 186	
31	**Elaidic acid** (*trans*-Oleic acid)	44 5, 51	234[15]				65	93-4, 89 90			*p*-Phenylphenacyl ester, 73 5, *p*-Chlorophenacyl ester, 56
32	**4-Cyanobutanoic acid** (γ-Cyanobutyric acid)	45						69 70, sealed tube		b p 245	
33	**Dimethylneopentylacetic acid**	45	230[732]					71			
34	***trans*-2-Methyl-2-butenoic acid** (Angelic acid)	45 6	185 (cor)		126, bz			127-8			Isobutyl ester, b p 177 2-Naphthylamide, 135, bz , Heating 2 hours in sealed tube → tiglic acid, 64-5
35	**Dibromoacetic acid**	48	232-5					156			
36	**α-Bromoisobutyric acid** (α-Bromoisobutanoic acid)	48 9	198 200	92 5, al	83, al -w			148			*o*-Toluidide, 63
37	***tert*-Butylpropiolic acid**	48-9	110[10]						b p 66[13], D^0 0 9209	b p 75[15], D^0 0 9209	
38	**Hydrocinnamic acid** (β-Phenylpropionic acid)	48 7, 40	279-80 (cor)	135	98, 96	36 3	104	105, 82			*p*-Phenylphenacyl ester, 95
39	**β-Cyanopropionic acid**	48-50						97, sealed tube	b p 215, n_D^{20} 1 42427, D^{20} 1 0792	b p 220[754] D^{20} 1 0353	..
40	**Benzylpyruvic acid**	49 50 (+½ H_2O), w						180			Semicarbazone, 175d , Oxime, 65, Phenylhydrazone, 144-5
41	**Bromoacetic acid**	50	208		131	88		91	b p 144d	b p 168-9	
42	**2-Pentynoic acid** (Ethylpropiolic acid)	50	100[10]					146			
43	**γ-Phenylbutyric acid**	52	290					84			
44	***n*-Pentadecylic acid** (*n*-Pentadecanoic acid)	52 3	212[16]		78	39 5-40 (cor)	77 2	102 5			
45	**β-Campholenic acid**	53 5	245					86		222 5	Nitrile, 225, D^{20} 0 9093
46	**Myristic acid** (Tetradecanoic acid)	53 9	202[16]	93	84		81	103			
47	**Trichloroacetic acid**	57 8	197 5	113	97, 94	80		141	b p 153 8	b p 168	Phenylhydrazide, 123
48	**α-Acetoxypropionic acid** (O-Acetyllactic acid)	57 60, 39-40	167-70[78]								Nitrile, b p 172-3
49	**β-Acetylglutaric acid**	58						*mono* 141-2, al -eth	89		
50	***sec*-*n*-Amylmalonic acid** (2-Ethylbutane-1,1-dicarboxylic acid, *sec*-*n*-Pentylmalonic acid)	58, bz			*di* 219-20					*di* b p 243 5	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p*-Toluidide	Anilide	*p* Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
51	*trans*-**Brassidic acid**	59 7	256[10]		78		94 2	94			
52	**5-Phenylpentanoic acid**	60			90			109			
53	**β-Cyclohexylacrylic acid**	60	154[11]					159			
54	**β-Chloroisocrotonic acid**	61	195 (subl)		108			110	b p 142	b p 161	
55	**Margaric acid** (*n*-Heptadecanoic acid)	61 2	231[16]			48 5 9 0 (cor)	82 6	108, 106			
56	**Chloroacetic acid**	α 61 3, β 56 2 γ 52 5	189	162	136 7		104	121	b p 130	b p 145 6	
57	**β-Bromopropionic acid**	62 5						111	b p 80[27], D[17] 1 4897	b p 70[12], D[15] 1 2609	2-Naphthylamide, 174
58	**Palmitic acid** (Hexadecanoic acid)	62 7	222[16]	98	90 6, al	42 5	86, 82	106 7, 105 3, al			
59	*cis*-**2-Methyl-2-butenoic acid** (Tiglic acid)	64 5 5 0	198 5 (cor)	70 0 1 5	77, pet eth	64	68	75 6, bz			
60	**Cyanoacetic acid**	66			198-9			119-20	b p 200	b p 207	Nitrile, 29-30, b p 218 9
61	**Benzoylformic acid**	66						91			Nitrile, 32-3, b p 206-8, 2,4-Dinitrophenylhydrazone, 196-7d (cor), Phenylhydrazone, 64
62	**Acetoxyacetic acid**	66-8, bz	145[12]		89-90, w					b p 179, D[17] 1 0993	
63	**2,3-Dibromopropionic acid**	67, stab , 51, unst	160[20]					130			
64	**3,3-Dimethylacrylic acid**	67	106[20]					108			
65	**2-Furylacetic acid**	67			85						
66	**3,3,4,4-Tetramethylpentanoic acid**	67						138			
67	**4-Ketocyclohexanecarboxylic acid** (4-Oxocyclohexanecarboxylic acid)	67-8, bz - pet eth							b p 140[20]	b p 158[40]	Semicarbazone, 200d , Oxime, 147, eth
68	*d,l*-**2-Phenyllactic acid**	68 (+½ H_2O), w 94 (anh), *d* 116-7, w , *l* 115 6, bz						101 2, dichloroethylene, *l* 62 5 3 5, bz			*d,l*-Et eth , 60-2, lgr , *d*-Quinine salt, 216d , al , *l*-l-Menthyl ester, 55 5-6 0
69	*d*-**Chaulmoogric acid** (*d*-ω-Cyclopentyltridecanoic acid)	68 5	247-8[20]	100	89			106, al	22	b p 230[20], D_4^{15} 0 9064	$[\alpha]_D$ +62 in chl
70	**Stearic acid** (Octadecanoic acid)	70-1, 69 6		102	95 5, al		92	109, 108 4, al			
71	*trans*-**Crotonic acid** (*trans*-2-Butenoic acid)	72, w	189 (cor)	132, bz	118, w , 115	67 4	95 6	159-60, bz	b p 121	b p 138, D_4^{20} 0 9175, n_D^{20} 1 42524	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
72	**γ-Bromocrotonic acid**	74, lgr						101	b p 87[15], D_4^{19} 1 490 n_D^{19} 1 498	b p 97-8[15], D_4^{16} 1 402, n_D^{19} 1 490	
73	**Caproylacetic acid**	74d						100	b p 118[19], D_4^0 0 9916	b p 127[19], D^0 0 9721	Nitrile, b p 127-8[14], D^{15} 0 9914
74	**3-Ketocyclohexanecarboxylic acid** (3-Oxocyclohexane-carboxylic acid)	75 6, bz	195-7[20]							b p 138[18]	Semicarbazone, 183-4, al, Oxime, 170d, w, Phenylhydrazone, 125, yel
75	**2-Thienylacetic acid**	76						148			
76	***sec*-Butylmalonic acid** (Isopentane-1,1-dicarboxylic acid)	76						*di* 242	*di* b p 217 8[748]	*di* b p 245-50[762]	
77	**Phenylacetic acid**	76 5, subl	256 5 (cor)	135-6	117-8	65	89	156			
78	**Eicosanoic acid** (Arachidic acid)	77, 75	204[1]	96	92		89	108 9			
79	**Glycolic acid** (Hydroxyacetic acid)	78 9, 80		143, w	97, w	106 8	138	120, al - et ac			On prolonged heating at 100° → anh, 128 30
80	**α-Hydroxyisobutyric acid** (2-Hydroxyisobutanoic acid Dimethylglycolic acid)	79	212	132-3, w	136, w	80 5	98, acet				
81	**α-Methylcinnamic acid**	81, 74						128			
82	**2-Ketocyclohexanecarboxylic acid** (2-Oxocyclohexane-carboxylic acid)	81-2, eth								b p 107-8[12], 159-60[100]	Alcoholic sol + $FeCl_3$ → blue color
83	***n*-Docosanoic acid** (Behenic acid)	81-2			101 2			111	54	50	
84	**β-Iodopropionic acid**	82, 85						101 142			
85	**α-Benzoylpropionic acid**	82-3, bz - pet eth			137-8, al			145-6			Phenylhydrazone, 100 4, br, bz
86	**Iodoacetic acid**	83						95			
87	**γ-Chlorocrotonic acid**	83	117 8[13]					130-2, w		b p 191-3[750]	Nitrile, b p 73[15], D^0 1 1495
88	**Lignoceric acid** (Tetracosanoic acid)	84					91				*p*-Chlorophenacyl ester, 100
89	**β-Methyladipic acid**	85, 91	223[18]		200						
90	**α-Benzoylbutyric acid** (α-Benzoylbutanoic acid)	85-7						148-9		b p 168-71[19]	Nitrile, b p 134-5[3]
91	***d,l*-α-Bromophenylacetic acid**	86, 84						148, 144			Nitrile, 29, b p 242d
92	**(4-Methoxyphenyl)acetic acid**	87, 84						189			
93	**Dineopentylacetic acid**	88						140			
94	**Dibenzylacetic acid**	89		175, abs al	155, abs al			128-9, bz			
95	**(2-Tolyl)acetic acid**	90, 88						161			
96	**α-Thienylglyoxylic acid**	91						88			
97	**Δ[5]-Campholytic acid** (4,5,5-Trimethylcyclopentene-1-carboxylic acid)	91						90, lgr			
98	**Citraconic acid** (Methylmaleic acid)	92d, 92-3, 91d, eth -lgr		*mono* 170-1, yel, eth	*mono* 153, *di* 175 5, al	*di* 70 6		*di* 185-7d	*di* b p 210-1	*di* b p 231	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
99	**2-Bromobenzoylformic acid**	93-101						136-7, w			Nitrile, 62-4, yel, Oxime, 162-4d
100	**β-Chlorocrotonic acid**	94	206-11 sl d		123-4			100 1	b p 64 7^{14}, D_4^{22} 1 555, n_D^{20} 1 463	b p 180, 184, D_4^{20} 1 1062, n_D^{20} 1 459	1-Naphthylamide, 169-70
101	**Phenyl-*n*-propylglycolic acid**	94						132			
102	**(2-Chlorophenyl)acetic acid**	95, w		170	138 5			175, w			Nitrile, 25, b p 251, *o*-Toluidide, 174
103	**(4-Tolyl)acetic acid**	95, 91	159^{15}					185			
104	***o*-Chlorohydrocinnamic acid**	96 5, w						119, bz	b p 255		Nitrile, b p 267-8
105	**2-Hydroxy-3-phenylpropionic acid**	97, 96						112			
106	**1,2,3,4-Tetrahydro-2-naphthoic acid**	97						139			
107	**Glutaric acid** (1,3-Propanedicarboxylic acid)	98	302 4	*dl* 218	*dl* 223 4	*dl* 69	*dl* 136 8	*dl* 175-6			
108	**3-Phenoxypropionic acid**	98						119			
109	**α-Crotonic acid**	99	212					112	161	176	Nitrile, b p 136
110	**Phenoxyacetic acid**	98-9, 99 100	285d		99, al		148 5	101 5			
111	**2-Benzofurylacetic acid**	99						164			
112	**1-Naphthylglycolic acid**	99 124-5						135			
113	**Citric acid**	100 (+1 H_2O), 153 (anh)		*tri* 189, al	*tri* 192	*tri* 102	*tri* 148	*tri* 210-5d, w			
114	**2-Methoxybenzoic acid** (*o*-Anisic acid Salicylic acid methyl ether)	100 1	200				113	129			
115	***l*-Malic acid** (Hydroxysuccinic acid)	100-1		*dl* 206-7	*dl* 197	*mono* 87 2, *dl* 124 5	*dl* 179	*dl* 156-7, *d,l* 162 3			
116	**Oxalic acid**	101 (+2 H_2O) (rapid htng), 189 5 (anh) subl at 150-60		*mono* 169, *dl* 268	*mono* 148 9, *dl* 254, 246, bz	*dl* 204		*mono* 219, *dl* 419d			
117	**Acetylpyruvic acid** (2,4-Diketo-*n*-valeric acid, 2,4-Dioxopentanoic acid)	101, bz						131-2d, al	63-4		
118	***n*-Butylmalonic acid** (Pentane-1,1-dicarboxylic acid)	101			*dl* 193			*dl* 200		*dl* b p 235-40	Mononitrile, 122 5-6 5, w, subl
119	**α-Cyanohydrocinnamic acid** (Benzylcyanoacetic acid)	101-2						130		b p $176-85^{21}$	
120	**2-Chloro-6-methylbenzoic acid**	102, w						167			Nitrile, 82-3, pet eth
121	**Aleuritic acid** (9,10,16-Trihydroxypalmitic acid)	102, w							63-4		Hydrazide, 139-40, Azide, 50d, al

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
122	**(2-Bromophenyl)acetic acid**	103 4, 109						186 7			Nitrile, b p 145 7^{14}
123	**Benzylacetic acid**	103 4d			107 8			113			Nitrile, 80 1, 1-Menthyl ester, 41
124	**Pimelic acid**	104–5, subl	223^{15}	*di* 206, al	*mono* 108 9 *di* 155 6, me al -w		*di* 136 6	*di* 175			
125	**2-Toluic acid** (2-Methylbenzoic acid)	104 5, 107 8	259^{751}	144	125	90 7	57	142 8 (cor)			
126	**Allylmalonic acid**	105, eth				46, al				*di* b p 222-3	Mononitrile, b p 223, Dinitrile, b p 217 8
127	**(4-Chlorophenyl)acetic acid**	105–6, 104		190	164 5, al			175, al		32, b p 260	*o*-Toluidide, 190, bz Nitrile, 30, b p 265–7
128	**Δ^2-Cyclogeranic acid** (1,5,5-Trimethylcyclohexene-6-carboxylic acid)	106, lgr	138^{11}					120 1, bz - pet eth		b p 101 2^{10}	
129	***d*-Campholic acid** (*d*-1,2,2,3-Tetramethylcyclopentane-1-carboxylic acid)	106, *d l* 109	255		91			80, *d l* 90	b p 208	b p 220	Nitrile, 73, Anhydride, 56, *d l* 66
130	**Atropic acid** (1-Phenylacrylic acid)	106–7, w			134			121 2, w		b p 124^{16}, n_D^{16} 1 52605	
131	***l*-Campholic acid**	106–7	250					78–9	b p 211	b p 228	Anhydride, 57 8
132	**Azelaic acid** (Heptane-1,7-dicarboxylic acid)	106 5	>360 sl d , 237^{15}	*di* 201 2	*mono* 107–8, dil al , *di* 186 7	*di* 43 8	*di* 130 6	*mono* 93–5, *di* 175			
133	**Methylneopentylglycolic acid**	109						116			
134	***trans*-4-Methylcyclohexanecarboxylic acid**	111						226			
135	***cis*-α-Chloroallocinnamic acid**	111			138 9, al -w			134, bz	b p 153 4^{28}	b p 157 8^{10}, D_4^{25} 1 1569 n_D^{25} 1 5525	
136	**Ethylmalonic acid**	111			150	75		*di* 214			
137	**3-Toluic acid** (3-Methylbenzoic acid)	111 3, 110–1	263, subl	118	126	86 6	108	94, 97			
138	**O-Benzoyllactic acid** (Lactic acid benzoate)	112						124		b p 288	Nitrile, b p 269–70, 1-Naphthylamide, 155, 2-Naphthylamide, 177
139	**2,4,6-Triethylbenzoic acid**	113						156			
140	**2-Phenylbenzoic acid**	113						177			
141	**(1-Naphthyl)glyoxylic acid**	113						151			
142	**Bromomalonic acid**	113d		*di* 217, ac a				*di* 181, al	*di* b p 215–25	*di* b p 233–5d	Dinitrile, 65–6
143	**(4-Bromophenyl)acetic acid**	114, subl						192 4		30	Nitrile, 46 7
144	**2-Acetylbenzoic acid** (Acetophenone-*o*-carboxylic acid)	114–5						116 5, w			Oxime, 159, 2,4-Dinitrophenylhydrazone, 186

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitro benzyl ester	*p*-Bromo-phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
145	**Pyrotartaric acid** (Methyl-succinic acid)	115		164	*mono* 159, et ac 123, chl *dl* 200			*dl* 225			
146	**2-Phenoxypropionic acid**	115-6, 112-3		115	117 118 9			132 3, 130			
147	**3-Benzoylpropionic acid**	116			150, 145			145-6, w		18 9	Semicarbazone, 181d
148	**Benzylmalonic acid**	117d, 121			*dl* 217	*dl* 119 5		*dl* 225			Dinitrile, 91, 79
149	***d l*-Tropic acid** (3 Hydroxy-2 phenylpropionic acid)	117 8 *d* 130						169			
150	**Cuminic acid** (4 Isopropyl benzoic acid)	117-8, al						133		b p 263 4	Nitrile, b p 243-4[734]
151	***d l*-Mandelic acid** (α-Hydroxy-phenylacetic acid)	118, *d* 133 *l* 134		172, al	151 2, al	123 4		133 4 (cor)			
152	***l*-Arabonic acid**	118 9, al		200	204			136, me al			*o*-Toluidide, 172
153	**α-Chlorodiphenylacetic acid**	118-9d, bz -lgr			88			115		43 4	Anhydride, 219
154	***d l*-Citramalic acid** (*d l*-2-Hydroxy-2-methylsuccinic acid)	119						*mono* 140 1	*dl* b p 112[15]		Me eth, 90 2 Et eth, 81 3
155	**Anilinomalonic acid**	119d, al -lgr			*mono* 157d, w *dl* 162, 246 7, ac a			*dl* 156	*dl* 68	*dl* 45, al	
156	**4-Chloromandelic acid**	119 22, 112 3						122 3			Nitrile, 43 Me eth 85-8, bz pet eth
157	**(3-Nitrophenyl)acetic acid**	120						110			
158	***cis*-2-Bromoallocinnamic acid**	120						129	b p 111°6, D_4^{20} 1 4726	b p 173 4[30], D_4^{25} 1 3713	
159	**3-Furoic acid** (3 Furancar-boxylic acid)	121						169			
160	**1-Cyclopentenylcarboxylic acid**	121		122	126						
161	**Cetylmalonic acid** (Heptade-cane-1,1-dicarboxylic acid)	121 5 2 0, ac a						*mono* 130 50d, lgr -al	*dl* 44, eth	*dl* 22	
162	***cis*-1,3-Cyclopentanedicar-boxylic acid**	122 *trans* 161						226			
163	***d l-trans*-Camphenic acid** (*d l-trans*-Camphene-camphoric acid)	122 3, ac a			*dl* 165, ac a			*dl* 231 2, ac a			
164	**Benzoic acid**	122.4, at 100, subl	249	158	160, boil 50% al	89	119 0	130	b p 199 6	b p 212 6	
165	**3,3,3-Trichlorolactic acid**	124			164			96			
166	**3-Nitrosalicylic acid**	125 (hyd)						145			
167	**Diethylmalonic acid**	125				*dl* 91		*mono* 146, *dl* 224			
168	**1,14-Tetradecanedicarboxylic acid**	126			163						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
169	**2,4-Dimethylbenzoic acid**	127 (anh) 90 (hyd)			141			179-81			
170	*cis*-**2-Chloroallocinnamic acid**	127						112			
171	**2-Benzoylbenzoic acid** (Benzophenone-2-carboxylic acid)	128, 91 (+1 H_2O), w			195	100 4		165 (cor)	52		
172	**1,10-Decanedicarboxylic acid**	128						185			
173	**2-Thenoic acid** (2-Thiophenecarboxylic acid)	129						180			
174	**4-Bromopyromucic acid** (4-Bromofuran-2-carboxylic acid)	129						155-6		29 b p 235 6	
175	**Maleic acid** (*cis*-Butenedioic acid)	130 (+30% Fumaric a), 137 (pure)		*di* 142, eth	*mono* 198, 187, yel , al , *di* 187, al	*di* 91 (cor)	168 70, 190	*mono* 172 3, w 153 sl d , *di* 260, 181, me al			Heated at 160 → anh , 60, b p 202
176	**Tribromoacetic acid**	131, 135	245d					122			
177	**(1-Naphthyl)acetic acid** (1-Naphthaleneacetic acid)	131, 135			155, al , 159 6			180 1, al			
178	*trans*-α-**Bromocinnamic acid**	131-2						119	23	b p 294-6	
179	**2,5-Dimethylbenzoic acid**	132			140			186			
180	*cis*-β-**Chloroallocinnamic acid**	132		142	134 5			76	34	b p 265 sl d	
181	*trans*-**Cinnamic acid**	133	300	168	153, 109	116 8	145 6	147 8			Nitrile, 20-1, b p 255 6
182	**Chloromalonic acid**	133			*di* 118, w			*di* 170	*di* b p 206-8[772]	*di* b p 222	Di-*p*-bromoanilide 239
183	**Sebacic acid** (Decanedioic acid, Octane-1,8-dicarboxylic acid)	33, subl	243[15]	*di* 201	*mono* 122 3, *di* 201 2	*di* 73 5, 72 6	*di* 147	*mono* 170, *di* 210, 208			Phenylhydrazide, 194
184	**2-Furoic acid** (2-Furancarboxylic acid, Pyromucic acid)	133-4, 132	230-2	170 5, al	123 5, al	133 5	138 5	142 3		34, b p 195	
185	**Malonic acid** (Propanedioic acid)	134 8- 9		*mono* 156d , *di* 252-3, al	*mono* 132, *di* 230, 227-8, al	*di* 85 5		*mono* 106 10, *di* 170, w -al		*di* b p 199	Phenylhydrazide, 194
186	**O-Acetylsalicylic acid** (Aspirin)	135, rapid htng	140d		136	90 5		138			Phenacyl ester, 105
187	β-**Campholytic acid** (1,5,5-Trimethylcyclopentene-2-carboxylic acid)	135	247-9, 255-6	114	104, al - w			130	b p 203 4	b p 214	
188	**2-Anilinoisovaleric acid**	135, w						102 3		b p 275-80	
189	**Acetone-1,3-dicarboxylic acid**	135d , et ac			*di* 155, al						Oxime, 53 4 w Acids or alkalis → acetone b p 56 + CO_2
190	*d l-cis*-**Camphenic acid** (*d l cis*-Camphenecamphoric acid)	135-7			*di* 212			*di* 225			
191	**Phenylpropiolic acid**	136-7, subl		142	128, 126, 125	83		99-100, 109			Melts under w at 80

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
192	***trans*-Glutaconic acid**	136–8			*mono* 167, *di* 228						Acetic anhydride → anh 88
193	**3-Ethoxybenzoic acid**	137						139 0– 5			
194	**Methylmalonic acid**	137, 138d		*mono* 145d, *di* 228, 214				217, 206			
195	***trans*-α-Chlorocinnamic acid**	137–8		116, al	118, al			121 2	33	b p 209[75], D_4^{25} 1 1719, n_D^{25} 1 5705	
196	**3-Thenoic acid** (3-Thiophenecarboxylic acid)	138					130	180			
197	***cis*-Cyclobutane-1,2-dicarboxylic acid**	138						*di* 228, w	*di* b p 225	*di* b p 238–42[720]	Anhydride, 75 71–3
198	**2-Pyridinecarboxylic acid** (Picolinic acid)	138						107			
199	**(3-Chloromethyl)benzoic acid**	138, w						124		b p 168 9[25]	Nitrile 67 al b p 258 60
200	**5-Chloro-2-nitrobenzoic acid**	139, w			164, eth			154, eth	48 5, me al		Methylamide, 134, al -w, Dimethylamide, 104 5
201	**Anhydrocamphoronic acid**	139			202 3				α 138, β 45		
202	**Butane-1,1,4-tricarboxylic acid**	139 40, bz -et ac			*mono* 177					*tri* b p 175 6[18], D^{15} 1 0726	
203	***meso*-Tartaric acid**	140			*mono* 193–4, pa yel, w	93		*di* 187, 189 90, dil me al			Diphenylhydrazide 245
204	**3-Nitrobenzoic acid**	140		162	154	141	132	143	78 5, 70	47, 40–1	
205	**3-Bromo-4-toluic acid** (2-Bromo-4-methylbenzoic acid)	140						137, subl			Nitrile, 47
206	**2-Chloro-4-nitrobenzoic acid**	140–2			168			172, al	73–5		
207	**(2-Nitrophenyl)acetic acid**	141, 138						161			
208	**Furanacrylic acid** (β-(2-Furyl)-acrylic acid)	141	286					168 9			
209	**2-Anilinobutyric acid**	141			92, al			123, w		26, b p 278	Nitrile, 39
210	**(2-Naphthyl)acetic acid** (2-Naphthaleneacetic acid)	141–2, 143						200, 205			
211	**4-Chloro-2-nitrobenzoic acid**	142, w						172, al	41 3		Nitrile, 98
212	***trans*-β-Chlorocinnamic acid**	142		122–5	128			118	29	b p 293	
213	**2-Chlorobenzoic acid**	142, 140		131	114, 118, pet eth	106	106	142, 202	b p 234	b p 243	
214	**(2-Bromophenoxy)acetic acid**	142 5, al						151, al		b p 160 70[16]	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	*p*-Toluidide	Anilide	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
215	**Suberic acid** (Octanedioic acid, Hexane-1,6-dicarboxylic acid)	144, 139 41		*di* 218, 219	*mono* 128 9, *di* 186–7	*di* 85	*di* 144 2	*mono* 125 7, *di* 216–7		*di* b p 282 6	
216	**Asaronic acid** (2,4,5-Trimethoxybenzoic acid)	144, bz - pet eth	*ca* 300		154 5			184 5	97 5, yel	72, yel	Nitrile, 112–4, al
217	**(2-Chlorophenoxy)acetic acid**	145 6, w			121			149 5	b p 186 8	32	
218	**2-Nitrobenzoic acid**	146			155	112	107	176	b p 275, 269, D_4^{20} 1 286	30, b p 148 50[10]	
219	**Phthalonic acid**	146			*mono* 176 *di* 208			α 179d β 155d			Phenylhydrazone, 171 2
220	**(2-Hydroxyphenyl)acetic acid**	147 149, 141						118			
221	**2-Anilinovaleric acid** (2-Anilinopentanoic acid)	147–8, al -w						99, eth - pet eth			Nitrile, 51, pet eth
222	**Diphenylacetic acid**	148		172 3	180			167 5 8 0			
223	**Diglycolic acid**	148, 142		*mono* 148, w	*mono* 118, *di* 152, eth al (2 1)			*mono* 135			
224	**Oxanilic acid**	148 9			*di* 154			228			
225	**(4-Hydroxyphenyl)acetic acid**	148 50, 148, w						175			Benzoate of amide, 167 9
226	**2-Bromobenzoic acid**	150			141	110	102	155	b p 243 4	b p 254–5	
227	**Benzilic acid** (α-Hydroxydiphenylacetic acid)	150		189–90	174 5	99 5	152	153, chl , 154 5	74–5	34	Acetate, 98, ac a
228	**Citric acid** (2-Hydroxypropane-1,2,3-tricarboxylic acid)	153 (slow htng)		*tri* 189 al	*tri* 192, al -w	*tri* 102	*tri* 148	*tri* 210 5d			Triphenyl ester, 124
229	**(4-Nitrophenyl)acetic acid**	153			198		207	198			
230	**2,5-Dichlorobenzoic acid**	153						155			
231	**Phenylmalonic acid**	153						233			
232	**Adipic acid** (Butane 1,4-dicarboxylic acid)	153 4 (cor)	216[15]	241	*mono* 151 3 w *di* 240 1 al	106	154 5, 152 6	*mono* 125 30, w , *di* 220	3, b p 162[10]	*di* 8, b p 112[10], f p 0	Diphenyl ester, 105–6, al -w
233	**(4-Bromophenoxy)acetic acid**	153–4 al								54, al	Phenyl ester, 73, al
234	**Phenylpyruvic acid**	154									Oxime, 159
235	**3-Bromobenzoic acid**	155			136	105	120	155	31 2	b p 254–5	
236	**2,4,6-Trimethylbenzoic acid**	155, 153						188			
237	**2-Chloro-4-methylbenzoic acid**	155–6						182			Nitrile, 61–2, subl
238	**(4-Chlorophenoxy)acetic acid**	155 6, w , 158			125		136	133	b p 177 80	49	
239	**3-(1-Naphthyl)propionic acid**	156						104			
240	**Tartronic acid** (Hydroxymalonic acid)	156 8d						*di* 198, dil al , 195–6d			
241	**Benzoylpyruvic acid**	156 8d (+1 H_2O), al -w						138d	59, 62	46	1-Oxime, 98–100d (+1 H_2O)

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p*-Toluidide	Anilide	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
242	**Cyclobutane-1,1-dicarboxylic acid**	157, w 158			*di* 214 5			*di* 275 7		b p 218 ¹² *di* b p 222 6	Dihydrazide 109 10 al -w
243	**3-Chlorobenzoic acid**	158 155			122 5 al	107	116	134	21 b p 231	b p 245	
244	**Salicylic acid** (2 Hydroxy-benzoic acid)	158 3, subl at 76		156	136	97 8	140	142 139	−8 6 b p 223 3	1 3 b p 234 231 5	
245	**1-Naphthoic acid**	161 2 (cor)			162 3 164		135 5	202 205			
246	**2-Iodobenzoic acid**	162			141	111	143	110	184		
247	**2-Anilinopropionic acid**	162, w			127, al			144		b p 272	Nitrile, 92, al N-Acetyl, 143, w
248	**4-Dibenzothienylacetic acid**	162						206			
249	**Alloxanic acid**	162 3d , eth						191, w	171, et ac	115, acet - chl	Phenylamide 99, eth
250	**5-Chloro-3-nitrosalicylic acid** (5-Chloro-2-hydroxy-3-nitro benzoic acid)	163						199		91, al	
251	**2-Benzofurylacetic acid**	163						210			
252	**Cholanic acid**	164, ac a						175		93-4, 80% al	$[\alpha]_D^{14}$ +21 74 in chl , Propyl ester 56-7, Butyl ester, 53
253	**4-Nitrophthalic acid**	165		*mono* 172	192			200d			
254	**Itaconic acid** (Methylene-succinic acid)	165			*mono* 151 5, eth	*di* 90 6	*di* 117 4	*di* 191 2 8, al			
255	**5-Bromosalicylic acid** (5-Bromo-2-hydroxybenzoic acid)	165			222			232	61, b p 264 6	50	
256	**6-Chloro-3-nitrobenzoic acid**	165, w						178, w	73, me al	28 9	Nitrile, 105-6
257	**3,4-Dimethylbenzoic acid**	166, 164			104, 108			130			
258	**Tricarballylic acid** (Propane-1,2,3-tricarboxylic acid)	166			*tri* 252, $PhNO_2$		*tri* 138 2	*tri* 205 7d			
259	**Mesitylenic acid** (3,5-Dimethyl-benzoic acid)	166						133			
260	***d,l*-Phenylsuccinic acid**	167-8, 84 (anh), *d l* 173 4		*mono* (α) 175, *mono* (β) 168-9	*mono* (α) 175, *mono* (β) 171, *di* 222			*mono* (α) 158 9 *mono* (β) 145, *di* 211			
261	**Mesitylacetic acid**	168						210			
262	**3-Chloro-4-hydroxybenzoic acid**	169 70, w , 164-5						180 2	106 7	77 8	Nitrile, 155
263	***d*-Tartaric acid**	169 71			*mono* 180d , 194 (cor), ac a , *di* 263 4d , al	*di* 163	*di* 204	*mono* 171-2, *di* 196d , al			Phenylhydrazide, 240

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
264	**Azobenzene-3-carboxylic acid**	170 1, or , al						198-9, or , al	58, me al		
265	**2,2-Diphenylpropionic acid**	171 175						149			
266	**8-Chloro-1-naphthoic acid**	171 2, al -w						207 5, red, al		50	
267	**4-Bromo-2,5-dimethylbenzoic acid**	171 5 2 5, lgr						209-10			Nitrile, 103-4
268	**5-Chlorosalicylic acid** (5-Chloro-2-hydroxybenzoic acid)	172 w						226-7	50, b p 249d	25	Nitrile, 165-7, Phenyl ester, 81-3, Me eth , 81-2, Et ester, 118
269	**4-Chloro-2-methylbenzoic acid**	172						183		b p 258	Nitrile, 67
270	**2,4-Dibromobenzoic acid**	174						198			
271	**3-Aldehydeobenzoic acid** (3 Formylbenzoic acid)	175						190d	53	b p 278	Nitrile, 79-81, eth , Semicarbazone, 265, Phenylhydrazone, 164
272	**3-Thianaphthenecarboxylic acid**	175			173			198			
273	**Apiolic acid** (2,5-Dimethoxy 3,4-methylenedioxybenzoic acid)	175, w							71-2, w		Nitrile, 135 5, al -w
274	**Allomucic acid** (2,3 4,5-Tetrahydroxyadipic acid)	176d , w						175 6, w , *di* 209d , w		*di* 139-41 al	Polyphenylhydrazide, 218d , al
275	**8-Bromo-1-naphthoic acid**	178, bz			151, al			179-80	33, pet eth	52, pet eth	
276	**3-Phenanthrylacetic acid**	178						176			
277	**Acetylenedicarboxylic acid**	179						*di* 294d			
278	**4-Toluic acid** (4-Methylbenzoic acid)	179 80, subl 182	275 (cor)	160, 165	144 5, 148, 140	104 5	153	160, 158			
279	**6-Bromo-3-nitrobenzoic acid**	180			166, al			197-8	82	66	Nitrile, 117, subl
280	**5-Bromo-2,4-dimethylbenzoic acid**	180 1						197 5-8 5			Nitrile, 88-9
281	**Veratric acid** (3 4 Di methoxybenzoic acid)	181 (anh)			154			164			
282	***N*-Benzoylanthranilic acid** (2 Benzamidobenzoic acid)	181			279			218-9	100	98	Nitrile, 156
283	**4-Chloro-3-nitrobenzoic acid**	181-2			131			156, al	83, me al	59, yel	Nitrile, 100-1
284	**3,5-Dinitrosalicylic acid** (3,5-Dinitro-2-hydroxybenzoic acid)	182 (anh) 174 (+1H_2O)						181			
285	**4-Fluorobenzoic acid**	182 182 6						154, 154 5			Nitrile, 35
286	**4-Chloropicolinic acid** (4-Chloropyridine-2-carboxylic acid)	182d						158, 152-4	57-8		Phenyl ester, 68, pet eth
287	**2,4-Dinitrobenzoic acid**	183				142	158	203			
288	**2-Naphthoic acid**	184, 185 5		192, al	171, bz , 173			192-3, al , 195			
289	**3-Bromosalicylic acid** (3-Bromo-2-hydroxybenzoic acid)	184						165			Nitrile, 49-50
290	**2-Anilinoisobutyric acid** (2-Anilinoisobutanoic acid)	184 5, w			155, al			136			Nitrile, 93-4, al
291	**4-Anisic acid** (4-Methoxybenzoic acid)	184 6, 184 2 (cor)	275-80	186	169-71	132	152	167, 162-3, w			

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	*p*-Toluidide	Anilide	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
292	**(2-Carboxyphenyl)acetic acid** (Homophthalic acid)	185, 180						228			
293	**Acetylanthranilic acid**	185, ac a			167 8, al			177, al			Nitrile, 133, w, *N*-Methylamide, 172 al
294	**Succinic acid** (Butanedioic acid, Ethane-1,2-dicarboxylic acid)	185, 182 8	235d	*mono* 179 80, *di* 254 5–5 5, 260	*mono* 148 5, *di* 230, al	*di* 88	*di* 211 0	*mono* 157 *di* 260d, w			
295	**5-Bromopyromucic acid** (5-Bromofuran-2-carboxylic acid)	186, w						144 5		b p 234	Hydrazide 135 5 6 0, Azide, 66 7
296	**Hippuric acid**	187			208	136	151	183			
297	**3-Iodobenzoic acid**	187				121	128	186			
298	**5-Bromo-2-toluic acid** (4-Bromo-2-methylbenzoic acid)	187, subl						180			Nitrile, 70
299	**2-Cyanobenzoic acid** (Phthalic acid mononitrile)	187, 192						173	151	70	
300	**3-Nitroanisic acid** (4-Methoxy-3-nitrobenzoic acid)	187			163						
301	**Fluorene-2-acetic acid**	187						266			
302	**Coumarin-3-carboxylic acid**	187d, w			250			236	116–7	94	Nitrile, 182
303	*d*-**Camphoric acid** (1,2,2-Trimethylcyclopentane-1,3-dicarboxylic acid)	187 5–8 0, *l* 187, *d,l* 202, 208		(*α*) 212–4, (*β*) 190–6	*mono* (*α*) 204, 209 10, *mono* (*β*) 196, *di* 226, *di*, *l* 226	65 5		*mono* (*α*-amide-*β*-acid) 176, *mono* (*β*-amide-*α*-acid) 182–3, *di* 192–3	(*α*) 77 (*β*) 86 *di* b p 263 4	(*α*) 47 8 (*β*) 57 *di* b p 285 6	
304	**3-Bromophthalic acid**	188								*mono* 127 8	Anhydride, 132–4
305	**4-Bromo-3,5-dinitrobenzoic acid**	188, al						188, pa yel, al -w	125 me al -w	118, al -w	
306	**Butane-1,2,3,4-tetracarboxylic acid** (low melting form)	189, w			187 (rapid htng), al -w			*di* 181d, dil H_2SO_4 *tetra* 310d, w	*tetra* 75–6, w	*di* 168 w	Heating → monoanh of high melting form
307	**Anthroxanic acid**	190, 196d						211–2, w	70	64–5	
308	**α-Chrysenic acid** (*o*-2-Naphthylbenzoic acid)	190						169 70	63		
309	*l*-**Ascorbic acid**	190d, *d,l* 168–9									$[\alpha]_D^{23}$ +48 in me al, Diphenylhydrazone, 178d, red, Di-*p*-nitrophenyl hydrazone 262d al Di 2 4 dinitro phenylhydrazone, 282d, br -red

*Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p*-Toluidide	Amide	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
310	**Chlorofumaric acid**	191 2, ac a			186, al	*di* 138 5			*di* b p 224	*di* b p 250 sl d	Ethyl ester amide, 102
311	***N*-Methylacetylanthranilic acid**	192 3					155				*N*-Methylamide, 171 2 *N*-Ethyl-amide, 140
312	**Coumarilic acid** (Coumarone-2-carboxylic acid)	192 3, w	310 5 sl d		159			159		27	Nitrile, 36, Phenyl ester, 101
313	**Dimethylmalonic acid**	193, subl				83 6		*di* 269			
314	***trans*-Aconitic acid**	194 5d (cor), *cis* 125 → *trans* on heat-ing			*di* 189, *cis*, *mono* 170d , al		*tri* 186	*tri* 250 → br , 260 → sinters			Heat → Itaconic acid, 165
315	**Benzylidenemalonic acid**	195 6d						*di* 189 90	*di* 44	85, *di* 32	Mononitrile, 183 Dinitrile, 87
316	**4-Ethoxybenzoic acid**	198 195 6			169, 170 172			202			
317	***trans*-3-Nitrocinnamic acid**	199 *cis* 138				174	178, 173	196			
318	**Chrysodiphenic acid** (2-Phenyl-naphthalene-1,2'-dicarboxylic acid)	199						1-*mono* 275, 2'-*mono* 220	1-*mono* 171 5, me al , 2'-*mono* 124, *di* 90		
319	**3,4-Dihydroxybenzoic acid** (Protocatechuic acid)	199-200d			166	188		212	134 5 w		
320	**3-Hydroxybenzoic acid**	200, subl		163 dil al	156 7, w 155	106 8	176, 176 1-4	170 167 w			
321	**Phthalic acid** (Benzene-1,2-dicarboxylic acid)	200 6, 191 (sealed tube), 230 (rapid htng)		*mono* 150 (slow htng), 160 5 (rapid htng), *di* 201	*mono* 170 *di* 253-5	*di* 155 5	*di* 152 8	*mono* 149, *di* 220			
322	**3,4-Dichlorobenzoic acid**	201 2, 208 9						133			
323	**(4-Chloromethyl)benzoic acid**	203						173			Nitrile, 79 80, al , b p 263
324	**5-Bromo-2-nitro-4-toluic acid** (2-Bromo-4-methyl-5 nitro-benzoic acid)	203, 200						191		61	Nitrile, 132
325	**4-Bromo-3-nitrobenzoic acid**	203 4			156, or -yel , al			156	104	74	Nitrile, 120
326	***d,l*-Tartaric acid**	203-4 (+1 H_2O) 205 6 (anh)			*di* 235-6	*di* 147 6		*di* 226, w -me al			
327	***cis*-Apocamphoric acid**	204, w , *trans* 190-1, w			*mono* 212						Anhydride, 178, al
328	**3,5-Dinitrobenzoic acid**	204-5			234	157	159	183			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p*-Toluidide	Anilide	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
329	**Mesaconic acid** (Methylfumaric acid)	204 5 (cor), subl		*mono* (α) 196, *di* 212, al	*mono* (α) 202, *mono* (β) 163, *di* 185 7	*di* 134 (cor)		*mono* (α) 222, *mono* (β) 174, *di* 176 5			
330	**5-Bromo-3-nitro-4-toluic acid** (6-Bromo-4-methyl-2-nitrobenzoic acid)	206						171			Nitrile, 130, subl
331	**Anthracene-9-carboxylic acid** (*meso*-Anthroic acid)	207, pa yel , al							111, yel		Nitrile, 170-2, lgr
332	**Vanillic acid**	207, 210				140d				44, b p 293	
333	*trans*-**2-Coumaric acid** (*trans*-2 Hydroxycinnamic acid)	207 8d , subl , w				152 5		209d			Acetate, 154 5, 146, bz
334	**Oxamic acid**	210			148-9			419d			
335	**Pentamethylbenzoic acid**	210						206			
336	**4-Coumaric acid** (4-Hydroxycinnamic acid)	210 3, 206 (anh)						194	137 126		Acetate, 200 5
337	*trans*-**2-Chlorocinnamic acid**	212, yel , al			176			168	10 5, b p 278-9	b p 162[12]	Nitrile, 40
338	**2,4-Dihydroxybenzoic acid** (β-Resorcylic acid)	213d (rapid htng), 216d , 217			126-7	188 9		222			Loses H_2O of crystallization at 100 Easy loss of CO, gives m p varying from 194 to 236
339	**2-Bromo-3,5-dinitrobenzoic acid**	213						216, pa yel , al -w	109, me al -w	74, al	
340	**4-Dibenzofurylacetic acid**	214						212			
341	**Mucic acid**	214d (varies with htng rate) 223 255				310	225	*mono* 192d , *di* 220			
342	**3-Chloroanisic acid** (3-Chloro-4-methoxybenzoic acid)	214 5						193	94 5		
343	**4-Hydroxybenzoic acid**	215, 213-4 210		203-4, al	196 7, yel , w	180 2	191 5 (cor), 184	162 (+1 H_2O), w			
344	**Piperic acid**	216				145					
345	**3-Chloro-2-naphthoic acid**	216 7, me al -w						237	58, me al	50	
346	**3-Nitrophthalic acid**	218		*di* 226	*di* 234	189		*di* 201d			
347	**Acenaphthene-5-carboxylic acid**	219, bz						198			Nitrile, 110-1
348	**4-Cyanobenzoic acid** (Terephthalic acid mononitrile)	219, 214			179	189		223	62	54	
349	**4-Phenylbenzoic acid**	221						223			
350	**3-Hydroxy-2-naphthoic acid**	222 3 (cor)		221-3	243-4, ac a , 249 (cor)			217 8 (cor), yel , al			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p* Toluidide	Anilide	*p* Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
351	**4-Hydroxy-2-naphthoic acid**	225 6		206				217 8			
352	**5-Bromo-3-nitro-2-toluic acid** (4-Bromo-2-methyl 6 nitro-benzoic acid)	226						235			Nitrile, 106-7, subl
353	**9-Fluorenecarboxylic acid**	227 230, 225						251			
354	**Biphenyl-2,2'-dicarboxylic acid** (2 2 Diphenic acid)	227 233 229			*mono* 176, *di* 229-30, al	*di* 187, 182 6		*mono* 193, 190 1, *di* 212, w			
355	**Methyliminodiacetic acid**	227d						*mono* 169, *di* 169			
356	**2,4,6-Trinitrobenzoic acid**	228						264d			
357	**Piperonylic acid**	229, 228						169, al			
358	**5-Nitrosalicylic acid**	229 30			224			225			
359	**4-Chloro-3-hydroxy-2-naphthoic acid**	231, yel						225	116, yel		
360	**1-Phenanthroic acid**	232						284			
361	**3-Pyridylacrylic acid**	233						148			
362	**4-Bromo-3-hydroxy-2-naphthoic acid**	233-5d, yel, al-ac a			161-2						Acetate, 183
363	**4-Chloro-1-hydroxy-2-naphthoic acid**	234, al		143-4	180-1				120-1	92-3	*o*-Toluidide, 148-9, *m*-Toluidide, 188-9
364	**3-Chloro-2-nitrobenzoic acid**	235 w			186						
365	**Benzophenone-2,4-dicarboxylic acid**	235, w						*di* >288	*di* 107		
366	**5-Bromo-2-hydroxy-3-toluic acid** (5 Bromo-2-hydroxy 3-methylbenzoic acid)	236			125, al -w			75-8	109	75	
367	**2-Thianaphthenecarboxylic acid**	236						177			
368	**Butane-1,2,3,4-tetracarboxylic acid** (high melting form)	236-7 (slow htng)			*di* 168, acet (slow htng)			*di* 169d	*tetra* 63-4, lgr		Di-imide, 320d, w
369	**7-Bromo-1-naphthoic acid**	237 (cor), 60% al			202, al -w			247, 50% al	55 (cor), 60% me al	46	
370	**3-Pyridinecarboxylic acid**	237 8 235, 232		150	85, 132, bz - lgr, 265, w			128, 122			
371	***trans*-2-Nitrocinnamic acid**	240, *cis* 146-7				132	141	185			
372	**2-Chloroquinoline-3-carboxylic acid**	240						200-1			
373	**4-Nitrobenzoic acid**	241		204, 192	211, 204	168	137	201, 198	96	57	
374	**Azobenzene-4-carboxylic acid**	241, red, al						224-5, red	123-4, or, me al	86-7, or - red, al	Nitrile, 120-1, br, bz, Propyl ester, 64, red, lgr
375	**4-Chlorobenzoic acid**	243, 240			194, al	129 5, al	126	179, 170	44	b p 238	
376	**7-Chloro-1-naphthoic acid**	243, 60% al			185, al - w			237, 50% al	54, 60% al		
377	**3-Chlorocinchonic acid** (2-Chloroquinoline-4-carboxylic acid)	244, al			202, al			334-5, al - w, 276-8 (after fusion)	89-90, acet	64 5	

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	*p*-Toluidide	Anilide	*p*-Nitro benzyl ester	*p*-Bromo-phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
378	**5-Chloro-1-naphthoic acid**	245, 241-2 subl						239		42	Nitrile, 145
379	**Azobenzene-2,2'-dicarboxylic acid**	245, dk yel, al						*mono* 215d, red-br, et ac, *di* 294d, red-br, ac a	*di* 101, red, me al	*di* 85, pa red, al	
380	**Anthracene-1-carboxylic acid** (α-Anthroic acid)	245, yel, al, 252						260, al	108, ac a		Nitrile, 126, yel, Phenyl ester, 207-9, yel
381	**2-Amino-9,10-anthraquinone-1-carboxylic acid**	250 2, or - red						300, or, $PhNO_2$			
382	**4-Bromobenzoic acid**	251-3			197	180		189-90, w			*p*-Phenylphenacyl ester, 193
383	**9-Phenanthroic acid**	251, 253						233			
384	**4-Bromocinnamic acid**	251 3			183				80		
385	**Cinchoninic acid** (Quinoline-4-carboxylic acid)	253 4 (+1 or $2H_2O$)						181	24	13, b p 173^{15}	Nitrile, 102
386	**Gallic acid** (3,4,5-Trihydroxy-benzoic acid)	253-4d, 222-40d			207	141	134	189			
387	**1-Acenaphthoic acid**	256						228			
388	**2-Phenanthroic acid**	260						243			
389	**Cinchomeronic acid** (Pyridine-3,4-dicarboxylic acid)	260d, w			*di* 199-206			3-*mono* 200d, 4-*mono* 170d, w, *di* 163-5d	3-*mono* 182 4-*mono* 154-72, *di* 141	4-*mono* 131-3, bz, *di* b p 172^{21}	Imide, 229-30, subl
390	**5-Bromo-1-naphthoic acid**	261, 256						241		48-9	Nitrile, 147, subl
391	**Chelidonic acid** (γ-Pyrone-2,6-dicarboxylic acid)	262						245	*di* 122 5	227, *di* 63	*p*-Phenylphenacyl ester, 195-8d
392	**4-Iodobenzoic acid**	270, 265			210	141	146	217			
393	**5-Chloro-2-naphthoic acid**	270, al			202 5			186-7	81	45	Nitrile, 144
394	**3-Phenanthroic acid**	270						234			
395	**Quinoline-3-carboxylic acid**	272						198			
396	**1-Chloroanthraquinone-2-carboxylic acid**	272, pa yel, al			248 9, pa yel, bz-ac a			317, yel	161 5, yel, acet, 155	142, yel, al	Benzyl ester, 135-6, yel, al
397	**Anthracene-2-carboxylic acid** (β-Anthroic acid)	281, yel, al						293-5, yel, al		134-5	
398	*trans*-**4-Nitrocinnamic acid**	285				186	191	204, 217			
399	**Fumaric acid** (*trans*-Butanedioic acid)	286-7, (sealed tube), >200, subl, 293-5			*mono* 233 0-4 5, *di* 313 4, ac a	150 8		270, 300 2 subl, *di* 266d	*di* 102, b p 192	*mono* 66, *di* b p 218	At 230 → maleic anh 56
400	**Muconic acid**	289d (slow htng), 306 (rapid htng)						*di* 240d			*trans-trans* 296-8, *cis-cis* 195

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	*p* Toluidide	Anilide	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
401	**9,10-Anthraquinone-2-carboxylic acid**	290–2, yel, ac a			258 60			280, ac a -bz	170	147	
402	**9,10-Anthraquinone-1-carboxylic acid**	293 4, pa yel, ac a			288 9, pa yel, $PhNO_2$			280 pa yel, al	189, pa yel, me al	169, yel, al	Nitrile, 247, yel, ac a
403	**Bromoterephthalic acid** (2-Bromobenzene-1,4-dicarboxylic acid)	299						*di* 270	1-*mono* 145, 4-*mono* 164 *di* 54		
404	**Terephthalic acid** (Benzene-1,4-dicarboxylic acid)	300, subl without melting			*di* 334 7, $PhNO_2$	*di* 263 5	*di* 225	*di* >225			
405	**Chloroterephthalic acid** (2-Chlorobenzene-1,4-di-carboxylic acid)	>300, w						*di* >300	*di* 60		
406	**4-Pyridinecarboxylic acid** (Isonicotinic acid)	324						156			
407	**9,10-Anthraquinone-2,3-dicarboxylic acid**	240–2, yel, ac a						*mono* >340, br, ac a			Anhydride, 290
408	**Isophthalic acid** (Benzene-1,3-dicarboxylic acid)	348, subl				202 5	179 1	*mono* 280, *di* 280			Ba salt (+6 H_2O) very soluble—differentiates from Terephthalic acid
409	**Benzophenone-4,4′-dicarboxylic acid**	subl <360						*di* >300	*di* 224 231		Dinitrile, 204–5
410	**Trimesic acid** (Benzene-1,3,5-tricarboxylic acid)	380 (cor)			*tri* 118–20d, ac a		*tri* 197 (sealed tube)	365d (cor)	*tri* 143–4, me al	*tri* 132 3, al 133 after sintering at 127	

*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide All of them appear therefore under the same title

Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid

$$RCOCl + H_2O \longrightarrow \underset{\text{Acid}}{RCOOH} + HCl$$

$$(RCO)_2O + H_2O \xrightarrow{NaOH} 2RCOONa \xrightarrow{H^+} \underset{\text{Acid}}{RCOOH}$$

From the acyl halide in water
For directions and examples see Wild, p 180
From the acyl halide with aqueous sodium hydroxide
See Vogel, p 369, Wild, p 180
From the acid anhydride with water
See Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, **97**, 1677 (1910)
From the acid anhydride with aqueous sodium hydroxide
See Linstead, pp 16 7 Wild, p 184

Amide *

$$RCOOH \xrightarrow{SOCl_2} \underset{\substack{\text{Acid}\\\text{chloride}}}{RCOCl} \xrightarrow{NH_3} RCONH_2 + NH_4Cl$$

$$RCOOH + NH_3 \longrightarrow RCONH_2$$

$$(RCO)_2O + NH_3 \longrightarrow \underset{\text{Amide}}{RCONH_2}$$

Acid chloride is prepared from the acid and thionyl chloride Amide is formed on addition of aqueous ammonia
For directions and examples see Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181
From the acid chloride in benzene with aqueous ammonia
See D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, **71**, 3017 (1942)
By passing gaseous ammonia through a benzene or ether solution of the acyl chloride
See Linstead, p 14, Wild, p 182
From the neat acid with gaseous ammonia
See J A Mitchell and E E Reid, *J Amer Chem Soc*, **53**, 1879 (1931)
From the acid anhydride with aqueous ammonia
See Wild, p 184, 185

Anilide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{C_6H_5NH_2} RCONHC_6H_5 + C_6H_5NH_3^+Cl^-$$

$$RCOOH + C_6H_5NH_2 \longrightarrow RCONHC_6H_5 + H_2O$$

$$(RCO)_2O + C_6H_5NH_2 \longrightarrow \underset{\text{Anilide}}{RCONHC_6H_5} + C_6H_5NH_3^+RCOO^-$$

From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether
For directions and examples see Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200–1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)
From the acid chloride with aniline in aqueous sodium hydroxide
See Wild, pp 181, 219
From the acid and aniline at high temperatures
See Vogel, p 362

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the sodium salt of the acid with aniline and concentrated hydrochloric acid
See Shriner, p 201, Wild, p 154
From the acid anhydride with aniline without solvent
See Linstead, p 17, Vogel, p 377, Wild, p 185
From the acid anhydride with aniline in benzene
See Linstead, p 15, Wild, p 185

p-Toluidide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{p\text{-}CH_3C_6H_4NH_2} RCONHC_6H_4CH_3\text{-}p + p\text{-}CH_3C_6H_4NH_3^+Cl^-$$

$$RCOOH + p\text{-}CH_3C_6H_4NH_2 \longrightarrow RCONHC_6H_4CH_3\text{-}p + H_2O$$

$$(RCO)_2O + p\text{-}CH_3C_6H_4NH_2 \longrightarrow RCONHC_6H_4CH_3\text{-}p + p\text{-}CH_3C_6H_4NH_3^+RCOO^-$$

From the acid chloride with *p*-toluidine in ether or benzene
For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361
From the acid and *p*-toluidine at high temperatures
See Cheronis, pp 441, 442-3, Vogel, p 362
From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid
See Shriner, p 201, Wild, p 154
From the acid anhydride with *p*-toluidine without solvent
See Cheronis, p 459, Linstead, p 17
From the acid anhydride with *p*-toluidine in benzene
See Wild, p 185

1- and 2-Naphthylamide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{1\text{- or }2\ C_{10}H_7NH_2} \underset{\text{Naphthylamide (1 or 2-)}}{RCONHC_{10}H_7} + C_{10}H_7NH_3^+Cl^-$$

From the acid chloride with the naphthylamine
For directions and examples see Cheronis, p 446, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)

p-Nitrobenzyl ester *

$$RCOONa + p\text{-}NO_2C_6H_4CH_2X \rightarrow \underset{p\text{-Nitrobenzyl ester}}{RCOOCH_2C_6H_4NO_2\text{-}p} + NaX \quad (X = Cl, Br, I)$$

From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol
For directions and examples see Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, pp 144 5
From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone
See F F Blicke and F D Smith, *J Amer Chem Soc*, **51**, 1947 (1929)
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1 2 water-ethanol
See E E Reid, *J Amer Chem Soc*, **39**, 124 (1917)
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1 2 water-ethanol
See J A Lyman and E E Reid, *J Amer Chem Soc*, **39**, 701 (1917)

p-Bromophenacyl ester *

$$RCOONa + \underset{\text{bromide}}{\underset{p\text{-Bromophenacyl}}{p\text{-}BrC_6H_4COCH_2Br}} \longrightarrow RCOOCH_2COC_6H_4Br\text{-}p + NaCl$$

$$RCOOH + \underset{\text{phenone}}{\underset{p\text{ Bromodiazoaceto-}}{p\text{-}BrC_6H_4\,COCHN_2}} \xrightarrow{CuCl_2} \underset{p\text{-Bromophenacyl ester}}{RCOOCH_2COC_6H_4Br\text{-}p} + N_2$$

From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with *p*-bromophenacyl halide in 1 2 water-ethanol

See W L Judefind and E E Reid, *J Amer Chem Soc*, **41**, 1043 (1920)

From the sodium salt of the acid (neutralization with sodium hydroxide) with *p*-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, *J Amer Chem Soc*, **52**, 818 (1930), C G Moses and E E Reid, *J Amer Chem Soc*, **54**, 2101 (1930)

From the acid and *p*-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

p-Phenylphenacyl ester *

$$RCOONa + \underset{\text{p Phenylphenacyl bromide}}{p\text{-}C_6H_5C_6H_4COCH_2Br} \longrightarrow RCOOCH_2COC_6H_4C_6H_5\text{-}p + NaBr$$

$$RCOOH + \underset{\substack{\text{p Phenyldiazoaceto}\\\text{phenone}}}{p\text{-}C_6H_5C_6H_4COCHN_2} \xrightarrow{CuCl_2} \underset{\text{p Phenylphenacyl ester}}{RCOOCH_2COC_6H_4C_6H_5\text{-}p} + N_2$$

From the sodium salt of the acid (neutralization with sodium carbonate) and *p*-phenylphenacyl bromide in aqueous alcohol

For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, *J Amer Chem Soc*, **52**, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and *p*-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

For dibasic acids from the acid, ethylamine and *p*-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

From the acid and *p*-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

Methyl ester

$$RCOOH + CH_3OH \xrightarrow{H_2SO_4} RCOOCH_3 + H_2O$$

$$RCOOH + CH_2N_2 \longrightarrow \underset{\text{Methyl ester}}{RCOOCH_3} + N_2$$

From the acid with methanol and a catalytic amount of sulfuric acid

For directions and examples see Linstead, p 16, Vogel, p 383

From the acid and diazomethane in ether

See B Eistert, in *Newer Methods of Preparative Organic Chemistry*, Interscience, New York, 1948, p 513

Ethyl ester

$$RCOOH + C_2H_5OH \longrightarrow RCOOC_2H_5 + H_2O$$

$$RCOOAg + C_2H_5I \longrightarrow RCOOC_2H_5 + AgI$$

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{C_2H_5OH} \underset{\text{Ethyl ester}}{RCOOC_2H_5} + HCl$$

From the acid and ethanol in the presence of a catalytic amount of sulfuric acid

For directions and examples see Vogel, pp 383, 385, 386, 387

From the silver salt of the acid with ethyl iodide

See Vogel, p 388

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

*S-Benzylthiuronium salt.**

$$\underset{}{RCOONa} + \underset{\text{S-Benzylthiuronium chloride}}{[C_6H_5CH_2SC(NH_2)_2]^+Cl^-} \rightarrow \underset{\text{S-Benzylthiuronium salt}}{[C_6H_5CH_2SC(NH_2)_2]^+RCOO^-} + NaCl$$

From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim.* [5], **5**, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* **6**, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, **58**, 1004 (1936).

Phenylhydrazide.

$$RCOOH + H_2NNHC_6H_5 \rightarrow \underset{\text{Phenylhydrazide}}{RCONHNHC_6H_5} + H_2O$$

From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, **64**, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

I. Acyl Fluorides (Listed in order of increasing b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
1	**Acetyl fluoride**	20-1			1 002[15]	118		82	114	147	134	
2	**Propionyl fluoride**	44 6				141		81	106	126		
3	**Fluoroacetyl fluoride**	50 5-51				167 9	31-2	108				
4	**Trichloroacetyl fluoride**	66 8				197	57 8	141	97	113		
5	***n*-Butyryl fluoride**	67				162 5		115	96	75	125	
6	**Chloroacetyl fluoride**	73 5					63	120	137	162	117 8	
7	**Phthaloyl difluoride**	224 6	42-3				206	220(*dt*)	253(*dt*)	201(*dt*)		
8	**Phenylacetyl fluoride**	88-9[17]	.				76	156	118	136	159	

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2 Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
1	**Acetyl chloride**	51-2		1 3897^{20}	1 105$_4^{20}$	118		82	114	147	134	
2	**Oxalyl chloride**	64	−12	1 434^{13}	1 488$_4^{13\ 4}$		101 (dih-yd)	419d	246	268		
3	**Fluoroacetyl chloride**	72-3				167 9	31-2	108				
4	**Acrylyl chloride**	76		1 4343^{20}	1 114$_4^{20}$	140		85	105	141		
5	**Propionyl chloride**	80		1 4051^{20}	1 065$_4^{20}$	141		81	106	126		
6	**Isobutyryl chloride**	92		1 4079^{20}	1 017$_4^{20}$	154 5		128	105	107		
7	**Methacrylyl chloride**	95-6		1 4435		160 5	15-6	102-6				
8	**Vinylacetyl chloride**	98				163		72-3	58			
9	***n*-Butyryl chloride**	101-2		1 4121^{20}	1 028$_4^{20}$	162 5		115	96	75		
10	**Pivalyl chloride**	105-6					35	154	129	120		
11	**Dichloroacetyl chloride**	108				194		98	118	153		
12	**Chloroacetyl chloride**	108-10		1 454^{20}	1 3997$_4^{18}$	189	63	120	137	162		
13	**DL-α-Chloropropionyl chloride**	110-11		1 440^{20}	1 285$_4^{20}$	185-6		80	92	124		
14	**Methoxyacetyl chloride**	113				204		97	58			
15	**DL-Ethylmethylacetyl chloride**	115-6				176		112	110	93		
16	**Isovaleryl chloride**	115		1 4136$^{24\ 3}$	0 985$_4^{24\ 3}$	176		135	109 10	107	138 5	
17	**Acetylglycyl chloride**	115-8					206	137				Hydrazide 115 Me ester 58 9
18	**Trichloroacetyl chloride**	118		1 470^{20}	1 620$_4^{20}$	197	57 8	141	97	113		
19	**Cyclopropane carbonyl chloride**	120			1 152$_0^{20}$	186	18	125				
20	**Ethoxyacetyl chloride**	123-4				207		80 2				
21	***trans*-Crotonyl chloride**	126		1 46^{18}	1 08$_4^{20}$		72	161	118	132		
22	***n*-Pentanoyl chloride** (*n*-Valeryl chloride)	126		1 420^{20}	1 0004$_4^{20}$	186		106	63	74	112	
23	**Allylacetyl chloride**	128			1 074^{16}	188 9		94				
24	**Bromoacetyl chloride**	133-5			1 908^{o}	208	50	91	131		134	
25	**Cyclobutane carbonyl chloride**	137 142 3				195		153				
26	**β-Methoxypropionyl chloride**	138		1 424		107^{10}		50 5				
27	**Diethylacetyl chloride**	140		1 4234		190		107				
28	**β-Chloropropionyl chloride**	144		1 455	1 331^{13}		42		119	121		
29	**Isocaproyl chloride** (4-Methylpentanoyl chloride)	147			0 9725$_4^{20}$	199		121	112	63		
30	**α-Acetoxypropionyl chloride** (O-Acetyl lactoyl chloride)	150 part d		1 4241^{17}	1 192		57 60, 40					
31	**DL-α-Bromobutyryl chloride**	150-2				217d	−4	112	98	92		
32	***n*-Hexanoyl chloride** (*n*-Caproyl chloride)	153		1 426^{20}	0 975$_4^{20}$	205		100	95	75	107	
34	**Furoyl chloride**	173 4					133-4	142-3	124	107		
35	***n*-Heptanoyl chloride** (Enanthoyl chloride)	175		1 4345^{15}	0 963$_4^{20}$	223		96	70 (65)	81	101	
36	**Hexahydrobenzoyl chloride** (Cyclohexane carboxylic acid chloride)	183 4		1 4766^{15}, 1 4711^{20}	1 096$_4^{15}$		29 30	185	143 4			
37	**3-Fluorobenzoyl chloride**	189, 204					124	130				
38	**Succinyl dichloride**	190d	20	1 473^{15}	1 395$_4^{15}$		186	260 (*di*)	230 (*di*)	255 (*di*)		
39	**4-Fluorobenzoyl chloride**	193	9				183	154 5				

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
40	***n*-Octanoyl chloride** (*n*-Capryloyl chloride)	196			$0\ 949_4^{20}$	239	16	110, 106	57	70	103	
41	**Benzoyl chloride**	197	−1	$1\ 558^{15}$	$1\ 212_4^{20}$		122	130	163	158		
42	**Diethyl malonyl dichloride**	197		$1\ 5537^{20}$	$1\ 2187_{15}^{15}$		125	224 (*dt*)				
43	**2-Fluorobenzoyl chloride**	206	4				126 5	116				
44	**Phenylacetyl chloride**	210		$1\ 533^{20}$	$1\ 1685_4^{20}$		76	156	118	136	159	
45	***n*-Nonanoyl chloride** (Pelargonyl chloride)	215			$0\ 946_4^{15}$	255	12	99	57	84	103	
46	**Glutaryl dichloride**	218		$1\ 473^{20}$	$1\ 324_4^{20}$	302	97 8	175 6 (*dt*)	224			
47	**4-Chlorobenzoyl chloride**	222	16	$1\ 579_4^{20}$	$1\ 362_4^{20}$		240	179 170	194			
48	**Hydrocinnamoyl chloride** (*β*-Phenylpropionyl chloride)	225 d			$1\ 135_{21}^{21}$		48	105	98, pet eth	135		
49	**3-Chlorobenzoyl chloride**	225					158	134	122			
50	**Phenoxyacetyl chloride**	225-6					98-9	101 5	101			
51	**4-Methylbenzoyl chloride** (4-Toluyl chloride)	225 6	−3 9	$1\ 545^{20}$	$1\ 1686_4^{20}$		179-80	160	145	160 165		
52	***n*-Decanoyl chloride**	232				268 70	31	108 98	70	78	104	
53	**2-Chlorobenzoyl chloride**	233					142	142	118	131		
54	**3-Methoxybenzoyl chloride**	242 4					110, 105					Benzylamine salt of acid, 112
55	**3-Bromobenzoyl chloride**	243, 239					155	155	136			Hydrazide, 151
56	**2-Bromobenzoyl chloride**	245	11				150	155 6	141			Hydrazide, 153
57	**2-Methoxybenzoyl chloride**	254						129	131			Phenyl ester, 59
58	**4-Methoxybenzoyl chloride** (Anisoyl chloride)	262 3 sl d	22	$1\ 58^{20}$	$1\ 261_4^{20}$		184	162 3	169, 163	186		Anisidide, 202
59	**Phthaloyl dichloride**	276	15 6	$1\ 569^{20}$	$1\ 406_4^{20}$		200 6	220 (*dt*)	253 5 (*dt*)	201 (*dt*)		
60	**3-Nitrobenzoyl chloride**	278	35				140	143	154	162		
61	**1-Naphthoyl chloride**	297 5	20				161	202				Piperidide, 85 7

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

II. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p °C	M p , °C					
1	**β-Ethoxypropionyl chloride**	78[52]				120[17]		51				
2	**Azidoacetyl chloride**	50[20]					16	58				
3	**Oleyl chloride**	163[2]					16	75 6	41	42 5		
4	**γ-Phenoxybutyryl chloride**	155[20]					64-5 60	80				
5	**γ-Phenylbutyryl chloride**	140-2[12]				290	52	84 5				
6	**ω-Undecenoyl chloride** (ω-Undecylenoyl chloride, ω-Hendecenoyl chloride)	128[14]				275	24 5	87				
7	**Benzoylformyl chloride**	125[9]					64-6	91				2,4-Dinitrophenyl-hydrazone of acid, 196 7, yel
8	**Iodoacetyl chloride**	49-52[15]			2 25[25]		83	95	143-4			
9	**β-Iodopropionyl chloride**	81[15]					82, 85	101, 142				
10	**Palmitoyl chloride**	194[17]	11-2				63	106-7	90	98	109	
11	**Myristoyl chloride**	174[16]	1-3				54, 58	107	84	93	108	
12	**Phenylpropiolyl chloride**	115-6[17]					136-7	108-9, 99 100	126	142		
13	**Dodecanoyl chloride** (Lauroyl chloride)	145[18]	-17	1 446[20]		299	44	110 102	78	87	106	
14	**α-Phenoxybutyryl chloride**	128-31[38]				258	82 3 99	111 123	93-4			Phenyl ester, 48-9
15	**Cyanoacetyl chloride**	57[0 5]					66	119 20	198-9			
16	**Nicotinyl chloride**	90[15]					235	122	85			
17	**Dibenzylacetyl chloride**	202[18]					89	129	155			
18	**α-Phenoxypropionyl chloride**	115[20]					115 6 112 3	132	117	115	117	
19	**DL-α-Bromoisovaleryl chloride**	59[15]					44	133	116	124	145	
20	**3-Ethoxybenzoyl chloride**	135-40[16]	27 8				137	139				
21	**α-Bromoisobutyryl chloride**	52[30]		1 475[23]			48 9	148	83	92 5	135	
22	**4-Isopropylbenzoyl chloride**	121[10]					256-8	153				
23	**Benzilic acid chloride** (α-Hydroxydiphenylacetyl chloride)	193 5[27]					150	154 5	175	190		Me ester 74-5
24	**1-Naphthoxyacetyl chloride**	194[10]					190	155	144			4-Phenetidide, 145 6
25	**Hexahydrophenylacetyl chloride** (Cyclohexylacetyl chloride)	98 100[23]				244-6	33	171-2				
26	**Azelayl dichloride**	166[18] 140[9]					106 5	175 (*dl*)	186-7 (*dl*)	191 (*dl*)		
27	**2-Nitrobenzoyl chloride**	148[9]	20				146	176	155			
28	**Mesaconyl dichloride** (Methylfumaryl dichloride)	64-5[14]					240 5	177 (*dl*)	186 (*dl*)	212		
29	**1-Naphthylacetyl chloride**	188[23]					131	180 1 154				
30	**2,4,6-Trimethylbenzoyl chloride**	155-6[18]		1 5263[25]	1 0967$_4^{25}$		152	188				
31	**3-Formylbenzoyl chloride**	130[20]					175	190				Me ester, 53, Semicarbazone of acid, 265
32	**4-Ethoxybenzoyl chloride**	160[20]					198	202	170			
33	**Sebacoyl dichloride**	182[16]		1 4684	1 1212$_4^{20}$		134 5	210 (*dl*)	198 (*dl*)			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

II. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
34	**Adipyl dichloride**	130–2[18]					153	220 (*di*)	240–1	241		Di-N-methyl-amide, 152–3
35	**Benzylmalonyl dichloride**	141[15]					117d	225 (*di*)	217 (*di*)			
36	**Phenylmalonyl dichloride**	122[15]					152–3	233				Di-Me ester, 51
37	*trans*-**Aconityl trichloride** (1,2,3-Propylenetricarboxylic acid trichloride)	155–7[20]					194–5	260 (*tri*) (sinters)				
38	**Fumaryl dichloride**	63[13]		1 5004[18]	1 408$_4^{20}$		300–2	266 (*di*)	314 (*di*)			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2 Naphthyl amide	Miscellaneous
						B p , °C	M p °C					
1	**Salicyloyl chloride**	92^{15}	19–20				158	142	136	156	189	
2	**Stearoyl chloride**	$202–3^{6}$	23				70 1	109	95	102	112	
3	**2-Iodobenzoyl chloride**		35–40, 30–1				162	184				
4	***trans*-Cinnamoyl chloride**	258	35 6	$1\ 6202^{37}$	$1\ 1632^{37}$		133	147 8	151	168		
5	**4-Bromobenzoyl chloride**	245–7	42				251 3	189–90	197			Hydrazide, 164
6	**Isophthaloyl dichloride**	276	43–4	$1\ 570^{47}$	$1\ 388^{47}_{4}$		345–7	280 (*dt*)				Di-Me ester, 68 Dihydrazide, 220
7	**2-Naphthoyl chloride**	304–6	43				184–5	192				Piperidide, 88–90
8	**2,4-Dinitrobenzoyl chloride**		46				183	203				Me ester, 70
9	**4-Formylbenzoyl chloride**	258	48				256					Me ester, 63, Phenylhydrazone of acid, 226
10	**4-Nitrophenylacetyl chloride**		48				153	198	198			
11	**2-Naphthoxyacetyl chloride**		54				156	147	145			4-Phenetidide, 164–5, Et ester, 48–9
12	**Diphenylacetyl chloride**		56–7				148	168	180	173	191 2	
13	***trans*-2-Nitrocinnamoyl chloride**		64 5				240	185				Me ester, 73
14	**3,5-Dinitrobenzoyl chloride**		68 9, 74				204 5	183	234			Me ester, 108, Et ester, 93
15	**4-Nitrobenzoyl chloride**	$150–2^{15}$	75				241	201	211	204		
16	**3-Nitrophthaloyl dichloride**		77				218	201 (*dt*)	234 (*dt*)	226 (*dt*)		
17	**Benzylidene malonyl dichloride**		77				195–6	189 (*dt*)				Di Me ester 45
18	**Fluorene-9-carboxylic acid chloride**		77				230–2	251				Me ester, 63
19	**Terephthaloyl dichloride**		83–4					>250 (*dt*)	334–7 (*dt*)			Di-1-naphthylamide, 334
20	**4-Iodobenzoyl chloride**		83 77–8				270 265	218	210			
21	**Diphenylcarbamyl chloride** (Diphenylaminoformyl chloride)		86					189				Me ester, 86, Et ester, 72, lgr
22	**2,2′-Diphenic acid dichloride**		94				228 9	212				
23	**α,α-Diphenylpropionyl chloride**		95–6				173–4	149				Benzyl ester, 71 2
24	**Phenanthrene-2-carboxylic acid chloride**		101				259 60	242 3	217–8			
25	**Phenanthrene-9-carboxylic acid chloride**		102				252	232 226	218			
26	**Diphenyl-4-carbonyl chloride** (4-Phenylbenzoyl chloride)		114–5				228	223				Me ester, 117–8, Et ester, 46
27	**Phenanthrene-3-carboxylic acid chloride**		116–7				269	233 227	216–7			
28	***trans*-4-Nitrocinnamoyl chloride**		124				286	217				Me ester, 161
29	**Fluorenone-4-carboxylic acid chloride**		128, yel				227, yel	230, 225				Oxime of acid, 263, Me ester, 132, Et ester, 103
30	**Fluorenone-1-carboxylic acid chloride**		140, yel					229–30				Oxime of acid 230 Me ester, 86 9, Et ester, 84 6

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES
II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
31	**Azobenzene-4,4'-dicarboxylic acid dichloride**		144–5, red				330d					Di-Me ester, 242, Di-Et ester, 146
32	**9, 10-Anthraquinone-2-carboxylic acid chloride**		147				290, yel	280	258–60			Me ester, 170
33	**Di-(1-naphthyl) acetyl chloride**		167–9				228 5					
34	**9, 10-Anthraquinone-2,6-dicarboxylic acid dichloride**		197–8				>400	>370				
35	**9,10-Anthraquinone-1,4-dicarboxylic acid dichloride**		203–5				>300					
36	**9,10-Anthraquinone-1,5-dicarboxylic acid dichloride**		260–3				>390					Di-Me ester, 236, Di-Et ester, 155, yel

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

III. Acyl Bromides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Acid		Amide	Anilide	*p* Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p °C					
1	**Oxalyl dibromide**	64					101 (hyd)	419d (*d*ı)	254 (*d*ı)	268 (*d*ı)		
2	**Acetyl bromide**	81		1 4538[16]	1 6625$^{16}_{4}$	118		82	114	147	132	
3	**Propionyl bromide**	103				141		81	106	126		
4	**Chloroacetyl bromide**	127					63	120	137	162	117–8	
5	***n*-Butyryl bromide**	128				162 5		115	96	75	125	
6	**Isovaleryl bromide**	138–40				176		135		107	138 5	
7	**Trichloroacetyl bromide**	143			1 90$^{15}_{15}$	197	57–8	162 5	95–7	113		4-Nitroanilide, 146–7
8	**Bromoacetyl bromide**	150			2 425	208	50	91	131		134	
9	**DL-α-Bromopropionyl bromide**	154–5			2 061$^{16}_{4}$	204	25 7	123	99, 110			
10	**α-Bromoisobutyryl bromide**	162–4				198–200	48 9	148	83	92 5	135	
11	**DL-α-Bromobutyryl bromide**	172 4				127[25]	–4	112, 108				
12	***n*-Hexanoyl bromide** (*n*-Caproyl bromide)	175–6				?05		100	95	75	107	
13	**DL-α-Bromoisovaleryl bromide**	184–94					44	133	116	124	145	
14	**Benzoyl bromide**	218–9			1 570[15]		122	130	163	158		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

III. Acyl Bromides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2 Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
1	**3-Methylbenzoyl bromide**	137[52]					111	94 97	126	118		
2	***n*-Pentanoyl bromide** (*n*-Valeryl bromide)	64[66]				186 5		106	63	74		
3	**3-Chlorobenzoyl bromide**	145[40]					158, 155	134	122			
4	**2-Chlorobenzoyl bromide**	144[37]					140	142	114, 118	131		
5	**2-Methylbenzoyl bromide**	135[37]					104 5	143	125	144		
6	**2-Bromobenzoyl bromide**	167[18]					150	155	141			
7	**Phenylacetyl bromide**	150–5[50]					76	156	117–8	135–6	159	
8	**4-Methylbenzoyl bromide**	147[42]					179–80	160	145 148	160, 165		
9	**4-Methoxybenzoyl bromide**	185[27]					184–6	167, 163	169–71	186		
10	**4-Chlorobenzoyl bromide**	142[27]					240	179, 170	194			
11	**4-Bromobenzoyl bromide**	136[18]					251	189	197			
12	**Succinyl dibromide**	105–6[13]					186	260 (*d*)	230 (*d*)	255 (*d*)		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

III. Acyl Bromides b) Solids (Listed in order of increasing m.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
1	**3-Nitrobenzoyl bromide**		43				140	143	154	162		
2	***trans*-Cinnamoyl bromide**		48				133	148	151, 153	168		
3	**4-Iodobenzoyl bromide**		55				270, 265	217	210			
4	**3,5-Dinitrobenzoyl bromide**		60				204–5	183	234			
5	**4-Nitrobenzoyl bromide**		64				241	201, 198	211	203		
6	**Phthaloyl dibromide**		80				206	220 (*d*)	253 (*d*)	201 (*d*)		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

IV. Acyl Iodides. Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
1	**Acetyl iodide**	108			1 98[17]	118		82	114	147	134	
2	**Propionyl iodide**	127				141		81	106 103	126		
3	***n*-Butyryl iodide**	146–8				162 5		115	96	75	125	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

IV. Acyl Iodides. Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p , °C					
1	**Dichloroacetyl iodide**	55[15]		1 5754		194		98	118	153		
2	**Chloroacetyl iodide**	37[4]		1 5903			63	120	137, 134	162	117-8	
3	**Benzoyl iodide**	109[10]					122	130	163	158		
4	**Trichloroacetyl iodide**	74[30]		1 5711		197	57-8	141	97 94	113		

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide All of them appear therefore under the same title

Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid

$$RCOCl + H_2O \longrightarrow \underset{\text{Acid}}{RCOOH} + HCl$$

$$(RCO)_2O + H_2O \xrightarrow{NaOH} 2RCOONa \xrightarrow{H^+} \underset{\text{Acid}}{RCOOH}$$

From the acyl halide in water
For directions and examples see Wild, p 180
From the acyl halide with aqueous sodium hydroxide
See Vogel, p 369, Wild, p 180
From the acid anhydride with water
See Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, **97**, 1677 (1910)
From the acid anhydride with aqueous sodium hydroxide
See Linstead, pp 16 7 Wild, p 184

Amide *

$$RCOOH \xrightarrow{SOCl_2} \underset{\substack{\text{Acid}\\\text{chloride}}}{RCOCl} \xrightarrow{NH_3} RCONH_2 + NH_4Cl$$

$$RCOOH + NH_3 \longrightarrow RCONH_2$$

$$(RCO)_2O + NH_3 \longrightarrow \underset{\text{Amide}}{RCONH_2}$$

Acid chloride is prepared from the acid and thionyl chloride Amide is formed on addition of aqueous ammonia
For directions and examples see Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181
From the acid chloride in benzene with aqueous ammonia
See D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, **71**, 3017 (1942)
By passing gaseous ammonia through a benzene or ether solution of the acyl chloride
See Linstead, p 14, Wild, p 182
From the neat acid with gaseous ammonia
See J A Mitchell and E E Reid, *J Amer Chem Soc*, **53**, 1879 (1931)
From the acid anhydride with aqueous ammonia
See Wild, p 184, 185

Anilide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{C_6H_5NH_2} RCONHC_6H_5 + C_6H_5NH_3^+Cl^-$$

$$RCOOH + C_6H_5NH_2 \longrightarrow RCONHC_6H_5 + H_2O$$

$$(RCO)_2O + C_6H_5NH_2 \longrightarrow \underset{\text{Anilide}}{RCONHC_6H_5} + C_6H_5NH_3^+RCOO^-$$

From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether
For directions and examples see Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200–1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)
From the acid chloride with aniline in aqueous sodium hydroxide
See Wild, pp 181, 219
From the acid and aniline at high temperatures
See Vogel, p 362

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the sodium salt of the acid with aniline and concentrated hydrochloric acid
See Shriner, p 201, Wild, p 154
From the acid anhydride with aniline without solvent
See Linstead, p 17, Vogel, p 377, Wild, p 185
From the acid anhydride with aniline in benzene
See Linstead, p 15, Wild, p 185

p-Toluidide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{p\text{-}CH_3C_6H_4NH_2} RCONHC_6H_4CH_3\text{-}p + p\text{-}CH_3C_6H_4NH_3^+Cl^-$$

$$RCOOH + p\text{-}CH_3C_6H_4NH_2 \longrightarrow RCONHC_6H_4CH_3\text{-}p + H_2O$$

$$(RCO)_2O + p\text{-}CH_3C_6H_4NH_2 \longrightarrow RCONHC_6H_4CH_3\text{-}p + p\text{-}CH_3C_6H_4NH_3^+RCOO^-$$

From the acid chloride with *p*-toluidine in ether or benzene
For directions and examples see Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361
From the acid and *p*-toluidine at high temperatures
See Cheronis, pp 441, 442-3, Vogel, p 362
From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid
See Shriner, p 201, Wild, p 154
From the acid anhydride with *p*-toluidine without solvent
See Cheronis, p 459, Linstead, p 17
From the acid anhydride with *p*-toluidine in benzene
See Wild, p 185

1- and 2-Naphthylamide *

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{1\text{- or }2\ C_{10}H_7NH_2} \underset{\text{Naphthylamide (1 or 2-)}}{RCONHC_{10}H_7} + C_{10}H_7NH_3^+Cl^-$$

From the acid chloride with the naphthylamine
For directions and examples see Cheronis, p 446, P W Robertson, *J Chem Soc*, **115**, 1210 (1919)

p-Nitrobenzyl ester *

$$RCOONa + p\text{-}NO_2C_6H_4CH_2X \rightarrow \underset{p\text{-Nitrobenzyl ester}}{RCOOCH_2C_6H_4NO_2\text{-}p} + NaX \quad (X = Cl, Br, I)$$

From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol
For directions and examples see Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, pp 144 5
From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone
See F F Blicke and F D Smith, *J Amer Chem Soc*, **51**, 1947 (1929)
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1 2 water-ethanol
See E E Reid, *J Amer Chem Soc*, **39**, 124 (1917)
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1 2 water-ethanol
See J A Lyman and E E Reid, *J Amer Chem Soc*, **39**, 701 (1917)

p-Bromophenacyl ester *

$$RCOONa + \underset{\text{bromide}}{\underset{p\text{-Bromophenacyl}}{p\text{-}BrC_6H_4COCH_2Br}} \longrightarrow RCOOCH_2COC_6H_4Br\text{-}p + NaCl$$

$$RCOOH + \underset{\text{phenone}}{\underset{p\text{ Bromodiazoaceto-}}{p\text{-}BrC_6H_4\,COCHN_2}} \xrightarrow{CuCl_2} \underset{p\text{-Bromophenacyl ester}}{RCOOCH_2COC_6H_4Br\text{-}p} + N_2$$

From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with *p*-bromophenacyl halide in 1 2 water-ethanol

See W L Judefind and E E Reid, *J Amer Chem Soc*, **41**, 1043 (1920)

From the sodium salt of the acid (neutralization with sodium hydroxide) with *p*-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, *J Amer Chem Soc*, **52**, 818 (1930), C G Moses and E E Reid, *J Amer Chem Soc*, **54**, 2101 (1930)

From the acid and *p*-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

p-Phenylphenacyl ester *

$$RCOONa + \underset{\text{p Phenylphenacyl bromide}}{p\text{-}C_6H_5C_6H_4COCH_2Br} \longrightarrow RCOOCH_2COC_6H_4C_6H_5\text{-}p + NaBr$$

$$RCOOH + \underset{\substack{\text{p Phenyldiazoaceto}\\\text{phenone}}}{p\text{-}C_6H_5C_6H_4COCHN_2} \xrightarrow{CuCl_2} \underset{\text{p Phenylphenacyl ester}}{RCOOCH_2COC_6H_4C_6H_5\text{-}p} + N_2$$

From the sodium salt of the acid (neutralization with sodium carbonate) and *p*-phenylphenacyl bromide in aqueous alcohol

For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, *J Amer Chem Soc*, **52**, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and *p*-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

For dibasic acids from the acid, ethylamine and *p*-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

From the acid and *p*-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

Methyl ester

$$RCOOH + CH_3OH \xrightarrow{H_2SO_4} RCOOCH_3 + H_2O$$

$$RCOOH + CH_2N_2 \longrightarrow \underset{\text{Methyl ester}}{RCOOCH_3} + N_2$$

From the acid with methanol and a catalytic amount of sulfuric acid

For directions and examples see Linstead, p 16, Vogel, p 383

From the acid and diazomethane in ether

See B Eistert, in *Newer Methods of Preparative Organic Chemistry*, Interscience, New York, 1948, p 513

Ethyl ester

$$RCOOH + C_2H_5OH \longrightarrow RCOOC_2H_5 + H_2O$$

$$RCOOAg + C_2H_5I \longrightarrow RCOOC_2H_5 + AgI$$

$$RCOOH \xrightarrow{SOCl_2} RCOCl \xrightarrow{C_2H_5OH} \underset{\text{Ethyl ester}}{RCOOC_2H_5} + HCl$$

From the acid and ethanol in the presence of a catalytic amount of sulfuric acid

For directions and examples see Vogel, pp 383, 385, 386, 387

From the silver salt of the acid with ethyl iodide

See Vogel, p 388

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the acid chloride and ethanol.

See: Vogel, p. 389.

NOTE: The same methods can be used for the formation of other esters.

*S-Benzylthiuronium salt.**

$$\underset{}{RCOONa} + \underset{\text{S-Benzylthiuronium chloride}}{[C_6H_5CH_2SC(NH_2)_2]^+Cl^-} \rightarrow \underset{\text{S-Benzylthiuronium salt}}{[C_6H_5CH_2SC(NH_2)_2]^+RCOO^-} + NaCl$$

From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

For directions and examples see: Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim.* [5], **5**, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* **6**, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

See: Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, **58**, 1004 (1936).

Phenylhydrazide.

$$RCOOH + H_2NNHC_6H_5 \rightarrow \underset{\text{Phenylhydrazide}}{RCONHNHC_6H_5} + H_2O$$

From the acid with phenylhydrazine without solvent.

For directions and examples see: Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, **64**, 470 (1942).

From the acid with phenylhydrazine in benzene.

See: Shriner, p. 201; Wild, p. 152.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Acid anhydride	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthylamide	Miscellaneous
						B P	M P					
1	**Trifluoroacetic**	39		$1\ 269^{25}$	$1\ 490_4^{25}$	72		75	88			
2	**Perfluoropropionic**	72		$1\ 273^{25}$	$1\ 571_4^{25}$	96		95				
3	**Perfluoro-*n*-butyric**	108		$1\ 285^{20}$	$1\ 665^{20}$	120		105	93			
4	**Acetic**	140	−73	$1\ 3904^{20}$	$1\ 0811^{20}$	118	16	82	114	153		
5	***n*-Propionic**	167	−45	$1\ 404^{20}$	$1\ 017^{15}$	141		81	106	126 (124)		
6	**Perfluoro-*n*-caproic** (Perfluoro-*n*-hexanoic)	176		$1\ 295^{20}$	$1\ 769_4^{25}$	157		117				
7	**Isobutyric**	182			$0\ 957^{17}$	154		128	105	107		
8	**Pivalic** (Trimethylacetic)	190				164	35	154	129	120		
9	***n*-Butyric**	198			$0\ 978^{15}$	162		115	96	75 (73)	125	
10	**Citraconic** (Methylmaleic)	214	7–8	$1\ 471^{21.5}$	$1\ 238_4^{25}$		92d	185–7 (*di*)	175 (*di*)			
11	**Isovaleric**	215				176		135 (137)		107	138	
12	**Dichloroacetic**	216d				194		98	118	153		
13	**Valeric** (Pentanoic)	218			$0\ 922_4^{17}$	186		106	63	74	112	
14	**Crotonic**	248		$1\ 4745^{20}$	$1\ 0397_4^{20}$	189	72	161 (158)	118 (115)	132		
15	**Caproic** (*n*-Hexanoic)	254–7 (245)		$1\ 4297^{20}$	$0\ 92_4^{20}$	205		100	95 (92)	75 (73)	107	
16	***n*-Heptanoic**	258		$1\ 4335^{15}$	$0\ 9175_4^{20}$	223		96	70 (65)	81	101	
17	**α-Methylglutaric**	272–5					79		175 6 (*di*) *mono* (2 forms) 114 or 100	174 5 (*di*) *mono* (2 forms) 126 or 98–9	227–8 (*di*), 115–9 (*mono*)	
18	**Caprylic** (*n*-Octanoic)	280–5	−1	$1\ 436^{17}$	$0\ 9065_4^{17}$	239	16	110 (106)	57 (55)	70	103	
19	***cis*-Hexahydroisophthalic**	304					187 9		298–9 (*di*)			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amide derivative)*

No.	Acid anhydride	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthyl-amide	Miscellaneous
						B.P.	M.P.					
1	**DL-α-Bromobutyric**.....	148–52[10]	.....	.....	.....	127[25]	−4	112	.....	.....	.....	4-Nitrophenyl ester, 48-9; 2-Naphthyl ester, 54
2	**DL-α-Bromopropionic**.....	120[5] (123–4[10])	.....	.....	.....	204	26	123	.....	.....	.....	.....

* Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

b) Solids (Listed in order of increasing m.p.)*

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	*p*-Toluidide	2 Naphthylamide	Miscellaneous
				B P	M P					
1	**Oleic**	22			16	76	41	43	169	
2	**Capric** (*n*-Decanoic)	24		268 70	31	108, 98	70	78	104	D_D^{20} 0 8596, n_D^{20} 1 4234
3	**β-Ethyl-β-methylglutaric**	25	185[20]		87		105 (*mono*)			1-Naphthylamide, 126
4	**Hexahydrobenzoic**	25	280-3	232	29-30	185-6				
5	**α,α-Dimethylsuccinic** (*unsym* - Dimethylsuccinic)	29	220		141					α-Me ester, 41 β Me ester, 52, Anil, 87
6	***cis*-Hexahydrophthalic**	32	145[18]		192					Conc HCl at 180 → *trans* form, 221
7	**DL-Methylsuccinic**	37	244-8		115 (112)	225 (*dl*)	123, chl (*mono*), 159 et, ac, (*mono*)	164 (*mono*)	155 (*mono*)	Anil, 109-10
8	***n*-Undecanoic** (*n*-Hendecanoic)	37		284	30	103, 99	71	80		
9	**2-Methylbenzoic** (*o*-Toluic)	39			104 5	143	125	144		
10	**β-Methylglutaric**	41	276-8		87		200 (*dl*) 121 (117) (*mono*)	*mono* 135	143 (*mono*)	
11	**Bromoacetic**	41-2		208	50	91	131		134	
12	**Lauric** (*n*-Dodecanoic)	42		299	44 (42)	110, 100	78	87	106	
13	**Benzoic**	42	360		122	130	163	158		
14	***trans*-α,β-Dimethylsuccinic**	43			198 (208)	238 (*dl*) 165 7 (*mono*)				Imide, 78
15	**Iodoacetic**	46			83	95	143 4			
16	**Chloroacetic**	46		189	63	121	134	162	117-8	
17	***n*-Tridecanoic**	50		312	44	100	80	88		
18	**DL-Phenylsuccinic**	54	204-6[22]		168	209 10 (*dl*) 158-9 (α) 144 5 (β-)	222 (*dl*) 175 (α-) 170-1 (β-)	175 (α-) 168 9 (β-)		Imide, 90
19	**Myristic** (*n*-Tetradecanoic)	54		202[16]	54	107,103	84	93	108	D_4^{70} 0 8502, n_D^{70} 1 4335
20	**Glutaric**	56		200[20]	97	*dl* 175 6	224	218		
21	**Maleic**	56, 52-4	198		130	181 (172) (*mono*) 266 (*dl*)	173-5 (*mono*) 187 (*dl*)	*dl* 142		
22	**Suberic** (*dimer*) (Octanedioic)	56-7			144 (141)	127 (*mono*) 217 (*dl*)	128 (*mono*) 186 (*dl*)	*dl* 218		
23	**α-Bromoisobutyric**	63-5		198-200	48-9	148	83	92	135	1-Naphthylamide, 116
24	**Palmitic** (*n*-Hexadecanoic)	64		222[16]	63	106 7	90	98	109	D_4^{70} 0 847, n_D^{70} 1 4357
25	**Margaric** (*n*-Heptadecanoic)	67		231[16]	61	108				
26	**Itaconic** (Methylenesuccinic)	67-8			165	*dl* 192	190, 185			
27	**Sebacic** (*dimer*) (Decanedioic)	68		243[15]	133	210 (*dl*) 170 (*mono*)	201 (*dl*), 122 (*mono*)	201		
28	**Stearic** (*n*-Octadecanoic)	70			70	109	95	102	112	
29	**3-Methylbenzoic** (*m*-Toluic)	71			111 3	94	126	118		Hydrazide, 97
30	**Phenylacetic**	72			76-7	156	118	136	159	
31	**2-Bromobenzoic**	75-6			150	155 6				Hydrazide, 153
32	**Arachidic** (*n*-Eicosanoic)	77-8			77	108-9	92	96	112	
33	**2-Chlorobenzoic**	79			142, 140	142	114, 118	131		
34	***cis*-α-Methylglutaconic**	85			118		148 (*mono*)			
35	***cis*-β-Methylglutaconic**	86			147-9		143 (*mono*)			Mono-Et ester, 73
36	***cis*-α,β-Dimethylsuccinic**	87			129,122	148 9 (*mono*) 244 (*dl*)	222 (*dl*)			Imide, 111, 101, Anil, 146
37	**3,5-Dichlorophthalic**	89			164					Imide, 208, N-Phenylimide, 150
38	**4-Methylphthalic**	92	295		152	188 (*dl*)				Imide, 196
39	**3-Chlorobenzoic**	95			158, 155	134	122			
40	**4-Methylbenzoic** (*p*-Toluic)	95			179 80	160	145	160		
41	**Diphenylacetic**	98			148	167-8	180			Me ester, 60

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthylamide	Miscellaneous
				B P	M P					
42	**4-Chlorophthalic**	99			157					Imide, 210-11, Di-Me ester, 37, Anil, 174
43	**Anisic** (4-Methoxybenzoic)	99			184-6	167, 163	169 71	186		
44	**DL-Benzylsuccinic**	102			161					Imide, 97 8, Dihydrazide, 146
45	**β-Phenylglutaric**	105			140		171 (168) (*mono*)	154 (*mono*)		Imide, 174, Di-Me ester, 86-7
46	**4-Ethoxybenzoic**	108			198	202	170			Hydrazide, 124
47	**α-Benzylcinnamic**	108-9			158					Me ester, b p 278, Et ester, 38-9
48	**3,5-Dinitrobenzoic**	109			204-5	183	234			
49	**4-Bromophthalic**	113 109			173-5, 166					Di-Me ester, 40
50	**3-Methylphthalic**	114-5, 110			157					Imide, 189-90
51	**4-Nitrophthalic**	119			165	200d	192	*mono* 172		
52	**Succinic**	120	261		186	157 (*mono*), 260 (*di*)	148 (*mono*) 230 (*di*)	180 (*mono*) 255 (*di*)		
53	**Nicotinic** (3-Pyridine-carboxylic)	123			237 8	128	85	150		
54	**3-Chlorophthalic**	124 5			186					Imide, 118 20 (sealed tube)
55	**4-Iodophthalic**	125-6			182, 185					Imide, 224-4
56	**3,4-Dimethylphthalic**	126			201					Imide, 240-1, Methylimide, 98 9
57	**3-Bromophthalic**	132-4			188, 178					Mono-Et ester, 127 8
58	**Phthalic**	132			206, 200	149 (*mono*) 220 (*di*)	170 (*mono*) 253-5 (*di*)	*mono* 160		
59	**3-Iodobenzoic**	134			187	187				Me ester, 54-5
60	**2-Naphthoic** (β-Naphthoic)	135			184	192-3	171-2	192		
61	**2-Nitrobenzoic**	135			146	176	155			
62	**Cinnamic**	136			133	148	151, 153	168		
63	*trans*-**DL-Hexahydrophthalic acid**	140			221	*mono* 196				Mono-Me ester, 96, Di-Me ester, 33
64	**Homophthalic** (2-Carboxy-phenylacetic)	141			180-1	230 (2-), 185 (α-)	231			α-Me ester 96 8 2-Me ester, 143 5, α-Et ester, 107 8, Imide, 233
65	**1-Naphthoic** (α-Naphthoic)	146			162	202	163			Piperidide, 85-7
66	**3-Bromobenzoic**	148-9			155	155				Hydrazide, 151
67	**3-Iodophthalic**	159 61			206					Di-Me, ester, 89, Di-Et ester, 70, Imide, 238
68	**2,4-Dinitrobenzoic**	160			183	203				
69	**3-Nitrobenzoic**	160, 163			140	143	154	162		
70	**3-Nitrophthalic**	162			218	201 (*di*)	234 (*di*)	226 (*di*)		
71	**3,5-Dinitrophthalic**	163-4, 161			226					Et ester, 187, Di-Et ester, 73
72	**4,5-Dichlorophthalic**	188	313		200, 188					Mono-Et ester, 133 4
73	**4-Nitrobenzoic**	189			241	201, 198	211, 204	204, 192		
74	**4-Chlorobenzoic**	194			240	179, 170	194			
75	**3,6-Dichlorophthalic**	194-5	339		194-5					Mono-Et ester, 130 1 Di-Et ester, 60, Imide, 242, Anil, 191
76	**3,4-Di-iodophthalic**	198			212-3					Anil, 270
77	**β-Phenylglutaconic**	206			154-5	138 (*mono*)	174 (*mono*)	184 (*mono*)		Mono-Et ester, 78, Imide, 256-7
78	**4,5-Dimethylphthalic**	208			123,196					Methylimide, 150, Ethylimide, 89

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	*p*-Toluidide	2-Naphthylamide	Miscellaneous
				BP	MP					
79	**2,2'-Diphenic**	217			229	191 (*mono*) 212 (*di*)	176 (*mono*) 230 (*di*)			H_2SO_4 at 100-120 → Fluorenone-4-carboxylic acid, 227
80	**4-Bromobenzoic**	218			251	189	197			
81	**D-Camphoric**	221			188	177 (*mono*) 193 (*di*)	209 (204) (*mono*), 226 (*di*)	α 212-4, β 190-6		
82	**4-Iodobenzoic**	228			270, 267	217 8				Me ester, 114
83	**Tetrachlorophthalic**	256, 249			250 d					Mono-Me ester, 142, Mono-Et ester, 94 5, Imide, 338-9, 2-Naphthylimide, 287, Anil, 268-9
84	**1,8-Naphthalenedicarboxylic**	274			274		250 82 (*di*)			Heat with aq NH_3 → 1,8-Naphthalimide, 300 N-Phenylimide, 202 Di-Me ester, 102 3
85	**Tetrabromophthalic**	280			266					Mono-Me ester, 267, Imide, > 380, yel , Anil, 279-80, *p*-Tolil, 280, 2-Naphthylimide, 306-8
86	**Tetraiodophthalic**	318, 325, yel			324 7					Mono-Me ester, 298

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XV

Hydrolysis of amide or imide to the corresponding carboxylic acid and amine *

$$RCONHR' + H_2O + HCl \rightarrow \underset{\text{Acid}}{RCOOH} + NH_3R'^+Cl^- \xrightarrow{OH^-} NH_2R'$$

Amine

$$RCONHR' + NaOH \rightarrow RCOONa \xrightarrow{H^+} \underset{\text{Acid}}{RCOOH} + \underset{\text{Amine}}{NH_2R'}$$

From the amide with aqueous hydrochloric acid

For directions and examples see Cheronis, pp 607, 608, Vogel, pp 404, 808

From the amide with 85% or 100% phosphoric acid

See Cheronis, p 609, G Berger and S C J Olivier, *Rec Trav chim*, **46**, 600 (1927), W M Dehn and K E Jackson, *J Amer Chem Soc*, **55**, 4284 (1933)

From the amide with 70% sulfuric acid

See Wild, p 193

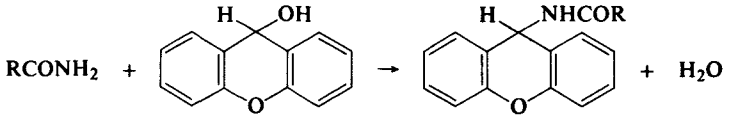
From the amide with aqueous sodium hydroxide

See Cheronis, p 609, Vogel, pp 404, 799, Wild, p 193

NOTE For directions and examples for preparation of derivatives of carboxylic acids formed on hydrolysis of amides and imides see explanations and references to Tables XII, XIII and XIV, p 186, 187, 188, 189

For directions and examples for preparation of derivatives of amines formed on hydrolysis of amides and imides see explanations and references to Table XVIII, p 291, 292, 293, 294

N-Xanthylamides *



N-Xanthylamide

From the amide with xanthydrol in glacial acetic acid

For directions and examples see Cheronis, p 610, Linstead, p 66, Shriner, p 222, Vogel, p 405, Wild, p 195, R F Phillips and B M Pitt, *J Amer Chem Soc*, **65**, 1355 (1943), W Andriani, *Rec Trav chim*, **35**, 180 (1916)

From the amide with xanthydrol in ethanol-water-acetic acid mixture

See Shriner, p 222, Wild, p 195, R F Phillips and B M Pitt, *J Amer Chem Soc*, **65**, 1355 (1943)

Hg salt (Hg derivative) *

$$RCONH_2 + HgO \rightarrow \underset{\text{Mercuric salt}}{(RCONH)_2Hg} + H_2O$$

From the amide with mercuric oxide in methanol or ethanol

For directions and examples see Cheronis, pp 610, 611, Wild, p 197, J W Williams, W T Rainey and R S Leopold, *J Amer Chem Soc*, **64**, 1738 (1942)

From the amide with mercuric oxide in water

See Vogel, p 405

From the amide with yellow mercuric oxide without solvent

See Cheronis, p 611, Wild, p 196, J W Williams, W T Rainey and R S Leopold, *J Amer Chem Soc*, **64**, 1738 (1942)

Oxalate

$$RCONH_2 + (COOH)_2 \rightarrow \underset{\text{Amide oxalate}}{RCONH_2 \cdot (COOH)_2}$$

From the amide with anhydrous oxalic acid in the presence of ethyl acetate

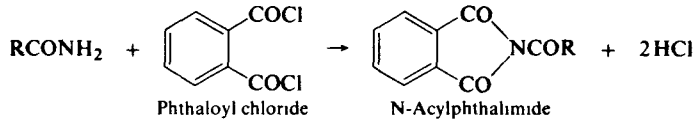
*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE XV (Continued)

For directions and examples see: Cheronis, p. 611; Wild, p. 196; C. A. MacKenzie and W. T. Rawles, *Ind. Eng. Chem., Anal. Ed.*, **12**, 737 (1940).

N-Acylphthalimide (Phthalimide derivative).



From the amide with phthaloyl chloride in toluene or without solvent.

For directions and examples see: Cheronis, p. 611; T. W. Evans and W. M. Dehn, *J. Amer. Chem. Soc.*, **51**, 3651 (1929).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

a) Liquids (Listed in order of increasing b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Derived acid				Derived amine				Miscellaneous
						M P , °C	B P , °C	*p*-Nitro benzyl ester	*p*-Bromo-phenacyl ester	M P , °C	B P , °C	Acet-amide	Benz-amide	
1	**N,N-Dimethylformamide**	153, 76[39]	−61	1 42938[22 4]	0 9484[22 4]	8 4	100 7	31	140, 135		7		41	
2	**N,N-Diethylformamide**	176–8, 68[15]			0 908[16]	8 4	100 7	31	140, 135		56		42	
3	**N-Methylformamide**	180–5, 131[90]	−3 8, −5 4	1 4310[25]	1 011[19]	8 4	100 7	31	140, 135		−6	28	80	
4	**Formamide**	193, 195d	2 55			8 4	100 7	31	140, 135		NH_3			Xanthyl deriv , 184, Oxalate, 107 4 7 7
5	**N-Ethylformamide**	197 9			0 952[21]	8 4	100 7	31	140, 135		16 5, 19		71	
6	**N-Formylpiperidine** (Form-N-piperidide)	222				8 4	100 7	31	140, 135		106		48	
7	**N-Acetylpiperidine** (Aceto-N-piperidide)	226				166	118 2	78	86 0		106		48	
8	**N-Methylformanilide**	243-4, 249–51, 128–9[15]	12 5		1 0928[23]	8 4	100 7	31	140, 135		196	102	63	
9	**N-Ethylformanilide**	258[728], 123[11]			1 0549	8 4	100 7	31	140, 135		205	54	60	
10	**N-Propylformanilide**	267[731] (cor)			1 044[16]	8 4	100 7	31	140, 135		222	47		
11	**N-Isobutylformanilide**	274[731] (cor)				8 4	100 7	31	140, 135		227			
12	**N-Isoamylformanilide**	285–6[728]			1 004[16]	8 4	100 7	31	140, 135		254 5 (cor)			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	*p* Nitro benzyl ester	*p* Bromo phenacyl ester	M P, °C	B P °C	Acet amide	Benz amide	
1	***n*-Butyranilide**	35		−5 5 −8	162 5 164		63		184	114	160	
2	**Oleanilide**	41		*α* 13 36 *β* 16 25	250 (super heated steam) 216[5]		40 46		184	114	160	
3	**N-Benzpiperidide** (*N*-Benzoyl piperidine)	48		122 4	249	89	119 0		106		48	
4	**Ethyl urethane** (Ethyl carbamate)	49 48	169						NH_3			
5	**Formanilide**	50 47		8 4	100 7	31	140 135		184	114	160	B p 271 Benzyl chloride → benzyl form anilide 48
6	**Malonic acid monoamide** (Malonamic acid)	50		134 8 9		*di* 85 5			NH_3			
7	**N-Propylacetanilide**	50		16 6	118 2	78	86 0			47		
8	**Difluoroacetamide**	52			134 5				NH_3			
9	**N-Benzyl-*n*-caproamide**	53		−3 9	203 35		72		184 5	60	105	
10	**Phenyl urethane** (Phenyl carbamate)	53							184	114	160	
11	***Methyl urethane*** (Methyl carbamate)	54 52	193						NH_3			
12	**N-Ethylacetanilide**	54		16 6	118 2	78	86 0		205	54	60	B p 249
13	***n* Butyl urethane** (*n* Butyl carbamate)	54							NH_3			
14	**N-Benzylisovaleramide**	54		−30	176 5	68 0	135 137		184 5	60	105	
15	**Acetoacetamide**	54							NH_3			
16	**Isobutyl urethane** (Isobutyl carbamate)	55	148						NH_3			
17	**N-Methyl-2-acetotoluidide**	56		16 6	118 2	78	86 0		208	56	66	
18	**Carprylanilide**	57 55		16 3	237 239 3		67 4		184	114	160	
19	**Pelargonanilide**	57		12 3	254 4		68 5		184	114	160	
20	**N-Benzylacetanilide**	58		16 6	118 2	78	86 0	37	298	58	107	
21	**Methoxyacetanilide**	58			204 203				184	114	160	
22	***d l*-Lactanilide**	59		18	122[15]		112 8		184	114	160	
23	**N-Ethylbenzanilide**	60		122 4	249	89	119 0		205	54	60	
24	***n*-Propyl urethane** (*n* Propyl carbamate)	60							NH_3			
25	**N-Benzylformamide**	60		8 4	100 7	31	140 135		184 5	60	105	
26	**N-Benzylacetamide**	61		16 6	118 2	78	86 0		184 5	60	105	
27	**Propiolamide**	61–2		18	144d				NH_3			
28	***n*-Valeranilide** (*n*-Pentananilide)	63		−34 5	186 4		75		184	114	160	
29	**Isoamyl urethane** (Isoamyl carbamate)	64	145						NH_3			
30	**Erucanilide**	65, 55		33 4	264[15]		62 5		184	114	160	
31	**3-Acetotoluidide** (N Acetyl-*m* toluidine)	66 65		16 6	118 2	78	86 0		203	65	125	
32	**N-Methyl-3-acetotoluidide**	66		16 6	118 2	78	86 0		206 7	66	125	
33	**Ethyl oxanilate**	66 7							184	114	160	
34	**Benzindole**	68		122 4	249	89	119	52	253	157 8	68	
35	**Heptananilide**	70, 65		−7 46	223		72		184	114	160	
36	**Capranilide** (*n*-Decananilide)	70		31 3	268 7		60		184	114	160	
37	***n*-Undecananilide** (*n* Hendecananilide)	71		28 5 *α* 13 4 *β* 16 3	280, 284		68 2		184	114	160	

*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
38	**2-Methylhexanamide**	72	.....	.....	209.6	.....	.....	NH_3		.....	.....	.....
39	**N,N-Diphenylformamide**	73	.....	8.4	100.7	31	140; 135	53-4	.....	101	180	.....
40	**Vinylacetanilide**	73	.....	−35	169; 163	.....	.....	.....	184	114	160	.....
41	**Oleamide**	76	.....	α: 13.36 β: 16.25	250 (superheated steam); 216[5]	.....	40-6	NH_3		.....	.....	.....
42	**Thioacetanilide**	76	.....	.....	93	.....	.....	.....	184	114	150	.....
43	**Tiglamide**	76	.....	64.5-5.0	198.5 (cor.)	64	68	NH_3		.....	.....	.....
44	**Tiglanilide**	77	.....	64.5-5.0	198.5 (cor.)	64	68	.....	184	114	160	.....
45	**4-Methylhexananilide**	77	.....	.....	217-8[254]	.....	.....	.....	184	114	160	.....
46	**Lauranilide** (Dodecananilide)	78	.....	44; 42	299	.....	76	.....	184	114	160	.....
47	***d,l*-2,3-Dimethylbutananilide**	78	.....	−1.5	191.7	.....	.....	.....	184	114	160	.....
48	**Pentadecananilide**	78	.....	52.3	212[16]	39.5-40 (cor.)	77.2	.....	184	114	160	.....
49	***d,l*-Lactamide**	78.5-9.0; 76	.....	18	122[15]	.....	112.8	NH_3		.....	.....	.....
50	**Transbrassidanilide**	79	.....	59.7	256[10]	.....	94.2	.....	184	114	160	.....
51	**2-Acetophenetidide** (N-Acetyl-*o*-phenetidine)	79	.....	16.6	118.2	78	86.0	.....	229	79	104	.....
52	***d,l*-2-Methylpentanamide**	79.6; 80	.....	.....	195-6	.....	.....	NH_3		.....	.....	.....
53	**Tridecananilide**	80	.....	43; 41.6	312; 177[10]	.....	75.0	.....	184	114	160	.....
54	***d,l*-α-Chloropropionamide**	80	.....	.....	186	.....	.....	NH_3		.....	.....	.....
55	**Propionamide**	81; 77	214; 211	−20.8	141	31	63.4	NH_3		.....	.....	Mercury deriv., 201; Oxalate, 80.8-1.0
56	**Acetamide**	82	245; 238-40	16.6	118.2	78	86.0	NH_3		.....	.....	Mercury deriv., 196-7; Oxalate: 127.3; Phthalimide, 135-6
57	**Ethoxyacetamide**	82	.....	.....	206-7	.....	104.8	NH_3		.....	.....	.....
58	**N-Methyl-4-acetotoluidide**	83	.....	16.6	118.2	78	86.0	.....	210	83	.....	.....
59	**α-Bromoisobutyranilide**	83	.....	48-9	198-200	.....	.....	.....	184	114	160	.....
60	**γ-Phenylbutyramide**	84	.....	52	290	.....	.....	NH_3		.....	.....	.....
61	**Myristanilide**	84	.....	53.9	212[16]	.....	81	.....	184	114	160	.....
62	**Acrylamide**	85	.....	13	141; 140	.....	.....	NH_3		.....	.....	.....
63	**Allylurea**	85	.....	.....	.....	.....	.....	.....	58	.....	.....	.....
64	**Acetoacetanilide**	85	.....	.....	.....	.....	.....	.....	184	114	160	.....
65	***d,l*-α-Ethylphenylacetamide** (α-Phenylbutyramide)	86; 83	.....	42	270	.....	.....	NH_3		.....	.....	.....
66	**4-*n*-Propylacetanilide**	87	.....	16.6	118.2	78	86.0	.....	225	87	115	.....
67	**α-Undecylenamide** (α-Hendecyleneamide)	87	.....	24.5	275	.....	.....	NH_3		.....	.....	.....
68	**Propiolanilide**	87	.....	18	144d.	.....	.....	.....	184	114	160	.....
69	**3-Bromoacetanilide**	87	.....	16.6	118.2	78	86.0	18	251	87	120; 136	.....
70	***d,l*-3-Methylpentananilide**	87	.....	−41.6	197.5	.....	.....	.....	184	114	160	.....
71	***n*-Butyl oxamate**	88	.....	189.5 (anh.); 101(+ $1H_2O$)	.....	*di*: 204	.....	NH_3		.....	.....	.....
72	**2-Chloroacetanilide**	88	.....	16.6	118.2	78	86.0	.....	209; 207	87	99	.....
73	**D-Chaulmoogranilide**	89	.....	68.5	247-8[20]	.....	.....	.....	184	114	160	.....
74	**Palmitanilide**	90	.....	62.7	222[16]	42.5	86;82	.....	184	114	160	.....
75	**N-Phenylmaleimide**	91	.....	130	.....	*di*: 91 (cor.)	168-70; 190	.....	184	114	160	.....

*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
76	**Bromoacetamide**	91		50	208	88			NH_3			
77	**α-Phenylpropionamide**	92	158		265				NH_3			
78	**Isopropyl urethane** (Isopropyl carbamate)	92							33			
79	**Arachidanilide**	92		77 75	204[1]		89		184	114	160	
80	***d l* α Chloropropionanilide**	92			186				184	114	160	
81	**2,2-Dimethylbutananilide**	92		−15 0	187 190				184	114	160	
82	**2-Nitroacetanilide**	92 94		16 6	118 2	78	86 0	71		92 94	98 110	
83	**Maleimide**	93		130		*di* 91 (cor)	168 70 190		NH_3			
84	**Elaidamide**	93 4		44 5 51	234[15]		65		NH_3			
85	**Transbrassidamide**	94		59 7	256[10]		94 2		NH_3			
86	**2-Ethylpentananilide**	94			209				184	114	160	
87	**N-Methyl-N-(1-naphthyl) acetamide**	94		16 6	118 2	78	86 0		294	94 5	121	
88	***n*-Caproanilide** (*n* Hexananilide)	95 92		−3 9	205 35		72		184	114	160	
89	**N-Butyranilide**	95		−5 5 −8	162 5 164	35	63		184	114	160	
90	**N-Benzylpalmitamide**	95		62 7	222[16]	42 5	86 82		184 5	60	105	
91	**Azelaic acid monoamide**	95		106 5	>360 sl d 237[15]	*di* 43 8	*di* 130 6		NH_3			
92	***d l*-2-Methylpentananilide**	95			195 6				184	114	160	
93	**Iodoacetamide**	95		83					NH_3			
94	**Stearanilide**	95		70 1 69 6			92		184	114	160	
95	**Heptanamide**	96	154 5	−7 46	223 0		72		NH_3			
96	**Trichlorolactamide**	96		124					NH_3			
97	**Semicarbazide**	96						1 4	113 5	*mono* 67 *di* (*sym*) 138	*mono* 172 5 *di* (*sym*) 241 (cor)	Gives semicarbazones with aldehydes and ketones
98	**3-Toluamide**	97, 94		111 3, 110 1	236, subl	86 6	108					Mercury deriv , 200
99	**Trichloroacetanilide**	97, 94		57 8	197 5	80			184	114	160	
100	**3-Acetophenetidide**	97		16 6	118 2	78	86 0		248	37	103	
101	**N-Benzylstearamide**	97		70 1 69 6			92		184 5	60	105	
102	**Glycollanilide**	97		78 9 80		106 8	138		184	114	160	
103	**Methoxyacetamide**	97			204 203				NH_3			
104	**Hydrocinnamanilide** (β Phenylpropionanilide)	98, 96		48 7, 40	279 80 (cor)	36 3	104		184	114	160	
105	**α-Hydroxyisobutyramide**	98		79	212	80 5	98		NH_3			
106	**Dichloroacetamide**	98, subl		5–6	194		99		NH_3			
107	**2-Methylhexananilide**	98			209 6				184	114	160	
108	**4-Methylhexanamide**	98			217 8[745]				NH_3			
109	**4-Methyl-2-nitroacetanilide**	99, 94		16 6	118 2	78	86 0	117		99	148	
110	**Capramide** (*n*-Decanamide)	99	148	31 3	268 7		67 0		NH_3			
111	**2-Bromoacetanilide**	99		16 6	118	78	86 0	32	250	99	116	
112	**Phenoxyacetanilide**	99		98 9, 99 100	285d		148 5		184	114	160	
113	**Pelargonamide**	99	147 5 8 5	12 3	254 4		68 5		NH_3			
114	**α-Bromopropionanilide**	99, 110		25 7	203 5				184	114	160	
115	***n*-Caproamide** (*n*-Hexaneamide)	100, 101	160	−3 9	203 35		72		NH_3			Oxalate, 71 1–3
116	**Tridecanamide**	100		43, 41 6	312, 177[10]		75		NH_3			
117	**Phenylpropiolamide**	100, 109		136–7, subl		83			NH_3			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
118	**N,N-Diphenylacetamide**	101		16.6	118.2	78	86.0	53–4		101	180	
119	***β*-Iodopropionamide**	101		82; 85				NH_3				
120	**N,N′-Diacetyltrimethylenediamine**	101		16.6	118.2	78	86.0		136	*mono*: 126; *di*: 101	*mono*: 140; *di*: 147	
121	**Methylurea**	101	230						−6	28	80	Picrate, 127d.
122	**Phenoxyacetamide**	101		98–9; 99–100	285d.		148.5	NH_3				
123	**N-Methylacetanilide**	102		16.6	118.2	78	86.0		196	102	63	B.p. 237; Conc. $HNO_3 + H_2SO_4 \rightarrow$ *p*-Nitro deriv., 153
124	**Levulinanilide**	102		33–5, deliq.	245–6	61	84		184	114	160	
125	**Pentadecanamide**	102		52.3	212[16]	39.5–40 (cor.)	77.2	NH_3				
126	**Isocrotonamide**	102		15	169		81	NH_3				
127	**Isocrotonanilide**	102		15	169		81		184	114	160	
128	***n*-Undecanamide** (*n*-Hendecanamide)	103; 99		28.5; *α*:13.4; *β*:16.3	280–4		68.2	NH_3				
129	**3-Benzophenetidide** (N-Benzoyl-*m*-phenetidine)	103		122.4	249	89	119		248	97	103	
130	**N,N-Dicyclohexylacetamide**	103		16.6	118.2	78	86.0	20	225 sl. d.	103	153	
131	**3,4-Dimethylbenzanilide**	104		166; 164					184	114	160	
132	**2-Benzophenetidide** (N-Benzoyl-*o*-phenetidine)	104		122.4	249	89	119		229	79	104	
133	**Pyruvanilide**	104, subl.		13.6	165d; 80[25]				184	114	160	
134	**N-Cyclohexylacetamide**	104		16.6	118.2	78	86.0		134	104	149	
135	**2-*n*-Propylacetanilide**	104–5		16.6	118.2	78	86.0		222–4	104–5	119	
136	**2-Ethylpentanamide**	105; 103			209			NH_3				
137	**Isobutyranilide**	105		−46.1	154.7		76.8		184	114	160	
138	**4-*n*-Butylacetanilide**	105		16.6	118.2	78	86.0		261	105	126	
139	**Acrylanilide**	105		13	141; 140				184	114	160	
140	***β*-Phenylpropionamide** (Hydrocinnamamide)	105	189	48.7; 40	279–80 (cor.)	36.3	104	NH_3				
141	**Propionanilide**	106; 103		−20.8	141	31	63.4		184	114	160	Conc. $HNO_3 + H_2SO_4 \rightarrow$ *p*-Nitro deriv., 182
142	**Palmitamide**	106	142	62.7	222[16]	42.5	86; 82	NH_3				
143	**N-Benzylbenzamide**	106		122.4	249	89	119		184–5	60	105	
144	**D-Chaulmoogramide**	106		68.5	247–8[20]			NH_3				
145	***sym*-Dimethylurea**	106							−6	28	80	
146	***n*-Valeramide** (*n*-Pentanamide)	106	167	−34.5	186.4		75	NH_3				Oxalate, 61.1–.4
147	**Myristamide**	107; 103		53.9	212[16]		81	NH_3				
148	**N-Benzylbenzanilide**	107		122.4	249	89	119	37	298	58	107	
149	**Margaramide** (Heptadecanamide)	108		61.2	231[16]	48.5–9.0 (cor.)	82.6	NH_3				
150	**Thioacetamide**	108		93				NH_3				
151	**Fluoroacetamide**	108		31–2	167–9			NH_3				
152	**Levulinamide**	108d.		33–5, deliq.	245–6	61	84	NH_3				
153	**Azelaic acid monoanilide**	108		106.5	> 360 sl. d.; 237[15]	*di*: 143.8	*di*: 130.6		184	114	160	
154	**Arachidamide**	108–9		77; 75	204[1]		89	NH_3				

*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
155	**Anthranilamide**	109		147d				NH_3				
156	**2-Iodoacetanilide**	109		166	118 2	78	86	61, 58		109	139	
157	**Pimelic acid monoanilide**	109		104–5, subl	223[15]		*di* 136 6		184	114	160	
158	**Stearamide**	109	139 41	70 1, 69 6			92	NH_3				
159	**α-Methylhydrocinnamamide**	109						NH_3				
160	**Lauramide** (Dodecanamide)	170, 102		44, 42	299		76	NH_3				
161	***n*-Caprylamide** (*n*-Octanamide)	110, 108	148	16 3	237, 239 3		67 4	NH_3				
162	**Isovaleranilide**	110		−30 0	176 5		68 0		184	114	160	
163	***d l*-2-Methylbutananilide**	110			176–7, 174		55		184	114	160	
164	**3-Nitrophenylacetamide**	110		120				NH_3				
165	**2-Ethylacetanilide**	111		166	118 2	78	86 0		210–1	111	147	
166	**β-Bromopropionamide**	111		62 5				NH_3				
167	**3-Aminobenzamide**	111		174d				NH_3				
168	**2-Ethylbutanamide**	112, 107		−31 8	195			NH_3				
169	**4-Methylpentananilide** (Isocaproanilide)	112, 110		−33	199 1[752]		77 3		184	174	160	
170	***d,l*-2-Methylbutanamide**	112			176–7, 174		55	NH_3				
171	**2-Acetotoluidide**	112		166	118 2	78	86 0	200		110 1[1]	146	$KMnO_4$ → Acetylanthranilic acid, 185
172	***d*-Hydnocarpamide** (α-Cyclopentylundecylamide)	112–3		60 5				NH_3				
173	**4-Aminobenzamide**	114		118d				NH_3				
174	**Acetanilide**	114 (cor)		166	118 2	78	86 0		184	114	160	B p 304, Conc HNO_3 + H_2SO_4 → *p*-nitro deriv, 210
175	**N-Benzylcrotonamide**	114		72	189 (cor)	67 4	95–6		184–5	60	105	
176	**Ethyl oxamate**	114		189 5 (anh), 101(+ $2H_2O$) (rapid htng)		*di* 204			16 5, 19		71	
177	**2-Chlorobenzanilide**	114, 118		142, 140		106	106		184	114	160	
178	**Dihydroacetic acid monoanilide**	115		109	270				184	114	160	
179	***n*-Butyramide**	115	185–7	−5 5, −8	162 5, 164		63	NH_3				Mercury deriv, 222–4, Oxalate, 65 9 6 2
180	**Methacrylamide**	116		16	161			NH_3				
181	**α-Bromoisovaleranilide**	116		44	230d				184	114	160	
182	***trans*-α-Crotonanilide**	118, 115		72, w	189 (cor)	67 4	95–6		184	114	160	
183	**Phenylacetanilide**	118		76 5, subl	256 5 (cor)	65	89		184	114	160	Conc HNO_3 → 2,4-dinitrophenylacetic acid, 189
184	**Dichloroacetanilide**	118		5–6	194		99		184	114	160	
185	***N*-Ethyl-4-nitroacetanilide**	118		166	118 2	78	86 0	96		119	98	
186	**Trimesic acid trianilide**	118–20d		380 (cor)			*tri* 197 (sealed tube)		184	114	160	
187	**3-Iodoacetanilide**	119		166	118 2	78	86 0	33, 27		119	157	
188	**Cyanoacetamide**	120	222–3	66				NH_3				

*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m. p.)* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	M P, °C	B P °C	Acet amide	Benz amide	
189	**Glycolamide**	120		78 9, 80		106 8	138		NH_3			
190	**Isocaproamide** (Isohexanamide)	120 1	159-60	−33	199 1^{752}		77 3		NH_3			
191	**Chloroacetamide**	121	208 9	α 61 3 β 56 2, γ 52 5	189		104					
192	**2-Chlorophenoxyacetanilide**	121		145 6, w					184	114	160	
193	**Tribromoacetamide**	122		131, 135	245d				NH_3			
194	**Sebacic acid monoanilide**	122		33, subl	243^{15}	*di* 73 5, 72 6	*di* 147		184	114	160	
195	**3-Chlorobenzanilide**	122 5		158 155		107	116		184	114	160	
196	**α-Bromopropionamide**	123		25 7	203 5				NH_3			
197	**Furanilide**	123 5		133 4 132	230-2	133 5	138 5		184	114	160	
198	**Pyruvamide**	124		13 6	165d 80^{25}				NH_3			
199	**3-Methylpentanamide**	125		−41 6	197 5				NH_3			
200	**4-Chlorophenoxyacetanilide**	125		155 6 w 158			136		184	114	160	
201	**3-Benzotoluidide** (N Benzoyl *m* toluidine)	125		122 4	249	89	119 0		203	65	125	
202	**2-Toluanilide**	125		104-5, 107 8	259^{750}	90 7	57		184	114	160	
203	**Acetyl-β-phenylhydrazine**	125 6		16 6	118 2	78	86 0	19, 23	243	128, *di* 107	168, *di* 177	
204	**Adipic acid monoamide**	125-30		153 4 (cor)	216^{15}	106	154 5, 152 6		NH_3			
205	**Succinimide**	126	245-7	185, 182 8	235d	*di* 88	*di* 211		NH_3			
206	**3-Toluanilide**	126		111-3, 110 1	263, subl	86 6	108		184	114	160	
207	**Angelanilide**	126		45-6	185 (cor)				184	114	160	
208	**β-Resorcylanilide** (2,4-Dihydroxybenzanilide)	126 7		213d (rapid htng) 216, 217		188-9			184	114	160	
209	**2-Ethylbutananilide**	127, 127 5		−31 8	195				184	114	160	
210	**Suberic acid monoamide**	127		144 139 41		*di* 85	*di* 144 2		NH_3			
211	**4-Methoxyacetanilide**	127		16 6	118 2	78	86 0	58	240	130 127	154, 157	
212	**Angelamide**	127 8		45 6	185 (cor)				NH_3			
213	**Phenylpropiolanilide**	128, 126		136 7, subl		83			184	114	160	
214	**Nicotinamide**	128 129, 129 31		237-8 subl					NH_3			B p 150 60$^{5\cdot10^{-4}}$ Chloroaurate, 205, N-Ethyl, 188-9, N isopropyl, 184 6
215	**Pivalanilide**	128 (cor), 132-3		35 5	163 4		75-6		184	114	160	
216	**Suberic acid monoanilide**	128-9		144, 139-41		*di* 85	*di* 144 2		184	114	160	
217	**Isobutyramide**	129, 127	210-1	−46 1	154 7		76 8		NH_3			
218	**2-Methoxybenzamide**	129		100-1	200		113		NH_3			Mercury deriv , 241
219	**2-Bromo-4-nitroacetanilide**	129		16 6	118 2	78	86 0	105		129	160	
220	**Benzamide**	130, 129	222 5-3 5, 224	122 4	249	89	119		NH_3			Mercury deriv , 222, Phthalimide, 168

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P , °C	B P , °C	*p*-Nitrobenzyl ester	*p* Bromophenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
221	**3,4-Dimethylbenzamide**	130		166, 164				NH_3				
222	**α,β-Dibromopropionamide**	130, 133		67 (stab), 50 (unstab)	160^{20}			NH_3				
223	**Anthranilanilide**	131		147					184	114	160	
224	**Bromoacetanilide**	131		50	208	88			184	114	160	
225	**2-Methoxybenzanilide**	131		100–1	200		113		184	114	160	
226	**Nicotinanilide**	132, bz , 85 (+ $2H_2O$), w , 265 (anh)		237 8, subl					184	114	160	
227	**2,2-Dimethylbutanamide**	132, 103		−15 0	187, 190				184	114	160	
228	***d,l*-2,3-Dimethylbutanamide**	132		−1 5	191 7			NH_3				
229	**3,3-Dimethylbutananilide**	132		6 7	184, 96[26]				184	114	160	
230	**3,3-Dimethylbutanamide**	132		6 7	184, 96[26]			NH_3				
231	**2,5-Dichloroacetanilide**	132		16 6	118 2	78	86 0	50		132	120	
232	**Malonic acid monoanilide**	132		134 8 9		*dl* 85 5			184	114	160	
233	**Urea** (Carbamide)	132 8	265, 274					NH_3				Phthalimide, 188–90, Picrate, 148
234	**2,4-Dimethylacetanilide**	133, 130		16 6	118 2	78	86 0		217	133, 130	192	
235	**Mesityleneamide** (3,5-Dimethylbenzamide)	133		16 6				NH_3				
236	**4-Isopropylbenzamide**	133		177, al				NH_3				
237	**α-Bromoisovaleramide**	133		44	230d			NH_3				
238	**4-Chlorophenoxyacetamide**	133		155–6, w , 158			136	NH_3				
239	***d l*-Mandelamide**	133 4 (cor)		118		123–4		NH_3				
240	**N-(2-Naphthyl)acetamide**	134		16 6	118 2	78	86 0	112		132	162	Br_2 → 1-Bromo deriv , 140
241	**3-Chlorobenzamide**	134		158, 155		107	116	NH_3				Mercury deriv , 245
242	**Phenacetin** (4-Acetophenetidide)	134		16 6	118 2	78	86 0	2 3	248 254	137	173	10% HNO_3 → 3-Nitro deriv , 103
243	**Chloroacetanilide**	134, 136–7		α 61 3, β 56 2, γ 52 5	189		104		184	114	160	
244	**2,3-Dimethylacetanilide**	135		16 6	118 2	78	86 0		221–2	135	189	
245	**Isovaleramide**	135, 136	182–3	−30 0	176 5		68 0	NH_3				
246	**Acetyl salicylanilide**	136		135 (rapid htng)	140d	90 5			184	114	160	
247	**3-Bromobenzanilide**	136		155		105	120		184	114	160	
248	**Salicylanilide**	136		158 3 (subl at 76)		97–8	140		184	114	160	
249	**α-Hydroxyisobutyranilide**	136		79	212	80 5	98		184	114	160	
250	**N,N-Diacetyltetramethylenediamine**	137		16 6	118 2	78	86 0	27	159	*dl* 137	*dl* 177	
251	**Benzo-2-iodonanilide** (N-Benzoyl-*o*-iodoaniline)	139		122 4 (subl at 100)	249	89	119	61, 58		109	139	
252	**3-Ethoxybenzamide**	139		137				NH_3				
253	**2,5-Dimethylacetanilide**	139		16 6	118 2	78	86 0	15 5	213–5	139	140	
254	**3-Aminobenzanilide**	140		174d					184	114	160	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
255	**2-Toluamide**	140, 143	199 200 5	104–5, 107 8	259[751]	90 7	57		NH_3			Mercury deriv, 196
256	**Trichloroacetamide**	141		57–8	197 5	80			NH_3			
257	**2-Iodobenzanilide**	141		162		111	143		184	114	160	
258	**2-Bromobenzanilide**	141		150		110	102		184	114	160	
259	**3-Tolylurea**	142							203	65	125	
260	**2-Chlorobenzamide**	142		142, 140		106	106		NH_3			
261	**Salicylamide**	142		158 3 (subl at 76)		97–8	140		NH_3			Mercury deriv, 190
262	**Furamide**	142–3	210	133 4, 132	230–2	133 5	138 5		NH_3			
263	**3-Nitrobenzamide**	143, 142		140		141	132		NH_3			
264	**Iodoacetanilide**	143–4		83					184	114	160	
265	**3,5-Dimethylacetanilide**	144, 140		16 6	118 2	78	86		220	144, 140	136	
266	**2-Benzotoluidide** (N-Benzoyl-o-toluidine)	144		122 4	249	89	119		200	110–11	146	$KMnO_4$ → Benzoylanthranilic acid, 177
267	**3-Nitrosalicylamide**	145 (hyd)		125					NH_3			
268	**2,4-Dichloroacetanilide**	145		16 6	118 2	78	86 0	63		145	177	
269	*α-d l*-**Phenylsuccinamide** (*β* form)	145		167–8, 84 (anh)					NH_3			
270	**4-Toluanilide**	145, 148		179 80, 182 subl	275 (cor)	104 5	153		184	114	160	
271	**Diethylmalonic acid monoamide**	146		125		*di* 91			NH_3			
272	**Cyclohexancarboxanilide** (Hexahydrobenzanilide)	146, 131		30–1	233				184	114	160	
273	**Phenylurea**	147	225						184	114	160	
274	**N,N'-Dibenzoyltrimethylenediamine**	147		122 4	249	89	119		136	*mono* 126, *di* 101	*mono* 140, *di* 147	
275	**Benzo-2-ethylanilide** (N-Benzoyl-*o*-ethylaniline)	147		122 4	249	89	119		210–11	111	147	
276	**2,4,6-Trichloroacetanilide**	148		16 6	118 2	78	86 0	78		148	172	
277	**α-Bromoisobutyramide**	148		48–9	198–200				NH_3			
278	**Cinnamamide**	148, 142		133	300	116 8	145 6		NH_3			
279	**Succinic acid monoanilide**	148 5		185, 182 8	235 d	*di* 88	*di* 211		184	114	160	
280	*N*-**Cyclohexybenzamide**	149		122 4	249	89	119		134	104	149	
281	**Benzylurea**	149							184–5	60	105	
282	**Phthalic acid monoamide** (Phthalamic acid)	149		200–6, 197 (sealed tube), 230 (rapid htng)		*di* 155 5	*di* 152 8		NH_3			
283	*β*-**Benzoylpropionanilide**	150, 145		116					184	114	160	
284	**Ethylmalonic acid monoanilide**	150		111		75			184	114	160	
285	**2-Chlorophenoxyacetamide**	150		145–6, w					NH_3			
286	**Adipic acid monoanilide**	151 3		153–4 (cor)	216[15]	106	154 5, 152 6		184	114	160	
287	**Cinnamanilide**	151, 153		133	300	116 8	145 6		184	114	160	Acid $KMnO_4$ → Benzoic acid, 122 4

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	*p* Nitro benzyl ester	*p*-Bromo phenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
288	**4-Fluoroacetanilide**	152		16 6	118 2	78	86 0	– 1	186	152	185	
289	***d l*-Mandelanilide**	152		118		123 4			184	114	160	
290	**4-Acetotoluidide** (N-Acetyl-*p*-toluidine)	153, 147		16 6	118 2	78	86 0	45	200	147	158	$KMnO_4$ → 4-Acetamido-benzoic acid, 256, Br_2 → 3-Bromo deriv, 117
291	**N-Methyl-4-nitroacetanilide**	153		16 6	118 2	78	86 0	152		153	112	
292	**Veratranilide**	154		181					184	114	160	
293	**4-Fluorobenzamide**	154		182, 182 6					NH_3			
294	**3-Nitrobenzanilide**	154		140		141	132		184	114	160	
295	**Benzilamide**	154–5, 155		150		99 5	152		NH_3			
296	**3-Nitrosalicylamide**	155, 145		125 (+ H_2O)					NH_3			
297	**2,5-Dichlorobenzamide**	155		153					NH_3			
298	**2-Bromobenzamide**	155		150		110	102		NH_3			Mercury deriv, 242
299	**Dibenzylacetanilide**	155		89					184	114	160	
300	**2-Nitrobenzanilide**	155		146		112	107		184	114	160	
301	**3-Bromobenzamide**	155		155		105	120		NH_3			Mercury deriv, 235
302	**N-(1-Naphthyl) acetanilide**	155, 159 6		131, 135					184	114	160	
303	**Phthalonamide** (β form)	155d		146					NH_3			
304	**3-Nitroacetanilide**	155		16 6	118 2	78	86 0		114	*mono* 155, *di* 76	*mono* 155, *di* 150	
305	**Pimelic acid dianilide**	155–6		104–5, subl	223^{15}		*di* 136 6		184	114	160	
306	**Pivalamide**	155–7, 153–4		35 5	163–4		75–6		NH_3			
307	**N-Phenylsuccinimide**	156		185, 182 8	235d	*di* 88	*di* 211		184	114	160	
308	**Dibromoacetamide**	156		48	232–5				NH_3			
309	**L-Malamide**	156 5–8 0		100–1		*mono* 87 2, *di* 124 5	*di* 179		NH_3			
310	**Phenylacetamide**	156, 157	196	76 5, subl	256 5 (cor)	65	89		NH_3			
311	**3-Hydroxybenzanilide**	157, 155		200, subl		106–8	176, 176 1 4		184	114	160	
312	**Succinic acid monoamide** (Succinamic acid)	157		185, 182 8	235d	*di* 88	*di* 211		NH_3			
313	**N-Acetylindole**	157–8		16 6	118 2	78	86	52	253	157–8	68	
314	***d l*-Phenylsuccinamide** (α form)	158		167–8					NH_3			
315	**4-Benzotoluidide** (N-Benzoyl-*p*-toluidine)	158		122 4	249	89	119	45	200	147	158	CrO_3 → 4-Benzamido benzoic acid, 278
316	**N-(1-Napthyl) acetamide**	159		16 6	118 2	78	86 0	50		159	160	Br_2 → 4-Bromo deriv, 193, Fuming HNO_3 → dinitro deriv, 250

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P , °C	B P , °C	*p*-Nitro benzyl ester	*p* Bromo phenacyl ester	M P , °C	B P , °C	Acet amide	Benz-amide	
317	**4-Toluamide**	159, 160	224-5	179-80, 182, subl	275 (cor)	104 5	153		NH_3			Mercury deriv , 260
318	**Crotonamide**	161, 158		72, w	189 (cor)	67 4	95 6		NH_3			
319	**N-(1-Naphthyl) benzamide**	161		122 4	249	89	119	50		159	160	
320	**N-(2-Naphthyl) benzamide**	162		122 4	249	89	119	112		132	162	
321	**4-Aminoacetanilide**	162		16 6	118 2		86 0	140, 147	267	*mono* 162 3, *di* 304	*mono* 128, *di* 300	Azo-β-naphthol deriv , 261
322	**4-Hydroxybenzamide**	162 (hyd)		215, 213 4, 210		180-2	191 5 (cor) 184		NH_3			
323	**Benzanilide**	163 160		122 4	249	89	119		184	114	160	Br_2 → 4-Bromo deriv , 204
324	**1-Naphthanilide**	163, 164		161 2 (cor)			135 5		184	114	160	
325	**Trichlorolactanilide**	164		124					184	114	160	
326	**Veratramide**	164		181					NH_3			
327	**2-Benzoylbenzamide**	165		128, 91 (hyd)		100 4			NH_3			
328	**L-Glutamamide**	165		211 (rapid htng), 197 (slow htng)					NH_3			
329	**Protocatechuanilide**	166		199-200d			188		184	114	160	
330	**4-Anisamide**	167, 163		184 6 184 2 (cor)	275-80	132	152		NH_3			Mercury deriv , 222
331	**4-Bromoacetanilide**	167, 168		16 6	118 2	78	86 0	66	245	168	204	
332	**Acetylanthranilanilide**	167		185 ac a					184	114	160	
333	**Diphenylacetamide**	168		148					NH_3			
334	**α-Benzoyl-β-phenylhydrazine**	168		122 4	249	89	119	19 23	243	128	168	
335	**2-Furanacrylamide** (β-(2-Furyl)-acrylic acid)	168-9		141	286				NH_3			
336	**Piperonylamide**	169		229, 228					NH_3			
337	***d l*-Tropamide**	169		117-8					NH_3			
338	**Methyliminodiacetic acid monoamide**	169		227d					NH_3			
339	**Methyliminodiacetic acid diamide**	169		227d					NH_3			
340	**4-Hydroxyacetanilide**	169		16 6	118 2	78	86 0	184, 186		*mono* 168, *di* 150	N- *mono* 216-7, N,O- *di* 234	
341	**4-Anisanilide**	169-71		184 6 184 2 (cor)	275-80	132	152		184	114	160	
342	**3-Hydroxybenzamide**	170 167		200 subl		106 8	176 176 7-4		NH_3			
343	**Sebacic acid monoamide**	170		33, subl	243^{15}	*di* 73 5 72 6	*di* 147		NH_3			
344	***cis*-Aconitanilide**	170d		125			*tri* 186		184	114	160	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
345	**Malonic acid diamide** (Malondiamide)	170	270	134.8–.9	.....	*di*: 85.5	.....	NH_3		.....	.....	.....
346	**D,L-Phenylsuccinic acid monoanilide** (β form)	170	.....	167–8; 84 (anh.)	.....	.....	.....	.....	184	114	160	.....
347	**4-Ethoxybenzanilide**	170; 172	.....	198; 195–6	.....	.....	.....	.....	184	114	160	.....
348	**2-Naphthylanilide**	171; 173	.....	184; 185.5	.....	.....	.....	.....	184	114	160	.....
349	**N,N'-Diacetylethylenediamine**	172	.....	16.6	118.2	78	86.0	8.5	116	*di*: 172	*di*: 244	.....
350	**Benzo-2,4,6-trichloroanilide** (N-Benzoyl-2,4,6-trichloroaniline)	172	.....	122.4	249	89	119	78	.....	148	172	.....
351	**Azelaic acid diamide**	172	.....	106.5	>360 sl. d.; 237[15]	*di*: 43.8	*di*: 130.6	NH_3		.....	.....	.....
352	**Maleic acid monoamide** (Maleamic acid)	172–3; 153 sl.d.	.....	137–8; 130 (+3% fumaric acid)	.....	*di*: 91 (cor.)	168–70; 190	NH_3		.....	.....	.....
353	**4-Phenetylurea** (Dulcin)	173	.....	.....	.....	.....	.....	2–3	248; 254	137	173	.....
354	**4-Benzophenetidide** (N-Benzoyl-*p*-phenetidine)	173	.....	122.4	249	89	119	2–3	248; 254	137	173	.....
355	**Benzylanilide**	174–5	.....	150	.....	99.5	152	.....	184	114	160	.....
356	**Pimelic acid diamide**	175	.....	104–5, subl.	223[15]	.....	*di*: 136.6	NH_3		.....	.....	.....
357	***d,l*-Phenylsuccinic acid monoanilide** (α form)	175	.....	167–8; 84 (anh.)	.....	.....	.....	.....	184	114	160	.....
358	**4-Hydroxyphenylacetamide**	175	.....	148–50; 148, w.	.....	.....	.....	NH_3		.....	.....	.....
359	**Citraconic acid dianilide**	175.5	.....	92–3; 22d.	.....	70.6	.....	.....	184	114	160	.....
360	**Glutaric acid diamide**	175–6	.....	98	302–4	*di*: 69	*di*: 139.8	NH_3		.....	.....	.....
361	**2-(4-Toluyl) benzamide**	175–6	.....	139–140	.....	.....	.....	NH_3		.....	.....	.....
362	**2-Nitrobenzamide**	176; 175	.....	146	.....	112	107	NH_3		.....	.....	.....
363	**Phthalonic acid monoanilide**	176	.....	146	.....	.....	.....	.....	184	114	160	.....
364	**N,N-Dibenzoyltetramethylenediamine**	177	.....	122.4	249	89	119	27	159	*di*: 137	*di*: 177	.....
365	**Acetylanthranilamide**	177	.....	185, ac. a.	.....	.....	.....	NH_3		.....	.....	.....
366	**2,6-Dimethylacetanilide**	177	.....	16.6	118.2	78	86.0	.....	215; 218	177	168	.....
367	**D-Camphoric acid monoamide**	177	.....	187.5–8.0	.....	65.5	.....	NH_3		.....	.....	.....
368	**Mesaconic acid diamide**	177	.....	204.5 (cor.), subl.	.....	*di*: 134 (cor.)	.....	NH_3		.....	.....	.....
370	**4-Cyanobenzanilide**	179	.....	219; 214	.....	189	.....	.....	184	114	160	.....
371	**N-Benzylphthalamide**	179	.....	200–6; 191 (sealed tube); 230 rapid htng.)	.....	*di*: 155.5	*di*: 152.8	.....	184–5	60	105	.....
372	**4-Chloroacetanilide**	179	.....	16.6	118.2	78	86.0	72	.....	179	192	.....
373	**α-Phthalonamide**	179d.	.....	146	.....	.....	.....	NH_3		.....	.....	.....

*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P , °C	B P , °C	*p* Nitro benzyl ester	*p* Bromophenacyl ester	M P , °C	B P , °C	Acetamide	Benzamide	
374	**2,4-Dimethylbenzamide**	179 81		127, 90 (+H_2O)					NH_3			
375	**D-Tartaric acid monoanilide**	180d		169 71		*di* 163	*di* 204		184	114	160	
376	**α-Acetyl-β-methylurea**	180		16 6	118 2	78	86 0		−6	28	80	
377	**Diphenylacetanilide**	180		148					184	114	160	
378	**3,5-Dinitrosalicylamide**	181		182					NH_3			
379	**1-Naphthylacetamide**	181		131, 135					NH_3			
380	**Maleic acid diamide**	181, 180		137		*di* 91 (cor)	168 70, 190		NH_3			
381	***unsym*-Dimethyl urea**	182	225						7		41	
382	**Thiourea**	182							NH_3			
383	**Hippuramide**	183		187		136	151		NH_3			
384	**4-Tolylurea**	183						45	200	147	158	
385	**3,5-Dinitrobenzamide**	183		204–5		157	159		NH_3			
386	**2-Iodobenzamide**	184		162		111	143		NH_3			
387	**4-Iodoacetanilide**	184		16 6	118 2	78	86 0	67–8		184	222	
388	**Benzo-4-fluoroanilide** (N-Benzoyl-*p*-fluoroaniline)	185		122 4	249	89	119	−1	186	152	185	
389	**N,N′-Diacetyl-*o*-phenylenediamine**	185		16 6	118 2	78	86 0	102		*di* 185	*di* 301	
390	**2-Nitrocinnamamide**	185		240		132	141		NH_3			
391	**Mesaconic acid dianilide**	185 7		204 5 (cor)		*di* 134 (cor)			184	114	160	
392	**Citraconic acid diamide**	185–7		92–3, 92d		*di* 70 6			NH_3			
393	**Chlorofumaranilide**	186		191–2		*di* 138 5			184	114	160	
394	**3-Iodobenzamide**	186		187		121	128		NH_3			
395	**Suberic acid dianilide**	186–7		144, 139–41		*di* 85	*di* 144 2		184	114	160	
396	**Maleic acid dianilide**	187		137		*di* 91 (cor)	168–70, 190		184	114	160	
397	**Maleic acid monoanilide**	187		137		*di* 91 (cor)	168–70, 190		184	114	160	
398	**Hippuric acid**	187 5		122 4	249	89	119	Glycine 228 30, 262d		206	187 5	Acetamide, 136, Benzamide, 151
399	***unsym*-Diphenylurea**	189	180					53 4		101	180	
400	**Aconitic acid dianilide**	189		194–5d (cor)			*tri* 186		184	114	160	
401	***meso*-Tartaric acid diamide**	189–90, 187		140		93			NH_3			
402	**4-Bromobenzamide**	189–90		251–3		180			NH_3			Mercury deriv , 266
403	**Itaconic acid dianilide**	190, 185		165		*di* 90 6	*di* 117 4		184	114	160	
404	**Picramide**	190		122 5					NH_3			Acetamide, 230, Benzamide, 196
405	**N,N′-Diacetyl-*m*-phenylenediamine**	191		16 6	118 2	78	86 0	63		*mono* 87–9, *di* 191	*mono* 125 *di* 240	
406	**Itaconic acid diamide**	191 2–8		165		*di* 90 6	*di* 117 4		NH_3			
407	**Mucic acid monoamide**	192d		214d , varies with htng rate, 223–255		310	225		NH_3			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M P °C	B P °C	Acet amide	Benzamide	
408	**4-Nitrophthalanilide**	192		165					184	114	160	
409	**2-Tolylurea**	192	228						200	110–11	146	
410	**Benzo-4-chloroaniline** (N Benzoyl *p*-chloroaniline)	192		122 4	249	89	119		72	179, 172	192	
411	**Biuret**	192d						NH_3				
412	**2-Naphthamide**	192 195		184 185 5				NH_3				
413	***D*-Camphoric acid diamide**	193		187 5 8 0		65 5		NH_3				
414	**4-Chlorobenzanilide**	194		243, 240		129 5	126		184	114	160	
415	**4-Coumaramide**	194		210 3 206 (anh)				NH_3				
416	**2-Benzoylbenzanilide**	195		128 91 (+1 H_2O)		100 4			184	114	160	
417	**3-Nitrocinnamamide**	196		199		174	178, 173	NH_3				
418	**D-Tartaric acid diamide**	196d		169 71		*dl* 163	*dl* 204	NH_3				
419	**2-Methyl-4-nitroacetanilide**	196 202		16 6	118 2	78	86 0	130		202		
420	**L-Malanilide** (Hydroxysuccinanilide)	197		100 1		*mono* 87 2 *dl* 124 5	*dl* 179		184	114	160	
421	**4-Hydroxybenzanilide**	198 196 7		215 213 4		180 2	191 5 (cor)		184	114	160	
422	**4-Nitrophenylacetamide**	198		153			207	NH_3				
423	**4-Nitrophenylacetanilide**	198		153			207	147 8		215	*dl* 193 , 203	
424	**Cyanoacetanilide**	198–9		66					184	114	160	
425	**Citric acid trianilide**	199 192 (+1 H_2O)		100 153 (anh)		*tri* 102	*tri* 148		184	114	160	
426	**4-Nitrophthalamide**	200d		165				NH_3				
427	***cis*-Aconitic acid dianilide**	200		125			*tri* 186		184	114	160	
428	**Methylsuccinic acid dianilide**	200		115					184	114	160	
429	**4-Nitrobenzamide**	200	232	241		168	137	NH_3				
430	**2-Naphthylacetamide**	200 205		141 2 143				NH_3				
431	**Isatin**	200 1										Acetamide, 147
432	**3-Nitrophthalic acid diamide**	201d		218		189		NH_3				
433	**Sebacic acid dianilide**	201		33, subl	243^{15}	*dl* 73 5 72 6	*dl* 147		184	114	160	
434	**1-Naphthoamide**	202		161 2 (cor)			135 5	NH_3				
435	**4-Ethoxybenzamide**	202		198 195–6				NH_3				
436	**2,4-Dinitrobenzamide**	203		183		142	158	NH_3				
437	***D*-Camphoric acid monoanilide**	204		187 5 8 0		65 5			184	114	160	
438	**Benzo-4-bromoanilide** (N Benzoyl-*p* bromoaniline)	204		122 4	249	89	119	66	245	168	204	
439	**4-Nitrocinnamamide**	204, 217		285		186	191	NH_3				
440	**N-Phenylphthalimide**	205		200 6 191 (sealed tube), 230 (rapid htng)		*dl* 155 5	*dl* 152 8		184	114	160	

*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	*p*-Nitro benzyl ester	*p*-Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
441	**Carballylic acid triamide**	207d 205 7d		166			*tri* 138 2	NH_3				
442	**Gallanilide**	207		253 4d 222 40d		141	134		184	114	160	
443	**Phthalonic acid dianilide**	208		146					184	114	160	
444	**Hippuranilide**	208		187		136	151		184	114	160	
445	**2-Coumaramide**	209d		207 8, subl		152 5		NH_3				
446	**Sebacic acid diamide**	210 208		133, subl	243[15]	*di* 73 5 72 6	*di* 147	NH_3				
447	**4-Iodobenzanilide**	210		270, 265		141	146		184	114	160	
448	**Citric acid triamide**	210–5		153 (slow htng)		*tri* 102	*tri* 148	NH_3				
449	**4-Nitrobenzanilide**	211 204		241		168	137		184	114	160	
450	***d l*-Phenylsuccinic acid diamide**	211		167 8 84 (anh)				NH_3				
451	**Protocatechuamide**	212		199 200d		188		NH_3				
452	**2,2′-Diphenic acid diamide**	212		227 233		*di* 187 182 6		NH_3				
453	**4-Nitroacetanilide**	213 4		16 6	118 2	78	86 0	147 8		215	*di* 199 203	
454	**Ethylmalonic acid diamide**	214		111		75		NH_3				
455	**3-Nitrophthalimide**	216		218		189		NH_3				
456	**Suberic acid diamide**	216 7		144 139 41		*di* 85	*di* 144 2	NH_3				
457	**Methylmalonic acid diamide**	217 206		137 138d				NH_3				
458	**4-Iodobenzamide**	217		270 265		141	146	NH_3				
459	**Benzylmalonic acid dianilide**	217		117d 121		*di* 119 5			184	114	160	
460	**4-Hydroxy-2-naphthamide**	217 8		225 6				NH_3				
461	**Acetylurea**	218		16 6	118 2	78	86 0	NH_3				
462	**3-Hydroxy-2-naphthamide**	218		222 3 (cor)				NH_3				
463	***sym* -Di-3-tolylurea**	218							203	65	125	
464	**Phthalic acid diamide**	220		200–6, 191 (sealed tube) 230 (rapid htng)		*di* 155 5	*di* 152 8	NH_3				
465	**Mucic acid diamide**	220		214d , varies with htng rate, 223–255		310	225	NH_3				
466	**Saccharin**	220	198 9	206				NH_3				
467	**Adipic acid diamide**	220, 229		153–4 (cor)	216[15]	106	152 6 154 5	NH_3				
468	***d l*-Phenylsuccinic acid dianilide**	222		167–8, 84 (anh)					184	114	160	

*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	*p* Nitro benzyl ester	*p* Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
469	β-Resorcylamide	222		213d (rapid htng) 216d 217		188 9			NH_3			
470	4-Cyanobenzamide	223		219 214		189			NH_3			
471	Diethylmalonic acid diamide	224		125	302 4	*di* 91			NH_3			
472	Glutaric acid dianilide	224		98		*di* 69	*di* 139 8		184	114	160	
473	5-Nitrosalicylanilide	224		229 30					184	114	160	
474	5-Nitrosalicylamide	225		229 30					NH_3			
475	Benzylmalonic acid diamide	225		117d 121		*di* 119 5			NH_3			
476	Methylsuccinic acid diamide	225		115					NH_3			
477	Malonic acid dianilide	225 227, 230		134 8- 9		*di* 85 5			184	114	160	
478	*d l*-Tartaric acid monoamide	226		203 4 (+1 H_2O) 205 6 (anh)		*di* 147 6			NH_3			
479	D-Camphoric acid dianilide	226		187 5 8 0		65 5			184	114	160	
480	Succinic acid dianilide	230, 226		185 182 8	235d	*di* 88	*di* 211		184	114	160	Heat above m p → succinanil, 155 6 + aniline, b p 184
481	2,2 -Diphenanilide	230		227 229 233		*di* 187 182 6			184	114	160	
482	Phthalimide	233 5 (cor) 238	176 7	200 6 191 (sealed tube) 230 (rapid htng)	249	89	119	122 119		232	198, 204	
483	3,5-Dinitrobenzanilide	234		204 5		157	159		184	114	160	
484	3-Nitrophthalic acid dianilide	234		218		189			184	114	160	
485	Terephthalic acid monoanilide	234 7		300, subl with out melting		*di* 263 5	*di* 225		184	114	160	
486	*d l*-Tartaric acid monoanilide	236		203 4 (+1 H_2O) 205 6 (anh)					184	114	160	
487	N-Benzylacrylamide	237		13	141, 140				184 5	60	105	
488	Carbanilide (*sym* -Diphenyl urea)	238, 240							184	114	160	
489	Muconic acid diamide	240d		289d (slow htng) 306 (rapid htng)					NH_3			
490	Adipic acid dianilide	241		153-4 (cor)	216^{15}	106	152 6, 154 5		184	114	160	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P , °C	B P , °C	*p*-Nitrobenzyl ester	*p*-Bromophenacyl ester	M P , °C	B P , °C	Acetamide	Benzamide	
491	**N,N′-Dibenzoylethylenediamine**	244		122 4	249	89	119	8 5	116	*di* 172	*di* 244	
492	**Gallamide**	245		253-4d , 222 40d		141	134	NH_3				
493	**3-Hydroxy-2-naphthanilide**	249 (cor), 244		222-3 (cor)					184	114	160	
494	***sym*-Di-2-tolylurea**	250							200	110 1	146	
495	**Carballylic acid trianilide**	252		166			*tri* 138 2		184	114	160	
496	**Phthalic acid dianilide**	253 5		200 6, 191 (sealed tube), 230 (rapid htng)		*di* 155 5	*di* 152 8		184	114	160	
497	**Oxalic acid dianilide**	254		189 5 (anh), 101 (+2 H_2O) (rapid htng)		*di* 204			184	114	160	
498	**Succinic acid diamide**	255, 260d	275	185, 182 8	235d	*di* 88	*di* 211	NH_3				
499	**2,4,6-Trinitrobenzamide**	264d		228				NH_3				
500	**D-Tartaric acid dianilide**	264d		169-71		*di* 163	*di* 204		184	114	160	
501	**Fumaric acid diamide**	266d		293 5 286-7 (sealed tube), 200, subl		150 8		NH_3				
502	***sym*-Di-4-tolylurea**	268						45	200	147	158	
503	**Isophthalic acid monoamide**	280		348, subl		202 5	179 1	NH_3				
504	**Isophthalic acid diamide**	280		348, subl		202 5	179 1	NH_3				
505	**Acetylenedicarboxylic acid diamide**	294d		179				NH_3				
506	**Mucic acid monoanilide**	310		214, varies with htng rate, 223-255		310	225		184	114	160	
507	**N,N′-Diacetyl *p*-phenylenediamine**	310		16 6	118 2	78	86 0	140, 147	267	*mono* 162-3, *di* 304	*mono* 128, *di* 300	
508	**Fumaric acid dianilide**	314		286 7 (sealed tube), 293-5, 200, subl		150 8			184	114	160	
509	**N,N′-Diacetylbenzidine**	317		16 6	118 2	78	86 0	127		*mono* 199, *di* 317	*mono* 203-5, *di* 352	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

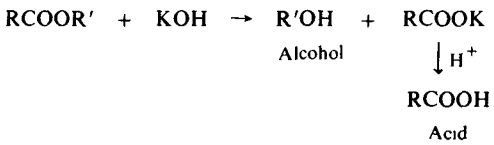
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P , °C	B P °C	*p* Nitro benzyl ester	*p*-Bromophenacyl ester	M P , °C	B P , °C	Acetamide	Benzamide	
510	**Terephthalic acid dianilide**	334 7		300, subl without melting		*di* 263 5	*di* 225					
511	**N,N'-Dibenzoylbenzidine**	352		122 4	249	89	119	127		*mono* 199 *di* 317	*mono* 203 5 *di* 352	
512	**Trimesic acid triamide**	365d		380 (cor)			*tri* 197 (sealed tube)	NH_3				
513	**Oxalic acid diamide**	419d (sealed tube)		189 5 (anh), 101 (+2 H_2O), (rapid htng)		*di* 204		NH_3				

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XVI

Hydrolysis to the corresponding acid and alcohol *



From the ester with aqueous sodium or potassium hydroxide
For directions and examples see Cheronis, p 539, Linstead, p 42, Vogel, pp 390, 391, 786, Wild, p 187
From the ester and potassium hydroxide in anhydrous or aqueous diethylene glycol
See Cheronis, p 538, C E Redemann and H J Lucas, *Ind Eng Chem, Anal Ed*, **9**, 514 (1937)
From the ester with sodium methoxide in methanol or with sodium ethoxide in ethanol
See Linstead, p 40, Vogel, p 391
From an α-hydroxy ester in water without catalyst
See A Findlay and E M H Hickmans, *J Chem Soc*, **95**, 1004 (1909)

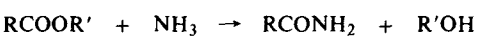
Saponification equivalent

The saponification equivalent (S E) measures the number of equivalents of base required for complete hydrolysis of an ester It is defined as

$$\text{S E} = \frac{\text{Milligrams ester taken for hydrolysis}}{\text{Milliequivalents of KOH required for complete hydrolysis}}$$

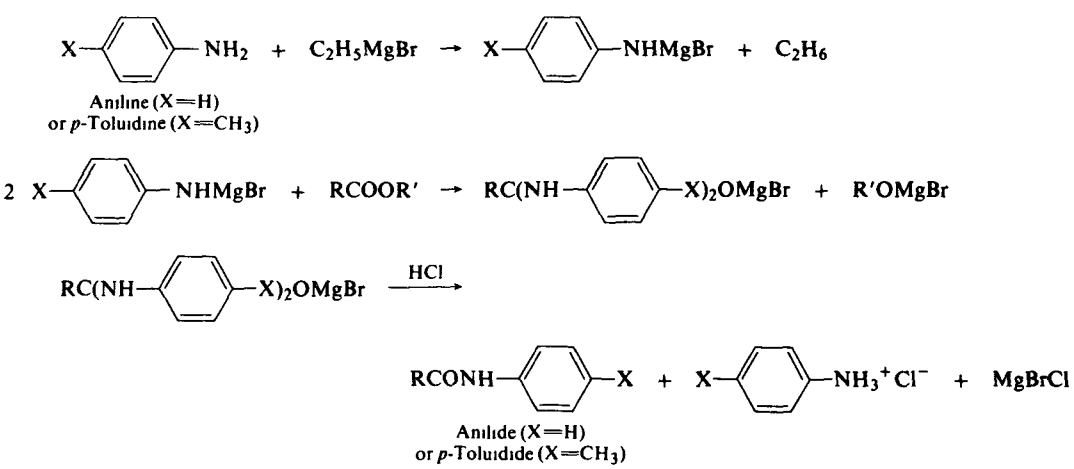
For directions and examples see Cheronis, pp 975 6, Shriner, p 235 Vogel, p 392
NOTE For directions and examples for preparation of derivatives of the carboxylic acids formed on hydrolysis of esters see explanations and references to Tables XII, XIII and XIV, pp 186, 187, 188, 189
For directions and examples for preparation of derivatives of alcohols formed on hydrolysis of esters see explanations and references to Table VI, pp 77, 78, 79

Amide



From the ester with aqueous or alcoholic ammonia
For directions and examples see Linstead, p 42, Wild, p 188

Anilide and p-Toluidide



From the ester and the N-magnesium bromide derivative of aniline or *p*-toluidine (prepared from the amine and ethylmagnesium bromide) in anhydrous ether
For directions and examples see Cheronis, p 537, Linstead, pp 42-3, Vogel, p 394, Wild, p 190, C F Koelsch and D Tenenbaum, *J Amer Chem Soc*, **55**, 3049 (1933), D V N Hardy, *J Chem Soc*, 398 (1936)

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE XVI (*Continued*)

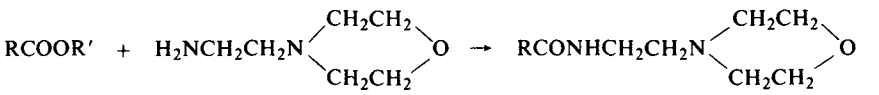
Hydrazide

$$RCOOR' + H_2NNH_2 \rightarrow RCONHNH_2 + R'OH$$

Hydrazide

From the ester and 90% hydrazine hydrate
For directions and examples see Linstead, p 42, Wild, p 191
From the ester and 85% hydrazine hydrate in alcohol
See Cheronis, p 535, Shriner, p 237, Vogel, p 395, P P T Sah, *Rec Trav chim*, **59**, 1036 (1940)

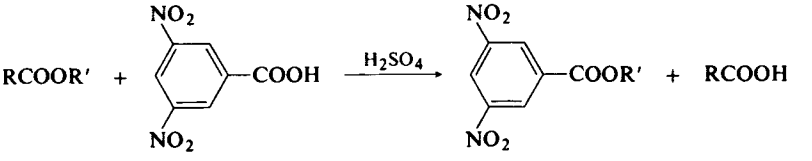
N-(β-Aminoethyl)morpholide *



N (β Aminoethyl)morpholide

From the ester and N-(β-aminoethyl)morpholine in ethylene glycol or without solvent
For directions and examples see Cheronis, p 536, R W Bost and L V Mullen, *J Amer Chem Soc*, **73**, 1967 (1951)

3,5-Dinitrobenzoate *



3 5 Dinitrobenzoate

From the ester with 3,5-dinitrobenzoic acid with a catalytic amount of sulfuric acid
For directions and examples see Linstead, p 43, Shriner, p 238, Vogel, p 393, W B Renfrow and A Chaney, *J Amer Chem Soc*, **68**, 150 (1946)
From the ester with 3,5-dinitrobenzoyl chloride and pyridine
See Cheronis, p 538

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.).*

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p* Toluidide	3,5 Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P., °C	M.P. °C	B.P. °C				
1	**Ethyl nitrite**	17			0.900$_4^{15}$	75			−117.3	78.32			93, al	
2	**Methyl formate**	31.50	−99	1.34648[17] He (yel)	0.97421	60	8.4	100.7	−97	64.65	2.55	53	108 (cor.), al	
3	**Ethyl formate**	54.15	−79.4	1.35975	0.92247	74	8.4	100.7	−117.3	78.32	2.55	53	93, al	
4	**Methyl acetate**	57.1	−98.7	1.36170 1.3639	0.9274 0.93347	74	16.6	118.2	−97	64.65	82	153 147	108 (cor.), al	
5	**Ethyl trifluoroacetate**	60.5		1.3093[15]		142	−15.25	72.4	−117.3	78.32			93, al	
6	**Methyl nitrate**	65			1.217$_4^{15}$	77			−97	64.65			108 (cor.), al	
7	**Isopropyl formate**	71, 68			0.8728	88	8.4	100.7	−89.5	82.4	2.55	53	123, pet eth	
8	**Butyl nitrite**	75			0.911	103			−90.2	117.6 116			64, 62.5	
9	**Methyl chloroformate**	75		1.38675	1.2231	94.5			−97	64.65			108 (cor.), al	
10	**Ethyl acetate**	77.15	−83.6	1.372	0.90055	88	16.6	118.2	−117.3	78.32	82	153 147	93, al	
11	**Methyl propionate**	79.65	−87.5	1.3779	0.9151	88	−20.8	141	−97	64.65	81 81.3, 79	126 123	108 (cor.), al	
12	**Methyl acrylate**	80.3		1.3984	0.961[19.2]	86	13	140, 141	−97	64.65	84-5, pet eth	141	108 (cor.), al	Polymerizes on standing
13	***n*-Propyl formate**	80.85, 81	−92.9	1.37789	0.9071, 0.918	88	8.4	100.7		97.1	2.55	53	74, pet eth	
14	***tert*-Butyl formate**	83				102	8.4	100.7	25.5	82.5	2.55	53	142, pet eth	
15	**Allyl formate**	83.6			0.946	86	8.4	100.7		97.1	2.55	53	49-50	
16	**Ethyl nitrate**	87	−112		1.106	91			−117.3	78.32			93, al	
17	**Isopropyl acetate**	88.9, 91	−73.4	1.3740[25]	0.872	102	16.6	118.2	−89.5	82.4	82	153, 147	123, pet eth	
18	**Dimethyl carbonate** (Methyl carbonate)	90.5		1.3687	1.0702 1.0694	90			−97	64.65			108 (cor.), al	
19	**Methyl isobutyrate**	92.6, 92.26	−87.7, −84.7	1.3840	0.8906	102	−46.1	154.7	−97	64.65	128, 129	108.5-9.5	108 (cor.), al	
20	**Ethyl chloroformate**	93		1.3974	1.13519	108.5			−117.3	78.32			93, al	
21	***sec*-Butyl formate**	97		1.384	0.884	102	8.4	100.7		99.5	2.55	53	76	
22	***tert*-Butyl acetate**	97.8		1.386	0.867	116	16.6	118.2	25.5	82.5	82	153, 147	142, pet eth	
23	**Isobutyl formate**	98.4	−95.8	1.38568	0.88535, 0.8755	102	8.4	100.7		108.1	2.55	53	87	
24	**Isoamyl nitrite**	99		1.38708[21]	0.880[15]	117			−117	132			61	
25	**Ethyl difluoroacetate**	99		1.3463		124		134.5	−117.3	78.32	52		93, al	

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p* Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P., °C	M.P. °C	B.P., °C				
26	**Methyl methacrylate**	99, 100 1	−50	1 413	0 936	100	16	161	−97	64 65	102 6		108 (cor) al	Polymerizes on standing or heating, 4-Bromoanilide, 116
27	**Ethyl propionate**	99 1	−73 85	1 3853	0 8889	102	−20 8	141	−117 3	78 32	81, 81 3, 79	126, 123	93, al	N-(β-Aminoethyl)morpholide, 85
28	**Ethyl acrylate**	101		1 4059[19 4]	0 9136[15]	100	13	141	−117 3	78 32	84-5, pet eth	141	93, al	Polymerizes on standing or heating
29	**Methyl pivalate** (Methyl trimethylacetate)	101		1 4228	0 891[0]	116	35 5	163-4	−97	64 65	155 7, 153 4, et ac - pet eth	119 20	108 (cor), al	
30	***n*-Propyl acetate**	101 55	−95	1 38468	0 8834	102	16 6	118 2		97 1	82	153 147	74, pet eth	
31	**Methyl *n*-butyrate**	102 3	−84 8	1 3879	0 8982	102	−5 5 −8	162 5, 164	−97	64 65	115 6	75	108 (cor), al	
32	**Allyl acetate**	104		1 40488	0 9276	100	16 6	118 2		97 1	82	153 147	49 50	
33	**Trimethyl orthoformate** (Methyl orthoformate)	105, 102		1 3793	0 9676	106	8 4	100 7	−97	64 65	2 55	53	108 (cor), al	
34	**Methyl isocrotonate**	106 2 108 2 (cor)				100	15	169	−97	64 65	101 2	132	108 (cor), al	
35	***n*-Butyl formate**	106 6	−91 9	1 38940	0 8885	102	8 4	100 7	−90 2	117 6, 116	2 55	53	64, 62 5	
36	**Ethyl isobutyrate**	109 8, 111	−88 2	1 3903	0 86930	116	−46 1	154 7	−117 3	78 32	128, 129	108 5-9 5	93, al	Hydrazide, 104, eth -al
37	***n*-Propyl nitrate**	110		1 3979	1 063	105				97 1			74, pet eth	
38	**Chloromethyl acetate**	111			1 094[15]	108 5	16 6	118 2			82	153 147		
39	**Isopropyl propionate**	111 3			0 8931[0]	116	−20 8	141	−89 5	82 4	81, 81 3, 79	126 123	123, pet eth	
40	***sec*-Butyl acetate**	112 0		1 3865[25]	0 872, 0 8648[25]	116	16 6	118 2		99 5	82	153, 147	76	
41	***n*-Propyl chloroformate**	113 115		1 40350	1 0901	122 5				97 1			74, pet eth	
42	**Methyl isovalerate**	116 7		1 3900[25]	0 8808	116	−30 0	176 5	−97	64 65	135, 137	106 7	108 (cor), al	
43	**Isobutyl acetate**	117 2 118		1 39008	0 8747	116	16 6	118 2		108 1	82	153, 147	87	
44	**Ethyl pivalate** (Ethyl trimethylacetate)	118 15		1 39061	0 85467	130	35 5	163-4	−117 3	78 32	155 7, 153-4, et ac - pet eth	119 20	93, al	
45	**Ethyl methacrylate**	118 5[-1]		1 41472	0 91063	114	16	161	−117 3	78 32	102 6		93, al	Polymerizes on heating, 4-Bromoanilide, 116

*Derivative data given in order m p crystal color solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P., °C	M.P., °C	B.P., °C				
46	**Methyl crotonate**	118.8–119.3			0.9806[4]	100	72	189 (cor.)	−97	64.65	118, w., 115	132, bz	108 (cor.), al	
47	**Isopropyl isobutyrate**	120.76			0.84708[21.3]	130	−46.1	154.7		82.4	128, 129	108.5–9.5	123, pet. eth.	Hydrazide, 104, eth.-al
48	**Ethyl *n*-butyrate**	121.6	−100.8	1.40002	0.87917	116	−5.5, −8	162.5, 164	−117.3	78.32	115–6	75	93, al.	
49	***n*-Propyl propionate**	122.2, 123.4	−75.9	1.39325	0.8809	116	−20.8	141		97.1	81, 81.3, 79	126, 123	74, pet. eth.	
50	***tert*-Amyl acetate** (Dimethylethylcarbinyl acetate)	124		1.392	0.8738[19]	130	16.6	118.2	−8.55	102.3	82	153, 147	116, 117–8	
51	**Allyl propionate**	124				114	−20.8	141		97.1	81, 81.3, 79	126, 123	49–50	
52	**Isoamyl formate**	124.2	−93.5	1.39756	0.8820	116	8.4	100.7	−117	132	2.55	53	61	
53	**Ethyl isocrotonate**	125.5–126[749]		1.42423	0.91820	114	15	169	−117.3	78.32	101.2	132	93, al.	
54	***n*-Butyl acetate**	126.1	−73.5	1.39614	0.881	116	16.6	118.2	−90.2	117.6, 116	82	153, 147	64, 62.5	
55	**Diethyl carbonate** (Ethyl carbonate)	126.5	−43.0	1.3852	0.9752	118			−117.3	78.32			93, al.	
56	***tert*-Butyl isobutyrate**	126.7		1.3921		144	−46.1	154.7	25.5	82.5	128, 129	108.5–9.5	142, pet. eth.	Hydrazide, 104, eth.-al
57	**Methyl *n*-valerate** (Methyl *n*-pentanoate	127.7	−91.0	1.397	0.885	116	−34.5	186.35	−97	64.65	106	74	108 (cor.), al.	
58	**Isopropyl *n*-butyrate**	128			0.8652[13]	130	−5.5, −8	162.5, 164	−89.5	82.4	115–6	75	123, pet. eth.	
59	**Isobutyl chloroformate**	130, 128.8		$1.40711_{He}^{17.9}$		136.5				108.1			87	
60	**Methyl methoxyacetate**	130		1.39636	1.0511	104		203	−97	64.65	96.5–7.0, 92.4		108 (cor.), al.	
61	**Methyl chloroacetate**	130, 132		1.4221	1.238	108.5	α 61.3, β 56.2, γ 52.5	189	−97	64.65	121	162	108 (cor.), al.	
62	**Ethyl methoxyacetate** .	132			1.0118[15]	118		203	−117.3	78.32	96.5 7.0, 92–4		93, al.	
63	***n*-Amyl formate**	132.1, 130	−73.5	1.39916	0.8853	116	8.4	100.7	−78.5	138 (cor.)	2.55	53	46.4	
64	***sec*-Amyl(3) acetate** (Diethylcarbinyl acetate)	133			1.4005	130	16.6	118.2		116.1	82	153, 147	101, 99, 97	
65	***sec*-Amyl(2) acetate** (Methyl *n*-propylcarbinyl acetate)	133.5		1.3960	0.8692[18]	130	16.6	118.2		119.85	82	153, 147	62	
66	**Allyl isobutyrate**	134				128	−46.1	154.7		97.1	128, 129	108.5 9.5	49–50	Hydrazide, 104, eth.-al
67	**Ethyl isovalerate**	134.7	−99.3	1.4009	0.86565	130	−30.0	176.5	−117.3	78.32	135, 137	106–7	93, al.	
68	***n*-Propyl isobutyrate**	135		1.3959	0.8843[0]	130	−46.1	154.7		97.1	128, 129	108.5 9.5	74, pet. eth.	Hydrazide, 104, eth.-al

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P. °C	M.P. °C	B.P. °C				
69	***n*-Butyl nitrate**	136			1.048[0]	119			−90.2	117.6 116			64, 62.5	
70	**Methyl pyruvate**	136.8 138, 134-7			1.154[0]	102	13.6	165d	−97	64.65	124.5 145	109 130	108 (cor.), al	2,4-Dinitrophenylhydrazone, 186.5-7.5 (cor.), yel., diox.-me al
71	**Methyl α-hydroxyisobutyrate**	137				118	79	212	−97	64.65		132.3, w	108 (cor.), al	
72	**Isobutyl propionate**	138, 137	−71.4	1.3975	0.8876[0]	130	−20.8	141		108.1	81, 81.3, 79	123-6	87	
73	**Ethyl crotonate**	138, 136.7[749]		1.42524	0.91752	114	72, w	189 (cor.)	−117.3	78.32	159-60, bz	132, bz	93, al	
74	**Allyl *n*-butyrate**	142				128	−5.5 −8	162.5, 164		97.1	115-6	75	49-50	
75	**Isoamyl acetate** (3-Methylbutyl acetate)	142		1.40034	0.8674	130	16.6	118.2	−117	132	82	153, 147	61	
76	**Isopropyl isovalerate**	142		1.3938[25]	0.8538[17]	144	−30	176.5	−89.5	82.4	135-137	106.7	123, pet. eth.	
77	***n*-Propyl *n*-butyrate**	143.8	−95.2	1.4005	0.872	130	−5.5 −8	162.5 164		97.1	115.6	75	74, pet. eth.	
78	**β-Methoxyethyl acetate** (Ethylene glycol monomethyl ether acetate, Methyl cellosolve acetate)	144			1.088	118	16.6	118.2		124.5	82	153 147		
79	**Methyl bromoacetate**	144d			1.657	153	50	208	−97	64.65	91		108 (cor.), al	
80	***n*-Butyl chloroformate**	145, 139		1.417[N.4]	1.079	136.5			−90.2	117.6, 116			64, 62.5	
81	**β-Chloroethyl acetate**	145		1.4234	1.178	122.5	16.6	118.2		131	82	153, 147		
82	**Methyl *d,l*-lactate**	145 144.8		1.4144	1.0931	104	16.8, 18	122[15]	−97	64.65	78.5-9.0 (cor.), bz.-al (3:1)	107	108 (cor.), al	
83	**Ethyl chloroacetate**	145	−26	1.42274	1.158	122.5	α 61.3, β 56.2, γ 52.5	189	−117.3	78.32	121	162	93, al	
84	***tert*-Butyl *n*-butyrate**	145-6.6		1.4001[17.5]		144	−5.5, −8	162.5, 164	25.5	82.5	115-6	75	142, pet. eth.	
85	**Triethyl orthoformate** (Ethyl orthoformate)	145.5		1.3922	0.8909	148	8.4	100.7	−117.3	78.32	2.55	53	93, al	
86	**Ethyl *n*-valerate** (Ethyl *n*-pentanoate)	145.5	−91.2	1.40094	0.8739	130	−34.5	186.35	−117.3	78.32	106	74	93, al	
87	**Ethyl α-chloropropionate**	146			1.087	136.5		186	−117.3	78.32	80	124	93, al	Phenylhydrazide, 95

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^n	D_4^{20}	Saponification					Amide	*p*-Toluidide	3 5 Dinitro benzoate	Miscellaneous
						Equivalent	Acid		Alcohol						
							M P °C	B P °C	M P °C	B P °C				
88	***n*-Butyl propionate**	146 8	−89 6	1 4038[15]	1 401	130	−20 8	141	−90 2	117 6, 116	81 81 3, 79	126, 123	64 62 5	
89	**Benzyl chloroacetate**	147		1 5246[18]	1 2223[4]	170 5	α 61 3, β 56 2 γ 52 5	189	−15 3	205 5	121	162	113	
90	**Di-isopropyl carbonate** (Isopropyl carbonate)	147 2 (cor)		1 3932	0 9162	146			−89 5	82 4			123, pet eth	
91	**Methyl isobutylcarbinyl acetate**	148			0 8805[0]	130	16 6	118 2	−97	64 65	82	153 147	108 (cor), al	
92	**Methyl ethoxyacetate**	148			1 0112[1]	118		206 7	−97	64 65	80 2	32, eth	108 (cor), al	
93	**Isobutyl isobutyrate**	148 6	−80 65	1 3999	0 87496[0]	144	−46 1	154 7		108 1	128, 129	108 5 9 5	87	Hydrazide, 104, eth -al
94	***n*-Amyl acetate** (*n*-Pentyl acetate)	149 25	−70 8	1 4031	0 8756	130	16 6	118 2	−78 5	138 (cor)	82	153 147	46 4	
95	**Ethyl α-hydroxyisobutyrate**	150				132	79	212	−117 3	78 32		132 3, w	93, al	
96	**Methyl glycolate**	151 2			1 1677[18]	90	78 9 80		−97	64 65	120 al - et ac	143, w	108 (cor), al	
97	**Methyl *n*-caproate** (Methyl *n*-hexanoate)	151 25	−71 0	1 405	0 88464	130	−3 9	205 35	−97	64 65	100 1	74 5	123, pet eth	
98	**Isopropyl *n*-valerate** (Isopropyl *n*-pentanoate)	153 5		1 4009	0 8579	144	−34 5	186 35	−89 5	82 4	106	74	61	
99	**Isoamyl chloroformate**	154		$1\ 41916_{He}^{12}$	1 032[15]	150 5			−117	132			93, al	
100	**Ethyl *d,l*-lactate**	154 5		1 410	1 030	118	16 8, 18	122[15]	−117 3	78 32	78 5 9 0 (cor), bz -al , (3 1)	107	93, al	
101	**Ethyl pyruvate**	155		0 0596[15 6]	1 408[15 6]	116	13 6	165d	−117 3	78 32	124 5, 145	109, 130	93, al	Phenylhydrazone, 118, dil al 4-Nitrophenylhydrazone, 185–7, 2 4-Dinitrophenylhydrazone, 154 5 155 (cor), diox -al
102	***n*-Propyl isovalerate**	155 5		1 40413[17 8]	0 8643[17 8]	144	−30	176 5		97 1	135, 137	106–7	74, pet eth	
103	***n*-Hexyl formate**	155 51	−62 65	1 40898[15] He (yel)	0 88133	130	8 4	100 7	−51 6 −46 1	157 5	2 55	53	58 4 (cor)	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3 5-Dinitro benzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C	B P °C				
104	**β-Ethoxyethyl acetate** (Ethylene glycol monoethyl ether acetate, Ethyl cellosolve acetate)	156 2, 158		1 40292	0 9701	132	16 6	118 2		135	82	153, 147	75, al	
105	**Isobutyl *n*-butyrate**	157		1 40295[18 4]	0 8620	144	−5 5 −8	162 5 164		108 1	115 6	75	87	
106	**Ethyl dichloroacetate**	158		1 43860	1 2821	157	5 6	194	−117 3	78 32	98 (subl)	153	93, al	
107	**Ethyl bromoacetate**	159		1 451	1 506	167	50	208	−117 3	78 32	91		93, al	
108	**Ethyl glycolate**	160			1 0869[15]	104	78 9 80		−117 3	78 32	120, al - et ac	143, w	93, al	
109	**Isoamyl propionate**	160 2		1 4065	0 870	144	−20 8	141	−117	132	81 81 3 79	126 123	61	
110	**Ethyl α-bromopropionate**	162			1 524	181	25 7	203 5	−117 3	78 32	123	125	93, al	
111	**Cyclohexyl formate**	162 5[750]		1 443	1 010	128	8 4	100 7	25 1	161 1	2 55	53	112-3, al	
112	**β-Bromoethyl acetate**	163			1 524	167	16 6	118 2		149d	82	153, 147		
113	**Tetraethyl silicate** (Ethyl orthosilicate)	165 5, 168 5		1 38619	0 93975	52			−117 3	78 32			93, al	Gives SiO_2 on hydrolysis
114	***n*-Propyl *n*-valerate** (*n*-Propyl *n* pentanoate)	166 2, 167	−70 7	1 4065	0 8699	144	−34 5	186 35		97 1	106	74	74, pet eth	
115	***n*-Butyl *n*-butyrate**	166 6	−91 5	1 406	0 869	144	−5 5 −8	162 5, 164	−90 2	117 6 116	115 6	75	64, 62 5	
116	**Ethyl *n*-caproate** (Ethyl *n* hexanoate)	167 7	−67 5	1 40727	0 8710	144	−3 9	205 35	−117 3	78 32	100 1	74 5	93, al	
117	**Ethyl trichloroacetate**	168		1 450	1 380	191 5	57 8	197 5	−117 3	78 32	141	113	93, al	Phenylhydrazide, 123
118	**Isopropyl *d,l*-lactate**	168, 166 8		1 4082[25]	0 998	132	16 8, 18	122[15]	−89 5	82 4	78 5 9 0 (cor), bz -al (3 1)	107	123, pet eth	
119	**Di-*n*-propyl carbonate** (*n*-Propyl carbonate)	168 5 (cor)		1 4014	0 9411	146				97 1			74, pet eth	
120	***n*-Amyl propionate** (*n*-Pentyl propionate)	168 7	−73 1	1 4096[15]	0 8761[15]	144	−20 8	141	−78 5	138 (cor)	81, 81 3, 79	126, 123	46 4	
121	**Ethylidene diacetate**	169			1 061[12]	73	16 6	118 2	−12 6	197 85	82	153, 147	169	
122	**Isoamyl isobutyrate**	169			0 8760[0]	158	−46 1	154 7	−117	132	128, 129	108 5-9 5	61	Hydrazide, 104, eth -al
123	**Methyl acetoacetate**	170		1 41964	1 0765[0]	116			−97	64 65			108 (cor), al	Semicarbazone, 152 5, me al
124	**Isobutyl isovalerate**	171		1 40569	0 8534	158	−30	176 5		108 1	135, 137	106 7	87	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P, °C	B P, °C	M P °C	B P, °C				
125	**Methyl enanthate** (Methyl *n*-heptanoate)	173 8	−55 8	1 412	0 88011	144	−74 7	223	−97	64 65	96, 96 5	81	108 (cor), al	
126	**Ethylene glycol diformate**	174			1 193[0]	59	8 4	100 7	−78 5	138 (cor)	2 55	53	46 4	
127	***sec*-Butyl *n*-valerate** (*sec*-Butyl *n*-pentanoate)	174 5		1 4081	0 8605[20]	158	−34 5	108 35		99 5	106	74	76	
128	**Cyclohexyl acetate**	175		1 442	0 970	142	16 6	118 2	25 1	161 1	82	153, 147	112 3, al	
129	***n*-Butyl chloroacetate**	175			1 081	150 5	α 61 3, β 56 2, γ 52 5	189	−90 2	117 6, 116	121	162	64, 62 5	
130	**Furfuryl acetate**	175 7		1 4627	1 118	140	16 6	118 2		172, 170	82	153, 147	80 1	
131	**Methyl methylacetoacetate**	177 4		1 418	1 030	130			−97	64 65			108 (cor), al	Semicarbazone, 138, al
132	***n*-Heptyl formate**	178 12		1 41505[15] He (yel)	0 87841	144	8 4	100 7	−34 6, −33 8	176 8	2 55	53	46 47	
133	***n*-Hexyl acetate**	178 1	−80 9, −60 9	1 41122[15] He (yel)	0 87336	144	16 6	118 2	−51 6, −46 1	157 5	82	153, 147	58 4 (cor)	
134	**Isoamyl *n*-butyrate**	178 6		1 411	0 864	158	−5 5, −8	162 5, 164	−117	132	115 6	75	61	
135	**Ethyl β-bromopropionate**	179			1 425	181	62 5		−117 3	78 32	111		93, al	2-Naphthylamide, 174
136	**Ethyl acetylglycolate**	179			1 0993[17]	73			−117 3	78 32			93, al	Hydrolysis → glycolic a + ac a + al
137	**Isobutyl *n*-valerate** (Isobutyl *n*-pentanoate)	179		1 4099	0 8625	158	−34 5	186 35		108 1	106	74	87	
138	**β-Hydroxyethyl formate** (Ethylene glycol monoformate)	180			1 1989[15]	90	8 4	100 7	−78 5	138 (cor)	2 55	53	46 4	
139	**Ethyl methylacetoacetate**	180 8 (cor), 187		1 419	1 0191	144			−117 3	78 32	73, eth		93, al	Anilide, 138-40, Semicarbazone, 194, 2,4-Dinitrophenyl hydrazone, 56-7
140	**Ethyl acetoacetate**	181		1 41976	1 025	130			−117 3	78 32			93, al	Semicarbazone, 129, 133, eth
141	**Methyl pyromucate** (Methyl 2-furoate)	181 3		1 4860	1 180	126	133 4, 132	230-2	−97	64 65	142-3	170 5, al	108 (cor), al	2,4-Dinitrophenylhydrazone, 93, 96, yel , al

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P. °C	B.P. °C	M.P. °C	B.P. °C				
142	**Dimethyl malonate** (Methyl malonate)	181.5	−62	1.41398	1.1539	66	134.8–9		−97	64.65	*mono* 106 110 *di*: 170 w.-al	*mono* 156d *di* 252 3, al	108 (cor.) al	Phenylhydrazide, 194
143	**Ethyl β-methoxyethyl carbonate**	182.6		1.4036[25]	1.0424[25]	148			−117.3	78.32			93 al	
144	**Methyl cyclohexanecarboxylate** (Methyl hexahydrobenzoate)	183		1.45372[15]	0.9954[15]	142	30.1	233	−97	64.65	185.6		108 (cor.), al	
145	**Diethyl oxalate** (Ethyl oxalate)	185.19	−41.5, −40.6	1.41043	1.0785	73	189.5 (anh.) 101 (+ $2H_2O$)		−117.3	78.32	*mono* 219 *di* 419d	*mono* 169 *di* 268	93, al	N-(β-Aminoethyl)-morpholide 170
146	***n*-Amyl *n*-butyrate** (*n*-Pentyl *n*-butyrate)	186.4	−72.3	1.412	0.866	158	−5.5, −8	162.5 164	−78.5	138 (cor.)	115–6	75	46.4	
147	***n*-Butyl *n*-valerate** (*n*-Butyl *n*-pentanoate)	186.9	−92.8	1.4123	0.8678	158	−34.5	186.35	−90.2	117.6 116	106	74	64 62.5	
148	**β-Hydroxyethyl acetate** (Ethylene glycol monoacetate)	187–9				104	16.6	118.2	−78.5	138 (cor.)	82	153 147	46.4	
149	***n*-Propyl *n*-caproate** (*n*-Propyl *n*-hexanoate)	187.15 186	−74.0	1.417	0.86719	158	−3.9	205.35		97.1	100.1	74.5	74, pet eth	
150	**Dimethyl sulfate** (Methyl sulfate)	188	−27	1.3874	1.3348[15]	63			−97	64.65			108 (cor.), al	
151	***n*-Butyl lactate**	188	−43	1.4216	0.984_{20}^{20}	146	16.8, 18	122[15]	−90.2	117.6 116	78.5–9.0 (cor.), bz.-al (3:1)	107	64 62.5	
152	**Ethyl enanthate** (Ethyl *n*-heptanoate)	188.6	−66.3	1.413	0.86856	158	−7.47	223	−117.3	78.32	96, 96.5	81	93, al	
153	**Methyl ethylacetoacetate**	189.7 (cor.)			0.989	144			−97	64.65	95.6, bz		108 (cor.), al	
154	**Di-isobutyl carbonate** (Isobutyl carbonate)	189.8 (cor.)		1.4072	0.9138	174				108.1			87	
155	***n*-Hexyl propionate**	190	−57.5	1.41621[15] He (yel.)	0.86980	158	−20.8	141	−51.6 −46.1	157.5	81, 81.3, 79	126 123	58.4 (cor.)	
156	**Ethylene glycol diacetate**	190.2	−31	1.4150	1.1040	73	16.6	118.2	−78.5	138 (cor.)	82	153, 147	46.4	
157	**Isoamyl isovalerate**	190.4		1.41300[18.7]	0.870	172	−30	176.5	−117	132	135, 137	106.7	61	
158	***n*-Heptyl acetate**	192.45		1.41653[15] He (yel.)	0.87070[15]	158	16.6	118.2	−34.6, −33.8	176.8	82	153, 147	46, 47	
159	**Cyclohexyl propionate**	193[750]			0.9718[0]	156	−20.8	141	25.1	161.1	81, 81.3, 79	126, 123	112.3, al	

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3 5 Dinitro benzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P , °C	B P , °C	M P , °C	B P °C				
160	**Di-isopropyl oxalate** (Isopropyl oxalate)	193 4		1 4100	1 0097	87	189 5 (anh), 101 (+ $2H_2O$)		−89 5	82 4	*mono* 219, *di* 419d	*mono* 169, *di* 268	123, pet eth	
161	**Ethyl β-ethoxyethyl carbonate**	194 5		1 5064[25]	1 0115[25]	162			−117 3	78 32			93, al	
162	***sec*-Octyl acetate**	194 5		1 4141	0 8606[19]	172	16 6	118 2		179	82	153, 147	32	
163	**Methyl *n*-caprylate** (Methyl *n*-octanoate)	194 6	−41	1 417	0 878	158	16 3	237 239 3	−97	64 65	57	70	108 (cor), al	
164	**α-Tetrahydrofurfuryl acetate**	195, 194		1 4350	1 0624[25]	144	16 6	118 2		177-8[743]	82	153, 147	83-4	
165	**Methyl levulinate**	196, 191		1 42333	1 04945	130	33 5	245-6	−97	64 65	107-8, al	108 9, w	108 (cor), al	Semicarbazone, 142-3, Phenylhydrazone, 94-6, 2,4-Dinitrophenylhydrazone, 141 5-2 5 (cor), diox -al , Oxime, 96
166	**Ethyl cyclohexanecarboxylate** (Ethyl hexahydrobenzoate)	196		1 45012[15]	0 9672[15]	156	30 1	233	−117 3	78 32	185 6		93, al	
167	**Diethyl methylmalonate**	196			1 019[15]	87	137, 138d		−117 3	78 32	217, 206	*mono* 145d , *di* 228, 214	93, al	
168	**Phenyl acetate**	196 7		1 503	1 078	136	16 6	118 2	41 8, 42	182	82	153, 147	145 8 (cor), al	
169	**Ethyl ethylacetoacetate**	198		1 422	0 9856	158			−117 3	78 32	95 6, bz		93, al	Ketone cleavage → 2-pentanone, b p 102
170	***n*-Octyl formate**	198 8	−39 1	1 42082[15] He (yel)	0 87435	158	8 4	100 7	−16, −16 7	195	2 55	53	61-2	
171	**2-Ethyl-1-hexyl acetate**	199			0 8733[20/20]	172	16 6	118 2		184 6	82	153, 147		
172	**Methyl benzoate**	199 2	−12 4	1 5164	1 0888	136	122 4	249	−97	64 65	130	158	108 (cor), al	
173	**Diethyl malonate** (Ethyl malonate) ...	199 3	−51 5	1 41618	1 05513	80	134 8 9		−117 3	78 32	*mono* 106 10, *di* 170, w -al	*mono* 156d , *di* 252-3, al	93, al	Phenylhydrazide, 194
174	**Methyl cyanoacetate**	200	−22 5		1 0962[25]	99	66		−97	64 65	119 20		108 (cor), al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5 Dinitro benzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P, °C	B P °C	M P °C	B P, °C				
175	**Dimethyl mesaconate**	203		1 45119	1 0914	79	204 5 (cor)		−97	64 65	*mono* (α) 222 (β) 174, *di* 176 5	*mono* (α) 196, *di* 212, al	108 (cor), al	Dihydrazide, 215d , dil al
176	**Benzyl formate**	203		1 516	1 080	136	8 4	100 7	−15 3	205 5	2 55	53	113	
177	**Vinyl benzoate**	203			1 065	148	122 4	249			130	158		
178	**Cyclohexyl isobutyrate**	204[750]			0 9489[0]	170	−46 1	154 7	25 1	161 1	128 129	108 5 9 5	112-3, al	Hydrazide, 104, al -eth
179	**Dimethyl maleate**	204 4	7 6	1 44156	1 14513[15]	72	137		−97	64 65	*mono* 172 3, w , 153, sl d , *di* 181, me al	*di* , 142, eth	108 (cor), al	
180	**α-Tetrahydrofurfuryl propionate**	204-7			1 044	158	−20 8	141		177 8[743]	81, 81 3 79	126 123	83 4	
181	**Ethyl levulinate**	205 8		1 42288	1 01114	144	33 5	245-6	−117 3	78 32	107-8d	108-9, w	93, al	Semicarbazone, 147 8, Phenylhydrazone, 103-4, 2,4-Dinitrophenylhydrazone, 101 2, diox -al , Oxime, 96
182	**Ethyl allylacetoacetate**	206 sl d , 211-2 sl d		1 43[17 6]	0 9898	170			−117 3	78 32			93, al	Semicarbazone, 125, w
183	***n*-Amyl *n*-valerate** (*n*-Pentyl *n*-pentanoate)	207 4		1 4181[15]	0 8825[0]	172	−34 5	186 35	−78 5	138 (cor)	106	74	46 4	
184	**Di-*n*-butyl carbonate** (*n*-Butyl carbonate)	207 5 (cor)		1 4117	0 9238	174			−90 2	117 6, 116			64, 62 5	
185	***n*-Butyl *n*-caproate** (*n*-Butyl *n*-hexanoate)	207 74	−63 1, −64 3	1 41877[15] He (yel)	0 86530	172	−3 9	205 35	−90 2	117 6, 116	100-1	74 5	64, 62 5	
186	***n*-Hexyl *n*-butyrate**	207 88	−78	1 41875[15] He (yel)	0 86519	172	−5 5, −8	162 5, 164	−51 6, −46 1	157 5	115-6	75	58 4 (cor)	
187	**2-Tolyl acetate** ("*o*-Cresyl acetate")	208			1 048	150	16 6	118 2	31	191 2	82	153, 147	134 8 (cor), al	
188	**Diethyl sulfate** (Ethyl sulfate)	208		1 4010[18]	1 172[25]	77			−117 3	78 32			93, al,	
189	***n*-Propyl *n*-enanthate** (*n*-Propyl *n*-heptanoate)	208	−64 8	1 41835[15]	0 86556	172	−7 47	223		97 1	96, 96 5	81	74, pet eth	
190	**Ethyl *n*-caprylate** (Ethyl *n*-octanoate)	208 35	α −43 1, β −59 2	1 41775	0 8667	172	16 3	237, 239 3	−117 3	78 32	110, 106	70	93, al	N-(β-Aminoethyl) morpholide, 59

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P, °C	B P, °C	M P °C	B P °C				
191	**Isobutyl enanthate** (Isobutyl *n*-heptanoate)	209			0 8593	186	−7 47	223		108 1	96, 96 5	81	87	
192	**Isopropyl levulinate**	209 3		1 42088	0 98724	158	33 5	245 6		82 4	107 8d	108–9, w	123, pet eth	Semicarbazone, 141–2, Phenylhydrazone, 108 9, 2,4-Dinitrophenylhydrazone, 88–9 (cor), 90 9
193	**Trimethylene glycol diacetate** (1,3-Diacetoxypropane)	210			1 069	80	16 6	118 2	−30	214 7 210 2	82	153 147	178	
194	***n*-Octyl acetate**	210			0 8847[0]	172	16 6	118 2	−16 −16 7	195	82	153 147	61 2	
195	***n*-Heptyl propionate**	210	−50 9	1 42605[15] He (yel)	0 86786	172	−20 8	141	−34 6 −33 8	176 8	81 81 3 79	126 123	46 47	
196	**Dimethyl citraconate**	210 5		1 44856	1 11531	79	92 91d eth lgr	206 11, sl d	−97	64 65	100 1		108 (cor), al	Dihydrazide, 177, w , 1-Naphthylamide, 169–70
197	***n*-Propyl pyromucate** (*n*-Propyl 2-furoate)	211		1 4737[25 9]	1 0745[25 9]	154	133–4, 132	230 2		97 1	142 3	170 5, al	74, pet eth	
198	**Ethylene glycol dipropionate**	211			1 0544[15/15]	87	−20 8	141	−78 5	138 (cor)	81, 81 3, 79	126 123	46 4	
199	**Cyclohexyl *n*-butyrate**	212[750]			0 9572[0]	170	−5 5, −8	162 5, 164	25 1	161 1	115 6	75	112–3, al	
200	**3-Tolyl acetate** ("*m*-Cresyl acetate")	212	12	1 4978	1 049	150	16 6	118 2	11 95	202 7	82	153, 147	164 5 (cor), al	
201	**Ethyl acetopyruvate**	213 5		1 4757[17]	1 1251	158	101, bz		−117 3	78 32	131 2d , al		93, al	
202	**Ethyl benzoate**	212 4 213 2	−34 7	1 50570	1 04684	150	122 4	249	−117 3	78 32	130	158	93, al	N-(β-Aminoethyl) morpholide, 123 4
203	**4-Tolyl acetate** ("*p*-Cresyl acetate")	212 5		1 500	1 051	150	16 6	118 2	36	202	82	153 147	188 6 (cor), al	
204	**Di-*n*-propyl oxalate** (*n*-Propyl oxalate)	213 9	−51 7	1 4168	1 0169	87	189 5 (anh), 101 (+2 H_2O)			97 1	*mono* 219, *di* 419d	*mono* 169, *di* 268	74, pet eth	$NH_4OH \rightarrow$ Di-*n*-propyl oxamate, 90–2, me al
205	**Methyl pelargonate**	214, 213–4			0 892	172	12 3	254 4	−97	64 65	99	84	108 (cor), al	
206	**Dimethyl glutarate**	214[751]	−34 7	1 42415	1 0874	80	98	302 4	−97	64 65	*di* 175	*di* 218	108 (cor), al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P , °C	B P , °C	M P , °C	B P , °C				
207	**2,6-Dimethylphenyl acetate** (*vic-m*-Xylenyl acetate)	214-6				164	16 6	118 2	49	203	82	153, 147	158 8 (cor), al	
208	**Methyl 2-toluate** (Methyl 2-methylbenzoate)	215			1 068	150	104-5, 107 8	259[751]	-97	64 65	142 8 (cor)	144	108 (cor), al	
209	**Benzyl acetate**	217		1 5200	1 055	150	16 6	118 2	-15 3	205 5	82	153, 147	113	N-(β-Aminoethyl) morpholide, 95 2
210	**Diethyl succinate**	217 25	-20 8	1 41975	1 0398	87	185 182 8	235d	-117 3	78 32	*mono* 157, *di* 260d , w	*mono* 179 80, *di* 254 5-5 5, 260	93, al	N-(β-Aminoethyl) morpholide, 174
211	**Diethylene glycol monoethyl ether acetate**	218			1 013	176	16 6	118 2		198	82	153, 147	oil	
212	**Diethyl fumarate**	218 4, 213-4	0 55	1 44103	1 052	86	286 7 (sealed tube), 233-5, 200, subl		-117 3	78 32	*mono* 270, 300-2, subl , *di* 266d	*mono* 233 0-4 5, *di* 313 4, ac a	93, al	
213	**Isopropyl benzoate**	218 5		1 4890[25]	1 013	164	122 4	249	-89 5	82 4	130	158	123, pet eth	
214	**Methyl phenylacetate**	220		1 507	1 068	150	76 5, subl	256 5 (cor)	-97	64 65	156	135-6	108 (cor), al	
215	*l*-**Linalyl acetate**	220		1 4460	0 8951	196	16 6	118 2		199	82	153, 147		$[\alpha]_D$ -3 to -17, 4-Nitrobenzoate, 70
216	**Methyl 3-toluate** (Methyl 3-methylbenzoate)	221, 215			1 061	150	111 3, 110-1	263, subl	-97	64 65	94, 97	118	108 (cor), al	
217	***n*-Propyl levulinate**	221 2		1 42576	0 98955	158	33-5	245 6		97 1	107-8d	108-9, w	74, pet eth	Semicarbazone, 129-30, Hydrazone, 88-90, Phenylhydrazone, 67-8 (cor), al , Oxime, 96
218	**Diethyl *d,l*-tartronate**	222-5d			1 152[15]	88	156-8d		-117 3	78 32	*di* 198, dil al , 195-6d		93, al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p* Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C	B P °C				
219	**Diethyl maleate**	222 7	−17	1 44156	1 066	86	137		−117 3	78 32	*mono* 172 3, w 152 3 sl d *di* 181, me al	*di* 142, eth	93, al	
220	**Methyl salicylate**	224		1 5369	1 184	152	158 3		−97	64 65	142, 139	156	108 (cor), al	
221	**Ethyl *n*-butoxyethyl carbonate**	224		1 4143[2]	0 9756[25]	190			−117 3	78 32			93, al	
222	***sec*-Butyl levulinate**	225 8		1 42495	0 96698	172	33 5	245 6		99 5	107 8d	108 9, w	76	Oxime, 96
223	***n*-Heptyl *n*-butyrate**	225 87	−57 5	1 42279[15] He (yel)	0 86371	186	−5 5 −8	162 5, 164	34 6 −33 8	176 8	115 6	75	46 47	
224	**2,4-Dimethylphenyl acetate** (*unsym-m*-Xylenyl acetate)	226 (cor)		1 4990[15]	1 0298[15 5]	164	16 6	118 2	27	211 5 (cor)	82	153, 147	164 6 (cor), 95% al	
225	**Methyl *n*-caprate** (Methyl *n*-decanoate)	226		1 426	0 873	186	31 5	268 70	−97	64 65	108 100 1	78	108 (cor), al	
226	***n*-Amyl *n*-caproate** (*n*-Pentyl *n* hexanoate)	226 16	−50, −47	1 42280[15] He (yel)	0 86349	186	−3 9	205 35	−78 5	138 (cor)	100 1	74 5	46 4	
227	***n*-Butyl *n*-enanthate** (*n*-Butyl *n*-heptanoate)	226 2		1 42280[15]	0 86382	186	−7 47	223	−90 2	117 6, 116	96 96 5	81	64 62 5	
228	***n*-Hexyl *n*-valerate** (*n*-Hexyl *n*-pentanoate)	226 3	−63 1	1 42286[15]	0 86345	186	−34 5	186 35	−51 6 −46 1	157 5	106	74	58 4 (cor)	
229	***n*-Propyl *n*-caprylate** (*n*-Propyl *n*-octanoate)	226 43	−46 2	1 42351[15] He (yel)	0 86591	186	16 3	237 239 3		97 1	110 106	57	74, pet eth	
230	**Ethyl 2-toluate** (Ethyl 2-methyl benzoate)	227		1 507[21 6]	1 0325[21 5]	164	104-5, 107 8	259[751]	−117 3	78 32	142 8 (cor)	144	93, al	
231	**Ethyl pelargonate**	227	α −55 0, β −36 7	1 42200	0 8657	186	12 3	254 4	−117 3	78 32	99	84	93, al	N-(β-Aminoethyl) morpholide, 61 3
232	***l*-Menthyl acetate**	227			0 9185	198	16 6	118 2	43	216	82	153, 147	153	
233	**Ethyl phenylacetate**	227 5		1 49921[18 5]	1 0333	164	76 5, subl	256 5 (cor)	−117 3	78 32	156	135-6	93, al	N-(β-Aminoethyl) morpholide, 88 9
234	***n*-Octyl propionate**	227 9	−41 6	1 42185[15] He (yel)	0 86633	186	−20 8	141	−16, −16 7	195	81, 81 3, 79	126, 123	61-2	
235	**Diethyl itaconate**	228		1 4377	1 0467	93	165		−117 3	78 32	*di* 191 2-8, al		93, al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P., °C	M.P., °C	B.P., °C				
236	**Diethyl mesaconate**	229		1.4488	1.0453	93	204.5 (cor.), subl		−117.3	78.32	*mono* (α) 222 (β) 174 *di* 176.5	*mono* (α) 196 *di* 212, al	93, al	
237	**Di-isobutyl oxalate** (Isobutyl oxalate)	229		1.4180	0.97373	101	189.5 (anh.), 101 (+2 H_2O)			108.1	*mono* 219 *di* 419d	*mono* 169 *di* 268	87	
238	**Allyl benzoate**	230		1.067_4^4	1.0578_{15}^{15}	162	122.4	249		97.1	130	158	49, 50	
239	**Isobutyl levulinate**	230.9		1.42677	0.96770	172	33.5	245.6		108.1	107.8d	108.9, w	87	Semicarbazone, 112.3, Phenylhydrazone, 84.6, 2,4-Dinitrophenylhydrazone, 55.6, Oxime, 96
240	***n*-Propyl benzoate**	231		1.500	1.023	164	122.4	249		97.1	130	158	74, pet eth	
241	**Diethyl citraconate**	231		1.4442	1.0491	93	92d, eth lgr	206.11 sl d	−117.3	78.32	100.1		93, al	1-Naphthylamide, 169-70
242	**Methyl 3-chlorobenzoate**	231				170.5	158, 155		−97	64.65	134		108 (cor.), al	
243	**β-Phenylethyl acetate**	232-224		1.5108	$1.057^{22.5}$	164	16.6	118.2	−25.8	219.8	82	153 147	108	
244	**Ethyl β-(2-furyl) acrylate**	232	14	1.5286	1.0891^{15}	166	141	286	−117.3	78.32	168.9, w		93, al	
245	**Di-(β-methoxyethyl) carbonate**	232		1.4193^{25}	1.0936^{25}	178				124.5				
246	**Di-isoamyl carbonate**	233 (cor.)		1.4174	0.9067	202			−117	132			61	
247	**Diethyl glutarate**	233.66	−23.8	1.02229	1.42395	94	98	302-4	−117.3	78.32	*di* 175-6	*di* 218	93, al	N-(β-Aminoethyl) morpholide, 152.7
248	**Ethyl 3-toluate**	234		$1.505^{21.4}$	$1.0265^{21.4}$	164	111.3, 110.1	263, subl	−117.3	78.32	94, 97	118	93, al	
249	**Ethyl salicylate**	234		1.52542	1.1396	166	158.3, subl at 76		−117.3	78.32	142, 139	156	93, al	
250	**Methyl 2-chlorobenzoate**	234				170.5	142, 144		−97	64.65	142, 202	131	108, (cor.), al	
251	**Ethyl 4-toluate**	234.5		$1.5089^{18.2}$	$1.0269^{18.2}$	164	179-80, subl	275 (cor.)	−117.3	78.32	160, 158	160, 165	93, al	
252	**Diethyl bromomalonate**	235			1.426_4^{15}	239	113d		−117.3	78.32	*di* 181, al	*di* 217, ac a	93, al	

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P., °C	M.P., °C	B.P., °C				
253	**Ethylene glycol di-*n*-butyrate**	235-7[749]		1.42619$_{He}$	1.0005	101	−5.5, −8	162.5, 164	−78.5	138 (cor.)	115.6	75	46.4	
254	**Diethyl butylmalonate**	235-40			1.425	101			−117.3	78.32	*di* 200		93, al	
255	**2,4,6-Trimethylphenyl acetate** (Mesityl acetate)	236				178	16.6	118.2	70, 69	220	82	153, 147		
256	**2,5-Dimethylphenyl acetate** (*p*-Xylenyl acetate)	237[768]			1.0264[15]	164	16.6	118.2	74.5	212	82	153, 147	137.2 (cor.), al	
257	***n*-Butyl levulinate**	237.8		1.42905	0.97353	172	33.5	245-6	−90.2	117.6, 116	107.8d	108-9, w	64, 62.5	Semicarbazone, 102-3, Phenylhydrazone, 79.81, 2,4-Dinitrophenylhydrazone, 65.8, Oxime, 96
258	**Benzyl *n*-butyrate**	238-40			1.033[16]	178	−5.5, −8	162.5, 164	−15.3	205.5	115-6	75	113	
259	**Methyl hydrocinnamate** (Methyl β-phenylpropionate)	239			1.0455[0]	164	48.7, 40	279-80 (cor.)	−97	64.65	105, 82	135	108 (cor.), al	
260	***n*-Propyl salicylate**	239, 249-51		1.51610	1.0979	180	158.3			97.1	142, 139	156	74, pet eth	
261	**Guaiacol acetate** (2-Methoxyphenyl acetate)	240		1.5101[25]	1.1285[25]	166	16.6	118.2	32, 28.2	205	82	153, 147	141.2 (cor.), al	
262	**Isopropyl salicylate**	240-2, 237		1.50650	1.0729	180	158.3, subl at 76		−89.5	82.4	142, 139	156	123, pet eth	
263	**Dimethyl *l*-malate**	242		1.4425	1.2334	81	100-1		−97	64.65	*di* 156-7	*di* 206-7	108 (cor.), al	$[\alpha]_D^{20}$ −6.85
264	**Geranyl acetate**	242		1.4660	0.9174[15]	196	16.6	118.2		230	82	153, 147	62-3	
265	**Isobutyl benzoate**	242.2 (cor.)			0.999	178	122.4	249		108.1	130	158	87	
266	**Di-*n*-butyl oxalate** (*n*-Butyl oxalate)	243, 245.5	−29.6	1.4240	0.98732	101	189.5 (anh.), 101 (+ $2H_2O$)		−90.2	117.6, 116	*mono* 219, *di* 419d	*mono* 169, *di* 268	64, 62.5	
267	**Methyl 2-bromobenzoate**	244				215	150		−97	64.65	155		108 (cor.), al	
268	***n*-Octyl *n*-butyrate**	244.1	−55.6	1.42674[15] He (yel)	0.86288	200	−5.5, −8	162.5, 164	−16, −16.7	195	115.6	75	61.2	
269	**Ethyl *n*-caprate** (Ethyl *n*-decanoate)	244.9	β −20, γ −30.6	1.42575	0.8650	200	31.5	268.70	−117.3	78.32	108, 100.1	78	93, al	N-(β-Aminoethyl) morpholide, 60.1

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3 5 Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P , °C	B P °C	M P °C	B P °C				
270	**Diethyl adipate**	245, 133 8[15]	−21	1 42765	1 0090	101	153-4 (cor)	216[15]	−117 3	78 32	*mono* 125 30, w , *di* 220	241	93, al	N-(β-Aminoethyl) morpholide 165
271	**Methyl phenoxyacetate**	245			1 150[17 5]	166	98 9	285d	−97	64 65	101 5		108 (cor) al	
272	**Thymyl acetate**	245			1 009[0]	192	16 6	118 2	51 5	233 5	82	153 147	103 2 (cor), al	
273	**Carvacryl acetate**	245 (cor)		1 49128[28]	0 98959[25]	192	16 6	118 2	1	237 5	82	153, 147	83	
274	**Diethylene glycol diacetate** (β,β'-Diacetoxy diethyl ether)	245 51, 148[26]		1 4348	1 1078[15/5]	95	16 6	118 2	−10 45	244 5	82	153 147	149 ac a	
275	***n*-Butyl *n*-caprylate** (*n*-Butyl *n*-octanoate)	245 02	−41 9, −43	1 42647[15] He (yel)	0 86278	200	16 3	237	−90 2	117 6 116	110 106	70	64 62 5	
276	***n*-Heptyl *n*-valerate** (*n*-Heptyl *n*-pentanoate)	245 2	−46 4	1 42536[15] He (yel)	0 86225	200	−34 5	186 35	−34 6 −33 8	176 8	106	74	46 47	
277	***n*-Amyl *n*-enanthate** (*n*-Pentyl *n*-heptanoate)	245 4	−49 5	1 42627[15] He (yel)	0 86232	200	−7 47	223	−78 5	138 (cor)	96 96 5	81	46 4	
278	***n*-Hexyl *n*-Caproate** (*n*-Hexyl *n*-decanoate)	245 4	−55 25	1 42637[15] He (yel)	0 86216	200	−3 9	205 35	−51 6 −46 1	157 5	100 1	74 5	58 4 (cor)	
279	**Di-(β-ethoxyethyl) carbonate**	245 5		1 4239[25]	1 0635[25]	206				135			75, al	
280	**Diethylene glycol monobutyl ether acetate**	246			0 983	204	16 6	118 2		228-30	82	153 147		
281	**Isobutyl phenylacetate**	247			0 999[18]	192	76 5 (cor)	256 5 (cor)		108 1	156	135-6	87	
282	**Ethyl hydrocinnamate** (Ethyl β-phenylpropionate)	247 2			1 0147	178	40, 48 7	279-80 (cor)	−117 3	78 32	105, 82	135	93, al	
283	**Di-*n*-propyl succinate**	248, 246	−10 4	1 4252	1 011	101	185, 182 8	235d		97 1	*mono* 157, *di* 260d , w	*mono* 179 80, *di* 254 5-5 5, 260	74, pet eth	
284	**Methyl 2-methoxybenzoate**	248		1 534[19 5]	1 1571[19]	166	100 1	200	−97	64 65	129		108 (cor), al	
285	**Methyl undecylenate** (Methyl hendecylenate)	248	−27 5	1 43928	0 889[15]	198	24 5	275	−97	64 65	87		108 (cor), al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P. °C	M.P. °C	B.P. °C				
286	**Isoamyl levulinate**	248.8		1.43102	0.96136	186	33.5	245.6	−1.17	132	107.8d	108.9, w	61	Semicarbazone, 91-2, Phenylhydrazone, 70.2, 2,4-Dinitrophenylhydrazone, 50.5 Oxime, 96
287	**Diethyl acetonedicarboxylate**	250d			1.113	101	135		−117.3	78.32			93, al	Dianilide, 155, bz., Semicarbazone, 94.5, $Cu(OAc)_2$ → Cu enolate, 142.3, grn bz
288	***n*-Butyl benzoate**	250.3	−22.4		1.000	178	122.4	249	−90.2	117.6, 116	130	158	64, 62.5	
289	**Ethyl phenoxyacetate**	251			$1.104^{17.5}$	180	98-9	285d	−117.3	78.32	101.5		93, al	
290	**Methyl 3-methoxybenzoate**	252		1.52236	1.131	166	109-10		−97	64.65			108 (cor.), al	α-Phenylethylamide, 128.6, 9.0, Benzylamide, 111.8, 2.8
291	**Diethyl *l*-malate**	253		1.4362	1.1290	95	100-1		−117.3	78.32	*dl* 156.7	*dl* 206.7	93, al	$[\alpha]_D^{20}$ −10.18
292	***n*-Amyl levulinate** (*n*-Pentyl levulinate)	253.4		1.43192	0.96136	186	33.5	245.6	−78.5	138 (cor.)	107.8d	108.9, w	46.4	2,4-Dinitrophenylhydrazone, 84.2, Oxime, 96
293	***n*-Butyl phenylacetate**	254		1.489	0.994	192	76.5, subl	256.5 (cor.)	−90.2	117.6, 116	156	135.6	64, 62.5	
294	**β-Methoxyethyl benzoate** (Methyl "cellosolve" benzoate)	255		1.5040^{25}	1.0891^{25}	180	122.4	249		124.5	130	158		4-Nitrobenzoate, 50.5, dil al
296	**Diethyl pimelate**	255	−23.8	1.42985	0.9929	108	105	223^{15}	−117.3	78.32	*dl* 175	*dl* 206, al	93, al	N-(β-Aminoethyl) morpholide, 137.9
297	**Ethyl benzoylformate**	256-7		1.5190^{25}	1.222^{25}	178	66		−117.3	78.32	91		93, al	Phenylhydrazone, 64, 2,4-Dinitrophenylhydrazone, 196.7d (cor.)

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p* Toluidide	3 5 Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C	B P °C				
298	**Glyceryl triacetate**	258			1 161[15]	72 7	16 6	118 2	17 9	290d	82	153 147		Tris-4-nitrobenzoate, 188
299	**Ethyl 3-methoxybenzoate**	260		1 5161	1 0993	180	109 10		−117 3	78 32			93, al	Benzylamide, 111 8 2 8, α-Phenylethylamide, 128 6 9 0
300	**β-Ethoxyethyl benzoate** ("Cellosolve" benzoate)	260–1[738 5]		1 4969[25]	$1\ 0585_{25}^{25}$	194	122 4	249		135	130	158	75, al	
301	**Isobutyl salicylate**	260 2		1 50872	1 0639	194	158 3, subl at 76			108 1	142, 139	156	87	
302	***n*-Amyl *n*-caprylate** (*n*-Pentyl *n*-octanoate)	260 21	−34 8	1 43019[15] He (yel)	0 86132	214	16 3	237 239 3	−78 5	138 (cor)	110, 106	70	46 4	
303	***n*-Hexyl *n*-enanthate** (*n*-Hexyl *n*-heptanoate)	260 9	−47 9	1 42939[1] He (yel)	0 86114	214	−7 47	223	−51 6, −46 1	157 5	96, 96 5	81	58 4 (cor)	
304	***n*-Heptyl *n*-caproate** (*n*-Heptyl *n*-hexanoate)	260 97	−34 4	1 42934[15] He (yel)	0 86115	214	−3 9	205 35	−34 6, −33 8	176 8	100 1	74 5	46 47	
305	**Ethyl 2-methoxybenzoate**	261		1 5224	1 1124	261	100 1	200	−117 3	78 32	129		93, al	
306	***n*-Octyl *n*-valerate** (*n*-Octyl *n* pentanoate)	261 1	−42 5	1 42743[15] He (yel)	0 86148	214	−34 5	186 35	−16 −16 7	195	106	74	61 2	
307	**Isoamyl benzoate**	262 3		1 4950	1 004	192	122 4	249	−117	132	130	158	61	
308	**Dimethyl *d*-camphorate**	263		1 46334[16 9]	1 0747	114	187 5 8 0		−97	64 65	*mono* (α-amide β-acid), 176, (β-amide-α-acid), 182 3, *di* 192-3	α 212 4, β 190-6	108 (cor), al	
309	**Ethyl undecylenate** (Ethyl hendecylenate)	264		1 4449[23]	$0\ 88271_{15}^{15}$	212	24 5	275	−117 3	78 32	87		93, al	
310	**Isobutyl succinate**	265		1 427	0 974	115	185, 182 8	235d		108 1	*mono* 157, *di* 260d , w	*mono* 179 80, *di* 254 5 5 5, 260	87	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P. °C	M.P. °C	B.P., °C				
311	**Ethyl benzoylacetate**	265 sl. d., 270 d.		1.5498	1.116	192			−117.3	78.32			93, al.	Ketone cleavage → acetophenone, m.p. 19.65, b.p. 202
312	**Di-isoamyl oxalate** (Isoamyl oxalate)	267.8, 262		1.427	0.961	115	189.5 (anh.) 101 (+ $2H_2O$)		−117	132	*mono* 219, *di* 419d	*mono* 169, *di* 268	61	
313	**Dimethyl suberate**	268	−5	1.43326	1.0198	101	144, 139-41		−97	64.65	*mono* 125.7, *di* 216.7	*di* 218, 219	108 (cor.), al.	
314	**Methyl laurate**	268		1.432	0.870	214	44, 42	299	−97	64.65	100, 99	87	108 (cor.), al.	β-Naphthol → β-naphthyl methyl ether, 72
315	**Ethyl 4-methoxybenzoate** (Ethyl anisate)	269	7	1.5254	1.1038	180	184.6, 184.2 (cor.)	275.80	−117.3	78.32	167, 162.3, w.	186	93, al.	N-(β-Aminoethyl) morpholide, 130.6
316	**Ethyl laurate**	269	−1.7	1.4321	0.8671_{15}^{19}	228	44, 42	299	−117.3	78.32	100, 99	87	93, al.	
317	**Trimethyl aconitate**	270				72	194-5 (cor.) d.		−97	64.65	*tri* turns br. at 250, sinters at 260		108 (cor.), al.	
318	***n*-Butyl salicylate**	270-2, 268		1.51148	1.0728	194	158.3, subl. at 76		−90.2	117.6, 116	142, 139	156	64, 62.5	
319	**Ethyl cinnamate**	271	6.70	1.55982	1.0490	176	133	300	−117.3	78.32	147-8	168	93, al.	N-(β-Aminoethyl) morpholide, 121.9
320	**Di-*n*-butyl succinate**	274.5	−29.3	1.4298	0.9760	115	185, 182.8	235d	−90.2	117.6, 116	*mono* 157, *di* 260d, w.	*mono* 179.80, *di* 254.5-5.5, 260	64, 62.5	
321	**Ethyl 2-nitrobenzoate**	275	30			195	146		−117.3	78.32	176		93, al.	
322	**Triethyl aconitate**	275d		1.45562	1.1064	86	194-5 (cor.)		−117.3	78.32	*tri* turns br. at 250, sinters at 260		93, al.	
323	**Di-isopropyl *d*-tartarate**	275			1.1274	117	169.71		−89.5	82.4	*mono* 171-2, *di* 196d, al.		123, pet. eth.	$[\alpha]_D^{20}$ +14.886, Phenylhydrazide, 240
324	**Ethyl 4-ethoxybenzoate**	275			1.076^{21}	194	198, 195-6		−117.3	78.32	202		93, al.	Hydrazide, 126-7, al.

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p* Toluidide	3 5 Dinitro benzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C	B P °C				
325	***n*-Octyl *n*-caproate** (*n* Octyl *n* hexanoate)	275 2	−28 4	1 43256[15] He (yel)	0 86032	228	−3 9	205 35	−16 −16 7	195	100 1	74 5	61 2	
326	**Isoamyl salicylate**	276 8		1 50799	1 0535	208	158 3 subl at 76		−117	132	142 139	156	61	
327	***n*-Heptyl *n*-enanthate** (*n* Heptyl *n* heptanoate)	277 2	−33 3	1 43183 He (yel)	0 86039	228	−7 47	223 0	−34 6 −33 8	176 8	96 96 5	81	46 47	
328	***n*-Hexyl *n*-caprylate** (*n* Hexyl *n* octanoate)	277 44	−30 6	1 43230[1] He (yel)	0 86033	228	16 3	237 239 3	−51 6 −46 1	157 5	110 106	70	58 4 (cor)	
329	**Resorcinol diacetate**	278 sl d			1 179	97	16 6	118 2	110 (stab) 108 8 5 (labile)	280 8 (cor)	82	153 147	*di* 201	
330	**Diethyl suberate**	282	5 9	1 43236	1 9807	115	144 139 41		−117 3	78 32	*mono* 125 7 *di* 216-7	*di* 218-9	93 al	N-(β-Aminoethyl) morpholide, 157 2
331	**Resorcinol monoacetate**	283				152	16 6	118 2	110 (stab) 108- 8 5 (labile)	280 8 (cor)	82	153 147	*di* 201	
332	**Dimethyl phthalate** (Methyl phthalate)	283 8		1 5138	1 191	97	200 6 191 (sealed tube)		−97	64 65	*mono* 149 *di* 220	*mono* 150 (slow htng) 160 5 (rapid htng)	108 (cor) al	
333	**Diethyl isophthalate**	286[733]	11 5			111	348 (subl)		−117 3	78 32	*mono* 280 *di* 280		93 al	
334	**Diethyl *d*-camphorate**	286		1 45354[26 2]	1 0298	128	187 5- 8 0		−117 3	78 32	*mono* (α amide β-acid) 176 (β amide-α-acid) 182 3, *di* 192 3	α 212-4 β 190-6	93, al	
335	**Glyceryl tripropionate**	289			1 083[19]	86 7	−20 8	141	17 9	290d	81 81 3, 79	126 123		Tris-4-nitrobenzoate, 188

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M P °C	B P °C	M P °C	B P, °C				
336	**Diethyl phthalate** (Ethyl phthalate)	289 5, 298		1 5019	1 1175	111	200 6, 191 (sealed tube)		−117 3	78 32	*mono* 149, *di* 220	*mono* 150 (slow htng), 160 5 (rapid htng)	93, al	
337	***n*-Heptyl *n*-caprylate** (*n*-Heptyl *n*-octanoate)	290 6	−10 2	1 43492[1] He (yel)	0 85958	242	16 3	237 239 3	−34 6, −33 8	176 8	110, 106	70	46, 47	
338	***n*-Octyl *n*-enanthate** (*n* Octyl *n*-heptanoate)	290 8	−21 5	1 43488[1] He (vel)	0 85961	242	−7 47	223 0	−16, −16 7	195	96, 96 5	81	61 2	
339	**Diethyl azelate**	291	−18 5	1 43509	0 97294	122	106 5	>360 sl d 237[15]	−117 3	78 32	*mono* 93 5 *di* 175	*di* 201-2	93 al	N-(β-Aminoethyl) morpholide, 141 3
340	**Triethyl citrate**	294		1 44554	1 1369	92	153 (anh) 100 (+1 H_2O)		−117 3	78 32	*tri* 210 5d , w	*tri* 189, al	93, al	
341	**Ethyl myristate**	295	α 11 9 β 12 3	1 4362	0 8573[25]	256	53 9	202[16]	−117 3	78 32	103	93	93, al	N-(β-Aminoethyl) morpholide, 76
342	**Di-*n*-propyl *d*-tartarate**	297			1 1390	117	169 71			97 1	*mono* 171-2, *di* 196d , al		74, pet eth	$[\alpha]_D^{20}$ +12 00, Phenylhydrazide, 240
343	**Isoamyl succinate**	297		1 434	0 958	129	185 182 8	235d	−117	132	*mono* 157 *di* 260d , w	*mono* 179-80, *di* 254 5 5 5, 260	61	
344	**Di-(β-*n*-butoxyethyl)carbonate**	297 8		1 4279[25]	0 9766[65]	262					170 6[743]			
345	**Diethyl benzylmalonate**	300			1 077[15]	125	117d		−117 3	78 32	225		93, al	
346	**α-Tetrahydrofurfuryl benzoate**	300 2 [50]			1 137$_0^{20}$	206	122 4	249		177 8[743]	130	158	83-4	
347	**Di-isopropyl phthalate** (Isopropyl phthalate)	302			1 065[19]	115	200 6, 191 (sealed tube)		−89 5	82 4	*mono* 149 *di* 220	*mono* 150 (slow htng), 160-5 (rapid htng)	123, pet eth	
348	***n*-Octyl *n*-caprylate** (*n*-Octyl *n*-octanoate)	306 8	−15 1	1 43698[15] He (yel)	0 85919	256	16 3	237, 239 3			110, 106	70	61 2	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D^{20}	D_4^{20}	Equivalent	Saponification				Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
							Acid		Alcohol					
							M P , °C	B P °C	M P , °C	B P °C				
349	**Diethyl sebacate**	307	1 3	1 43657	0 9631	129	33, subl	243^{15}	−117 3	78 32	*mono* 170 *di* 210, 208	*di* 201	93, al	
350	**2-Tolyl benzoate** ("*o*-Cresyl" benzoate)	307			$1\ 114^{19}$	212	122 4	249	31	191 2	130	158	138 4 (cor), al	
351	**Ethyl 1-naphthoate**	309			$1\ 1274_{15}^{15}$	200	161 2 (cor)		−117 3	78 32	202 205		93, al	
352	**Glyceryl tributyrate**	318			$1\ 033^{1}$	100 7	−5 5 −8	162 5, 164	17 9	290d	115 6	75		Tris-4-nitrobenzoate, 188
353	**Di-*n*-butyl *d,l*-tartarate** (Di-*n*-butyl racemate)	320			$1\ 0879^{18}$	131	205 6 (anh), 203–4 (+1 H_2O)		−90 2	117 6, 116	*di* 226, w -me al		64, 62 5	Dianilide, 235-6
354	**Benzyl salicylate**	320				228	158 3, subl at 76		−15 3	205 5	142, 139	156	113	
355	**Di-*n*-butyl phthalate** (*n* Butyl phthalate)	340 7		1 4900	$1\ 047_{20}^{20}$	139	200 6, 191 (sealed tube)		−90 2	117 6, 116	*mono* 149, *di* 220	*mono* 150 (slow htng), 160 5 (rapid htng)	64, 62 5	N-(β-Aminoethyl) morpholide, 124
356	**Di-*n*-butyl sebacate**	345			0 9329[15]	157	133, subl	243^{15}	−90 2	117 6, 119	*mono* 126 5, *di* 210, 208	*di* 201	64, 62 5	Phenylhydraziide, 194
357	**Di-isoamyl phthalate** (Isoamyl phthalate)	349			$1\ 024^{17}$	153	200–6, 191 (sealed tube)		−117	132	*mono* 149, *di* 220	*mono* 150 (slow htng), 160–5 (rapid htng)	61	
358	**Tricresyl phosphate**	400d , 275 80^{20}	−30	1 5568	$1\ 197^{25}$	122 7			36	202 32			188 6 (cor), al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Reduced pressure b.p. only

a) Liquids. 2) (Listed in order of increasing m.p. of the corresponding amide)*

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
						Equivalent	Acid		Alcohol					
							M.P., °C	B.P. °C	M.P., °C	B.P., °C				
1	**3,5-Dimethylphenyl acetate** (*Sym-m*-Xylenyl acetate)	130[26], 120[11]				164	16.6	118.2	63.2 68	220.2	82	153, 147	195.4, al	
2	**Dimethyl azelate**	156[20], 146.2[10]		1.43607	1.0069	108	106	>360 sl. d.	−97	64.65	*mono* 93.5, *di* 172	*di* 201.2, 198	108 (cor.), al	
3	**Dimethyl adipate**	107.6[11]	8.5	1.4277	1.0625	87	153.4 (cor.)	216[15]	−97	64.65	*mono* 125 30, w., *di* 220	241	108 (cor.), al	
4	***β-n*-Butoxyethyl benzoate** (Butyl "cellosolve" benzoate)	156.5 7.0[14.5], 131.6 2.6[3.0]		1.4925[25]	1.0277_{25}^{45}	222	122.4	249		170 6[7.1]	130	158		4-Nitrophenylurethane, 58.7 9.1, CCl_4
5	**Ethyl furoylacetate**	170[20] 143[10]		1.5055[16]	1.1651_{17}^{17}				−117.3	78.32	159, al.		93, al.	Oxime, 131.2, dil., al.
6	**Methyl furoylacetate**	144.5[20], 96–8[1]							−97	64.65	159, al.		108 (cor.), al.	Semicarbazone, 141–2, bz.-al. (3:1), Oxime, 124.5, bz.
7	**Di-*n*-propyl adipate**	155[16]	−20	1.4314	0.9790	115	153.4			97.1	*mono* 161 *di* 220	*di* 241	74, pet. eth.	
8	**Dimethyl pimelate**	119.3 9.6[10]	−20.6	1.42888	1.0383	94	105		−97	64.65	*di* 175	*di* 206, al.	108 (cor.), al.	
9	**Di-*n*-propyl maleate**	114–7[6]		1.444[18.3]	1.026	100	137			97.1	*di* 181, me. al.	*mono* 195d., chl., *di* 142, eth.	74, pet. eth.	

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M.P., °C	B.P., °C	M.P. °C	B.P. °C				
1	**Dimethyl succinate**	18.2	196	73	185, 182.8	235d	−97	64.65	*mono* 157, *di* 260d	*mono* 179.80, *di* 254.5 5.5 260	108 (cor.), al	n_D^{20} 1.41965 D_4^{20} 1.1192
2	**Methyl myristate**	18.5	323	242	53.9	202[16]	−97	64.65	103	93	108 (cor.), al	n_D^{t} 1.428
3	**Ethyl piperonylate**	18.5	286	194		228, 229	−117.3	78.32	169, al		93, al	
4	**Diethyl *d*-tartarate**	18.6	280	103	169.71		−117.3	78.32	*mono* 171-2, *di* 196d, al		93, al	n_D^{20} 1.44677, D_4^{20} 1.2028 $[\alpha]_{Hg(grn)}^{20}$ +7.87, Phenylhydrazide, 204
5	**Phenyl propionate**	20	211	150	−20.8	141	41.8 42	182 183	81	123 126	145.8 (cor.), al	D_{25}^{25} 1.0467, Tribromo, 95
6	**Ethyl margarate**	20.6 (β)		298	61.2	231[16]	−117.3	78.32	108, 106		93, al	
7	**Methyl 3-chlorobenzoate**	21	231	170.5	158, 155		−97	64.65	134		108 (cor.), al	
8	**Benzyl benzoate**	21	323-4 (cor.)	212	122.4		−15.3	205.5	130	158	113	n_D^{21} 1.5681, D^{19} 1.1224
9	**Di-*n*-butyl *d*-tartarate**	22		131	169.71		−90.2	117.6, 116	*mono* 171-2 *di* 196d, al		64, 62.5	D_4^{18} 1.0886, $[\alpha]_D^{15}$ + 10.09, Phenylhydrazide, 240
10	**3,4-Dimethylphenyl acetate**	22	235	164	16.6	118.2	62.5	225	82	153, 147	181.6, rods, al	
11	**Isobutyl stearate**	(a) 22.5, (b) 28.9, (two forms)		340	70.1			108.1	109, 108.4, al	102	87	
12	**Isoamyl stearate**	23		354	70-1		−117	132	109, 108.4, al	102	61	
13	**Cetyl acetate** (*n*-Hexadecyl acetate)	α 18.5, β 24.2, 22		284	16.6	118.2	49.27	190[18]	82	153, 147	66	
14	**Ethyl palmitate**	α 19.4, β 24.2	185	284	62.7	222[16]	−117.3	78.32	106-7, 105.3, al	98	93, al	
15	**Methyl anthranilate** (Methyl 2-aminobenzoate)	24.4	299.8	151	146		−117.3	78.32	109	151	93, al	N-(β-Aminoethyl) morpholide, 126, Picrate, 106
16	**Di-*n*-propyl *d,l*-tartarate**	25	286[765]	117	203-4 (+1 H_2O), 205-6 (anh.)			97.1	226, w-me al		74, pet eth	D_4^{20} 1.1256
17	**Dimethyl sebacate**	26.6, 27-8		115	133, subl	243[15]	−97	64.65	*mono* 170, *di* 210, 208	*di* 201	108 (cor.), al	n_D^{28} 1.43549, D_4^{28} 0.98818, Phenylhydrazide, 194

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P °C	B P, °C	M P, °C	B P, °C				
18	**Methyl β-(2-furyl) acrylate**	27	227	152	141	286	−97	64 65	168 9		108 (cor), al	
19	***n*-Butyl stearate**	27 5, 28		340	70 1		−90 2	117 6, 116	109 108 4, al	102	64 62 5	
21	***d*-Bornyl acetate**	29	226, 221	196	16 6	118 2	204 5 5 5	212	82	153, 147	154	$n_D^{22.6}$ 1 4633, D_4^{15} 0 991 (undercooled)
22	**Methyl margarate**	29		284	61 2	231[16]	−97	64 65	108, 106		108 (cor), al	
23	**Eugenyl acetate**	30	282	206	16 6	118 2	−9 1	253	82	153, 147	130 8 (cor), 95% al	n_D^{20} 1 52069 D_{15}^{1} 1 087
24	**Methyl palmitate**	30	184[12]	270	62 7	222[16]	−97	64 65	106 7 105 3, al	98	108 (cor), al	n_D^{45} 1 4317
25	***n*-Amyl stearate** (*n*-Pentyl stearate)	30		354	70 1		−78 5	138 (cor)	109, 108 4, al	102	136 (cor)	
26	**Ethyl 2-nitrobenzoate**	30	275	195	146		−177 3	78 32	176		93, al	
27	***n*-Octadecyl acetate**	α 29 97, β 31 95		312	16 6	118 2	α 57 95, 59 5	210 5[15]	82	153, 147	66	β-Form exist below 0°, α-Form seeding with crys or cooling soln of the compound
28	**Ethyl 2-naphthoate**	32	304	200	184, 185 5		−117 3	78 32	192–3, 195, al	192, al	93, al	n_D^{20} 1 596, D_4^{20} 1 117
29	**Methyl-3-bromobenzoate**	32		229	155		−97	64 65	155		108 (cor), al	
30	**Methyl 4-toluate**	33	222 5, 217	150	179–80, subl	275 (cor)	−97	64 65	160, 158	160, 165	108 (cor), al	
31	**Thymyl benzoate**	33		255	122 4		51 5	233 5	130	158	103 2, al	
32	**Di-(β-ethoxyethyl) phthalate**	33		155	200 6, 191 (sealed tube)			134 8	*mono* 149, *di* 220	*mono* 150 (slow htng), 160–5 (rapid htng) *di* 201	75, al	
33	**Ethyl stearate**	α 30 9, β 33 5	199[10]	312	70–1		−117 3	78 32	109, 108 4, al	102	93, al	α → β Slowly on rubbing, N-(β-Aminoethyl) morpholide, 58
34	**Di-isopropyl *d,l*-tartarate**	34	275[765]	117	203 4 (+ $1H_2O$), 205–6 (anh)		−89 5	82 4	226, w - me , al		123, pet eth	D_4^{20} 1 1166
35	**Ethyl pyromucate** (Ethyl furoate)	34	197	140	133 4, 132	230–2	−117 3	78 32	142–3	170 5, al	93, al	n_D 1 4797, $D_4^{20.8}$ 1 1174 (undercooled)
36	**Diethyl 4-nitrophthalate**	34		133 5	165		−117 3	78 32	200 d	*mono* 172	93, al	
37	**Ethyl benzilate**	34		256	150		−117 3	78 32	153, chl	189–90	93, al	

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitro benzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P °C	B P, °C	M P °C	B P °C				
38	**2,4,5-Trimethylphenyl acetate** (Pseudocumenyl acetate)	34–4 5	245 6	178	16 6	118 2	71	232	82	153, 147		
39	**Methyl cinnamate**	36	261	162	133	300	−97	64 65	147 8	168	108 (cor) al	
40	**Ethyl *d,l*-mandelate**	37	254	180	118		−117 3	78 32	133 4	172, al	93, al	
41	**Dimethyl itaconate**	38	208	79	165		−97	64 65	*di* 191 2 8, al		108 (cor), al	n_D^{20} 1 44413 D_4^{18} 1 12410
42	**Methyl sebacate**	38	288d	216	133, subl	243^{15}	−97	64 65	*mono* 170, *di* 210, 208	*di* 201	108 (cor), al	Phenylhydrazide, 194
43	**Methyl stearate**	38 8	$214–5^{15}$	298	70–1		−97	64 65	109, 108 4, al	102	108 (cor), al	
44	**Benzyl cinnamate**	39		238	133	300	−15 3	205 5	147	168	113	
45	**Methyl dibenzylacetate**	41		254	89		−97	64 65	128 9, bz	175, abs al	108 (cor), al	
46	**Phenyl salicylate** (Salol)	42		214	158 3, subl at 76		41 8, 42	182, 183	142 139	156	145 8 (cor), al	Tribromo deriv of phenol, 95
47	**Benzyl succinate**	42		208	185 182 8	235d	−15 3	205 5	*mono* 157, *di* 260d	*mono* 179 80, *di* 254 5 5 5, 260	113	
48	**Dibenzyl phthalate**	43 -		173	200 6, 191 (sealed tube)				*mono* 149, *di* 220	*mono* 150 (slow htng), 160 5 (rapid htng), *di* 201	113	
49	**Diethyl terephthalate**	44	302	111	300, subl without melting		−117 3	78 32	>225		93, al	Dianilide, 334–7, $PhNO_2$
50	**Cinnamyl cinnamate**	44		264	133	300	33	257	147–8	168	121	
51	**Ethyl 2-nitrocinnamate**	44		221	240		−117 3	78 32	185		93, al	
52	**Methyl 2-chloro-cinnamate**	44		196 5	212, yel , al		−97	64 65	168		108 (cor), al	
53	**Diethyl 3-nitrophthalate**	46		133 5	218		−117 3	78 32	*di* 201d	*di* 226	93, al	N-(β-Aminoethyl) morpholide, 131 9
54	**Ethyl 3-nitrobenzoate**	47	296	195	140		−117 3	78 32	*di* 187, 189 90, dil me al		93, al	
55	**Dicyclohexyl oxalate**	47, 42		127	189 5 (anh), 101 (+ $2H_2O$)		25 15	161 1	*mono* 219, *di* 419d	*mono* 168, *di* 268	112–3, al	
56	**2-Phenylethyl cinnamate**	47 8		252	133	300	−25 8	219 8	147 8	168	108	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M.P. °C	B.P., °C	M.P., °C	B.P. °C				
58	**1-Naphthyl acetate**	48-49		186	16.6	118.2	94	278-80	82	153, 147	217.4, yel al	
59	**Methyl 4-methoxybenzoate** (Methyl anisate)	49, 45	255	166	184-6	275-80	−97	64.65	167, 162.5, w	186	108 (cor.), al	
60	**Phenacyl acetate** (Benzoylcarbinyl acetate, ω-Acetoxyacetophenone)	49		178	16.6	118.2	86	118 20^{11}	82	153, 147		
61	**Di-3-tolyl carbonate** (Di-"*m*-cresyl" carbonate)	49		242				12	203		165.4 (cor.), al	
62	**Triphenyl phosphate**	49	260^{20}	108.7			41.8, 42	182, 183			145.8 (cor.), al	D_4^{20} 1.185, Tribromo deriv of phenol, 95
63	**Dibenzyl *d*-tartarate**	50		165	169-71		−15.3	205.5	*mono* 171.2, *di* 196d, al		113	Phenylhydrazide, 240
64	**Dibenzyl succinate**	51.2		149	185, 182.8	235d	−15.3	205.5	*mono* 157 *di* 260d	*mono* 179-80, *di* 254.5-5.5, 260	113	
65	**Methyl piperonylate**	51-2	$270-1^{777}$	180	229, 228		−97	64.65	169, al		108 (cor.), al	
66	**Cetyl palmitate** (*n*-Hexadecyl palmitate)	51.6		480	62.7	222^{16}	49.27	190^{18}	106.7 105.3, al	98	66	
68	**Furfuryl diacetate**	52	220	99	16.6	118.2			82	153 147		Hydrolysis → furfural, b.p., 161.7, Semicarbazone, 202
69	**Ethylene glycol dilaurate**	52		213	44, 42	299	−12.6	197.85	100, 99	87	169	
70	**Phenyl stearate**	52		360	70-1		41.8, 42	182, 183	109, 108.4, al	102	145.8 (cor.), al	Tribromo deriv of phenol, 95
71	**Methyl *d,l*-mandelate**	53.3	250 sl. d	166	118		−97	64.65	133-4	172, al	108 (cor.), al	
72	**Dimethyl tartronate**	53.4		74	156-8d		−97	64.65	*di* 198, dil. al		108 (cor.), al	
73	**Dimethyl oxalate**	54	163.5^{262}	59	189.5 (anh.), 101 (+ $2H_2O$)		−97	64.65	*mono* 219, *di* 419d	*mono* 168, *di* 268	108 (cor.), al	
74	**Tetraethyl pyromellitate**	54		91.5	275		−117.3	78.32			93, al	
75	**Diethyl *meso*-tartrate**	55		103	140		−117.3	78.32	*di* 187, 189-90, dil. me al		93, al	Bis-phenylhydrazide, 245

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Saponification					Amide	*p*-Toluidide	3 5-Dinitro benzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P, °C	B P, °C	M P °C	B P °C				
76	**3-Tolyl benzoate** ("*m*-Cresyl" benzoate)	55	314	212	122 4	249	12	203	130	158	165 4 (cor), al	
77	**Ethyl 4-nitrobenzoate**	56	186 3	195	241		−117 3	78 32	201, 198	204, 192	93, al	N-(β-Aminoethyl) morpholide, 186 3
78	**1-Naphthyl benzoate**	56		248	122 4	249	94	278-80	130	158	217 4, yel , al	
79	**Cetyl stearate** (*n*-Hexadecyl stearate)	56 6		508	70-1		49 27	190[18]	109, 108 4, al	102	66	
80	**Di-isobutyl *d,l*-tartarate**	58	311	131	203 4 (+ $1H_2O$), 205 6 (anh)			108 1	*di* 226, w -me al		87	
81	**Ethyl diphenylacetate**	58		240	148		−117 3	78 32	167 5 8 0	172 3	93, al	
82	**Ethyl 2-benzoylbenzoate**	58		254	128 (anh) 91 (+ $1H_2O$), w		−117 3	78 32	165 (cor), 162		93, al	N-(β-Aminoethyl) morpholide, 150 2
83	**Diethyl naphthalate**	58 60		136	274		−117 3	78 32			93, al	
84	**Methyl diphenylacetate**	60		226	148		−97	64 65	167 5 8 0	172 3	108 (cor), al	
85	**Di-2-tolyl carbonate** (Di-"*o*-cresyl" carbonate)	60		242			30 75	190 8			138 4 (cor), al	
86	**Methyl 2-(4-toluyl)-benzoate**	61		254	139-46		−97	64 65	175 6, al		108 (cor), al	
87	**Dimethyl *d*-tartarate**	61 5		89	169 71		−97	64 65	*mono* 171 2, *di* 196d , al		108 (cor), al	Two other forms, m p 48 and 50, Phenylhydrazide, 240
88	**Ethylene glycol dimyristate**	63 0		241	53 9	202[16]	−12 6	197 85	103	93	169	
89	**Dimethyl 4-nitro-phthalate**	66		119 5	165		−97	64 65	200d	*mono* 172	108 (cor), al	
90	**Dicyclohexyl phthalate**	66		165	200-6 191 (sealed tube)		25 15	161 1	*mono* 149, *di* 220	*mono* 150 (slow htng), 160-5 (rapid htng), *di* 201	112-3, al	n_D^{20} 1 451, D_4^{20} 1 383
92	**Ethyl oxanilate**	66-7		193	148 9		−117 3	78 32	228		93, al	
93	**Dimethyl isophthalate**	67 8		97	348, subl		−97	64 65	*mono* 280, *di* 280		108 (cor), al	
94	**Ethyl 2-(4-toluyl)benzoate**	68, 69	314, 299	268	139-40		−117 3	78 32	175 6, w		93, al	
95	**Phenyl benzoate**	69, 71	314	198	122 4	249	41 8; 42	182, 183	130	158	145 8 (cor), al	$AlCl_3$ → 4-Hydroxy benzophenone, Tribromo deriv of phenol, 95

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P °C	B P °C	M P °C	B P °C				
96	**Dimethyl 3-nitrophthalate**	69		133 5	218		−97	64 65	*di* 201d	*di* 226	108 (cor), al	
97	**Methyl 3-hydroxybenzoate**	70		152	200, subl		−97	64 65	170 167	163, dil al	108 (cor), al	
98	**Ethylene glycol dipalmitate**	70 5 69		269	62 7	222^{16}	−12 6	197 85	106 7 105 3, al	98	169	
99	**2-Naphthyl acetate**	71		186	16 6	118 2	123	285 6	82	153 147	210 2 al	
100	**Glyceryl tristearate**	71		297	70 1		17 9	290d	109 108 4 al	102		n^{80} 1 4399 D_4^{80} 0 862
101	**4-Tolyl benzoate** ("*p*-Cresyl" benzoate)	71	316	212	122 4	249	36	202	130	158	188 6 (cor), al	
102	**Glyceryl tribenzoate**	72, lgr , 76, al		135	122 4	249	17 9	290d	130	158		
103	**Phenyl cinnamate**	72		238	133	300	41 8 42	182 183	147 8	168	145 8 (cor), al	Tribromo deriv of phenol, 95
104	**Ethylene glycol dibenzoate**	73		135	122 4	249	−12 6	197 85	130	158	*di* 169	
105	**Methyl 2-nitrocinnamate**	73		207	240		−97	64 65	185		108 (cor), al	
106	**Di-isobutyl *d*-tartarate**	73-4, 70		131	169 71			108 1	*mono* 171 2, *di* 169d , al		87	Phenylhydrazide, 240
107	**Ethyl 3-hydroxybenzoate**	73 8	282	166	200, subl		−117 3	78 32	170, 167	163, dil al	93 al	
108	**Diphenyl phthalate** (Phenyl phthalate)	74-5, 70		159	200 6, 191 (sealed tube)		41 8, 42	182, 183	*mono* 149 *di* 220	*mono* 150 (slow htng), 160 5 (rapid htng), *di* 201	145 8 (cor), al	Tribromo deriv of phenol, 95
109	**Methyl 3-hydroxy-2-naphthoate**	75		202	222-3 (cor)		−97	64 65	217 8 (cor), yel , al	221-3	108 (cor), al	
110	**Methyl benzilate**	75		242	150		−97	64 65	154 5, chl	189 90	108 (cor), al	
111	**Ethylene glycol di-*n*-stearate**	76, 73		297	70, 69 6		−12 6	197 85	109, 108 4, al	102	169	
112	**Trimethyl citrate**	76, 78 9	283 7d	78	100, 153 (anh)		−97	64 65	*tri* 210-5d , w	*tri* 189, al	108 (cor), al	
113	**Methyl 2-naphthoate**	77	290	186	184, 185 5		−97	64 65	192-3, al	192, al	108 (cor), al	
114	**Methyl α-phenyl-*n*-butyrate**	77-8		178	42	270	−97	64 65	85-7		108 (cor), al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P , °C	B P , °C	M P , °C	B P , °C				
115	**Diphenyl carbonate**	78	306	214			41 8, 42	182 183			145 8 (cor), al	Phenylhydrazine → N,N′-diphenylcarbazide, Tribromo deriv of phenol, 95
116	**Methyl 3-nitrobenzoate**	78	279	181	140		−97	64 65	143	162	108 (cor), al	
117	**Ethyl 3-nitrocinnamate**	79		221	199		−117 3	78 32	196		93, al	
118	**Isoeugenyl acetate**	79	283	206	16 6	118 2		267 5	82	153, 147	158 4 (cor), BuOH	Dibromide, 132-3
119	**Methyl 2-benzoylbenzoate**	79–80, 52	352	240	128 (anh), 91 (+1 H_2O), w		−97	64 65	165 (cor), 162		108 (cor), al	
120	**Benzyl oxalate**	80		135	189 5 (anh) 101 (+2 H_2O)		−15 3	205 5	*mono* 219, *di* 419d	*mono* 169 *di* 268	113	
121	**Methyl 4-bromobenzoate**	81		215	251 3		−97	64 65	189 90, w		108 (cor), al	
122	**Benzoin acetate**	83		254	16 6	118 2	133	344	82	153, 147		
123	**Pentaerythritol tetraacetate**	84		76	16 6	118 2	262 253		82	153, 147		
124	**Pyrocatechol dibenzoate** (Catechol dibenzoate)	84		159	122 4	249	105	245 6	130	158	*di* 152	
125	**Ethyl 3-hydroxy-2-naphthoate**	85	291	216	222 3 (cor)		−117 3	78 32	217 8 (cor), yel , al	221-3	93, al	
126	**Diguaiacol carbonate** (Di-(2-methoxyphenyl) carbonate, "Guaiacol carbonate")	87		274			32	205			141 2 (cor), al	Monobromo deriv , 178
127	**Dimethyl *d l*-tartarate**	90 (stab), 84 (metastab)	282	89	203 4 (+1 H_2O), 205 6 (anh)		−97	64 65	226, w - me al		108 (cor), al	
128	**Di-2-tolyl oxalate** (Di-"*o*-cresyl" oxalate)	91		135	189 5 (anh), 101 (+2 H_2O)		30 75	190 8	*mono* 219 *di* 419d	*mono* 169, *di* 268	138 4 (cor), al	
129	**Ethyl 3,5-dinitrobenzoate**	94, 93		240	204-5		−117 3	78 32	183		93, al	N-(β-Aminoethyl) morpholide, 189 5
130	**2-Naphthyl salicylate**	95 5, 93 5		264	158 3 subl at 76		123	285-6	142, 139	156	210 2, al	
131	**Methyl 4-nitrobenzoate**	96		181	241		−97	64 65	201, 198	204, 192	108 (cor), al	
132	***n*-Propyl 4-hydroxybenzoate**	96		180	215, 210			97 1	162 (+1 H_2O), w	203-4, al	123, pet eth	
133	**1,2,4-Triacetoxybenzene** ("Hydroquinone triacetate")	96-7		76	16 6	118 2	140 5		82	153, 147		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Saponification					Amide	*p*-Toluidide	3,5 Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P °C	B P, °C	M P, °C	B P °C				
134	**Ethyl 3,5-dinitrosalicylate**	99		256	182, 173 (+1 H_2O)		−117 3	78 32	181		93, al	
135	**Dimethyl fumarate**	101 7	193 25	72	286 7 (sealed tube), subl 200		−97	64 65	*mono* 270, 300 2 subl *di* 266d		108 (cor), al	$n_D^{110\,5}$ 1 40625, $D^{110\,5}$ 1 0397
136	**Ethyl 5-nitrosalicylate**	102		211	229 30		−117 3	78 32	225		93, al	
137	**Dimethyl naphthalate**	104		122	274		−97	64 65			108 (cor), al	
138	**Di-3-tolyl oxalate** (Di-"*m*-cresyl" oxalate)	105		135	189 5 (anh), 101 (+2 H_2O)		12	203	*mono* 219, *di* 419d	*mono* 169 *di* 268	164 5 (cor), al	
139	**Phloroglucinol triacetate** (1,3,5-Triacetoxybenzene)	105-6		76	16 6	118 2	200 9 (slow htng), 217 9 (rapid htng)		82	153, 147	*tri* 162	
140	**Diphenyl adipate**	106		149	153-4 (cor)	216^{15}			*mono* 125-30, w , *di* 220	241	145 8 (cor), al	Tribromo deriv of phenol, 95
141	**Acetylsalicylaldehyde diacetate** ("Salicyl aldehyde triacetate")	107, 103		89	16 6	118 2			82	153, 147		Hydrolysis → salicylaldehyde, b p 197 (cor)
142	**2-Naphthyl benzoate**	107		248	122 4	249	123	285-6	130	158	210 2, al	
143	**Methyl 3,5-dinitrobenzoate**	108		226	204 5		−97	64 65	183		108 (cor), al	
144	**Dimethyl mesotartrate**	111		89	140		−97	64 65	*di* 187, 189 90, dil me al		108 (cor), al	Bis-phenylhydrazide, 245
145	**Di-4-tolyl carbonate** (Di-"*p*-cresyl" carbonate)	114		242			36	202			188 6 (cor), al	
146	**Ethyl oxamate**	114 5		117	210		−117 3	78 32	419d		93, al	
147	**Cholesteryl acetate**	114		416	16 6	118 2	148 5		82	153, 147		
148	**Ethyl 4-hydroxybenzoate**	116		166	215, 210		−117 3	78 32	162 (+1 H_2O), w	203-4, al	93, al	N-(β-Aminoethyl) morpholide, 184
149	**Resorcinol dibenzoate**	117		159	122 4	249	110 (stab), 108 8 5 (labile)	280 8 (cor)	130	158	*bis* 201	
150	**Ethyl 3-nitrosalicylate**	118		211	125 (+1 H_2O)		−117 3	78 32	145		93, al	
151	**Methyl 5-nitrosalicylate**	119		197	229 30		−97	64 65	225		108 (cor), al	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

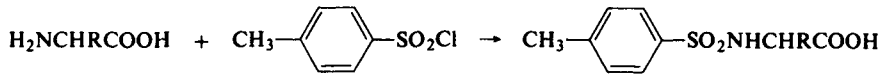
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	*p*-Toluidide	3,5-Dinitro benzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M P °C	B P °C	M P, °C	B P °C				
152	**Diphenyl succinate**	121		135	185 182 8	235d	41 8, 42	182, 183	*mono* 157, *di* 260d	*mono* 179 80, *di* 254 5 5 5, 260	148 5 (cor), al	Tribromo deriv of phenol, 95
153	**Di-4-tolyl succinate** (Di-"*p*-cresyl" succinate)	121		149	185 182 8	235d	36	202	*mono* 157, *di* 260d	*mono* 179 80, *di* 254 5-5 5, 260	188 6 (cor), al	
154	**Hydroquinone diacetate**	124		97	16 6	118 2	171	286	82	153, 147	*bis* 317	
155	**Methyl 3-nitro-cinnamate**	124		207	199		−97	64 65	196		108 (cor), al	
156	**Methyl 3,5-dinitro-salicylate**	127		242	182		−97	64 65	181, 173 (+1 H_2O)		108 (cor), al	
157	**Methyl 4-hydroxy-benzoate**	131		152	215, 210		−97	64 65	162 (+1 H_2O), w	203-4, al	108 (cor), al	
158	**Methyl 3-nitro-salicylate**	132		197	125 (+1 H_2O)		−97	64 65	145		108 (cor), al	
159	**Triethyl trimesate**	133		98	380 (cor)		−117 3	78 32	*tri* 365d (cor)		93, al	
160	**Ethyl 4-nitro-cinnamate**	137, 142		221	285		−117 3	78 32	204, 217		93, al	
161	**Dimethyl terephthalate**	141		97	300 (subl without melting)		−97	64 65	*di* >225		108 (cor), al	
162	**Tetramethyl pyromellitate**	142		77 5	275		−97	64 65			108 (cor), al	
163	**Trimethyl trimesate**	144		84	380 (cor)		−97	64 65	*tri* 365d (cor)		108 (cor), al	
164	**Di-4-tolyl oxalate** (Di-"*p*-cresyl" oxalate)	148-9		135	189 5 (anh), 101 (+2 H_2O)		36	202	*mono* 219, *di* 419d	*mono* 169, *di* 268	188 6 (cor), al	
165	**Methyl 4-nitro-cinnamate**	161		207	285		−97	64 65	204, 217		108 (cor), al	
166	**Diethyl mucate**	163-4		133	214d , 223-55		−117 3	78 32	*mono* 192d , *di* 220		93, al	
167	**Pyrogallol triacetate**	165, 172		84	16 6	118 2	133	309	82	153, 147	*tri* 205	
168	**Dimethyl mucate**	165 7d		119	214d , 223-55		−97	64 65	*mono* 192d , *di* 220		108 (cor), al	
169	**Methyl gallate**	200-1		184	253-4d , 222 40d		−97	64 65	189		108 (cor), al	
170	**Hydroquinone di-benzoate**	204 (cor), 199		159	122 4	249	171, 172	286	130	158	*bis* 317	

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XVII

*p-Toluenesulfonamide (p-Toluenesulfonyl derivative).**



p-Toluenesulfonamide

From the amino acid in aqueous sodium hydroxide with *p*-toluenesulfonyl chloride in ether.

For directions and examples see: Cheronis, pp. 453–454; Linstead, pp. 77–78; Shriner, p. 231; Vogel, p. 437; Wild, pp. 169–170; E. Fischer and P. Bergell, *Chem. Ber.*, **35**, 3779, 3784 (1902); E. W. McChesney and W. K. Swann, *J. Amer. Chem. Soc.*, **59**, 1116 (1937).

From the amino acid in aqueous sodium hydroxide with *p*-toluenesulfonyl chloride.

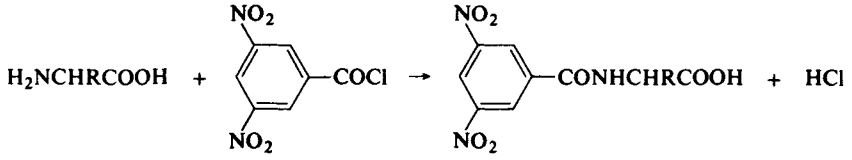
See: J. I. Harris and T. S. Work, *Biochem. J.*, **46**, 582 (1950).

From the amino acid with *p*-toluenesulfonyl chloride and triethylamine in aqueous tetrahydrofuran.

See: D. Theodoropoulos and L. C. Craig, *J. Org. Chem.*, **21**, 1376 (1956).

For an extensive list of references for the preparation of the *p*-toluenesulfonyl derivatives of amino acids *see*: J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 886–889.

*3,5-Dinitrobenzamide (3,5-Dinitrobenzoyl derivative).**

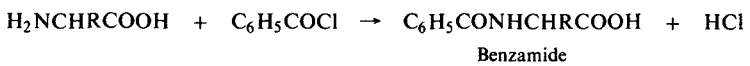


3,5-Dinitrobenzamide

From the amino acid in aqueous sodium hydroxide with 3,5-dinitrobenzoyl chloride.

For directions and examples see: Cheronis, p. 453; Vogel, p. 436; Wild, p. 168; B. C. Saunders, *Biochem. J.*, **28**, 580 (1934); *J. Chem. Soc.*, 1397 (1938); B. C. Saunders, G. J. Stacey and I. G. E. Wilding, *Biochem. J.*, **36**, 368 (1942); B. W. Town, *Biochem. J.*, **35**, 578 (1941).

Benzamide (Benzoyl derivative).



Benzamide

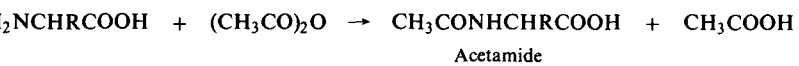
From the amino acid in aqueous sodium carbonate or bicarbonate and benzoyl chloride.

For directions and examples see: Linstead, p. 77; Vogel, p. 436; Wild, p. 167.

From the amino acid in aqueous sodium hydroxide with benzoyl chloride.

See: Cheronis, p. 453; E. Fischer and P. Bergell, *Chem. Ber.*, **35**, 3779, 3784 (1902); **39**, 597 (1906).

Acetamide (Acetyl derivative).



Acetamide

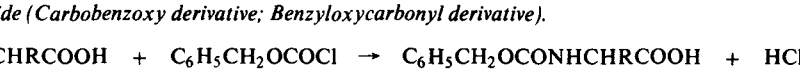
From the amino acid with acetic anhydride in water.

For directions and examples see: Linstead, p. 77; Shriner, p. 226; Wild, p. 167; R. M. Herbst and D. Shemin in *Organic Syntheses*, Coll. Vol. 2, (Ed. A. H. Blatt), John Wiley and Sons, New York, 1943, p. 11.

From the amino acid in aqueous sodium hydroxide with acetic anhydride.

See: Cheronis, p. 454; M. Bergmann and L. Zervas, *Biochem. Z.*, **203**, 288 (1928).

Carbobenzoxamide (Carbobenzoxy derivative; Benzyloxycarbonyl derivative).



Carbobenzoxamide

From the amino acid in aqueous sodium hydroxide with carbobenzoxy chloride (benzyl chloroformate).

For directions and examples see: M. Bergmann and L. Zervas, *Chem. Ber.*, **65**, 1192 (1932); M. Winitz, L. Bloch-Frankenthal, N. Izumiya, S. M. Birnbaum, C. G. Baker and J. P. Greenstein, *J. Amer. Chem. Soc.*, **78**, 2423 (1956).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLE XVII (Continued)

For an extensive list of references for the preparation of the carbobenzoxy derivatives of amino acids *see:* J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 887-895.

*Phenylurethane (Phenylurea derivative).**

$$H_2NCHRCOOH + C_6H_5N{=}C{=}O \rightarrow \underset{\text{Phenylurethane}}{C_6H_5NHCONHCHRCOOH}$$

From the amino acid with aqueous potassium hydroxide and phenylisocyanate.
For directions and examples see: Linstead, p. 78; Shriner, p. 211; Wild, p. 171.

*Phenylhydantoin.**

$$C_6H_5NHCONHCHRCOOH \xrightarrow{HCl} \underset{\text{Phenylhydantoin}}{C_6H_5N(CO)NH(CO)CHR} + H_2O$$

From the phenylurethane (obtained as described above) in aqueous hydrochloric acid.
For directions and examples see: Cheronis, p. 456.

Rf Values.

For the determination of the Rf values of amino acids in aqueous phenol, in collidine-lutidine and in butanol-acetic acid mixtures *see:* R. J. Block, R. LeStrange and G. Zweig, *Paper Chromatography*, Academic Press, New York, 1952, pp. 51-66; E. Lederer and M. Lederer, *Chromatography*, Elsevier Publishing Co., New York, 1957, pp. 306-311.

NOTE: For additional information regarding directions and examples for the preparation of derivatives of amino acids which are similar to those of amines (e.g., phenylurethane, acetamide, etc.) see explanations and references to Table XVIII, p. 291, 292, 293, 294.

*Derivatives recommended for first trial.
WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS
(Listed in order of increasing decomposition temperatures)* **

No	Name	Decomp temp °C	Specific rotation			Rf values***			*p* Toluene-sulfonyl	Phenyl urea	Benzoyl	3 5 Dinitro benzoyl	Picrate	Miscellaneous
			$[\alpha]_D$	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
1	**3-Aminohydro-cinnamic acid**	84-5												Acetyl, 162, Hydrochloride, 191
2	**N-Methyl-β-alanine**	99 100												Hydrochloride, 105, aq al
3	**Aminomalonic acid**	109									61, pet eth			Formyl, 48, Heat → glycine decom temp 228 30 262
4	**2-Aminophenyl-acetic acid**	119									179, al			Acetyl, 158, Formyl, 110
5	**2-Amino-1-Naphthoic acid**	126												N-Acetyl, 195-6, al
6	**N-Phenyl-glycine**	127								195	63			Acetyl 124
7	**4-Aminohydro-cinnamic acid**	132									194-5			Acetyl 143 (anh) 124 (hyd)
8	**L-Ornithine**	140	11 5	25	c = 6 5	0 79	0 11	0 15		190	240 (*mono*), 189 (*di*)		208	α,δ-Dicarbo-benzyloxy, 112 4
9	**Anthranilic acid** (2 Amino benzoic acid)	147				0 85			217	181	182	278	104	
10	**3-Aminophenyl-acetic acid**	151												Amide, 164 6, al Chloro-acetyl 187-8, al
11	**5-Amino-pentanoic acid** (ω-Amino-*n*-valeric acid)	157									105 94			
12	**2-Aminocin-namic acid**	158, yel									191 3, al			Monoacetyl, 250 1, al , Diacetyl 158, lgr
13	**DL-β-Amino-*n*-valeric acid** DL-3-Amino pentanoic acid)	160 5									145 6			N-β Naphthalenesulfonyl 134
14	**2-Amino-4-toluic acid**	165										. . .		Acetyl, 279-81
15	**3-Aminoben-zoic acid**	174				0 86				270 264	248	270		
16	***trans*-4-Amino-cinnamic acid**	175-6									274			Acetyl, 259 60
17	**ω-Aminotri-decylic acid**	177									111 105			Benzenesulfonyl, 120, al
18	**3-Amino-4-toluic acid** (Homoanthranilic acid)	177												Amide, 146, Acetyl, 184, Formyl, 186, al

* Derivative data given in order m p , crystal color, solvent from which crystallized

** Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

*** Aqueous phenol 80°, w/w for basic amino acids 3 vol —% of a conc aq NH_4 has to be present (in a separate vessel) in the chamber, otherwise low values are obtained Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS
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No	Name	Decomp temp °C	Specific rotation			Rf values***			*p*-Toluene-sulfonyl	Phenyl urea	Benzoyl	3 5-Dinitro benzoyl	Picrate	Miscellaneous
			$[\alpha]_D$	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
19	**4-Amino-1-naphthoic acid**	177												Acetyl, 189, Amide, 175
20	*trans*-**3-Amino-cinnamic acid**	181, yel									229			Acetyl, 237, al
21	**3-Amino-1-naphthoic acid**	181												Acetyl, 254 5
22	**N-Ethylglycine**	182												Hydrochloride, *ca* 180
23	**L-Canavanine**	184	7 9	20		0 51					*tri* 186		163 4	
24	**L-Glutamine**	185				0 6								Carbo-benzyloxy, 137
25	**Hippuric acid**	187												4 Nitrobenzyl ester 136 4-Bromo phenacyl ester, 151
26	**4-Aminobenzoic acid**	188				0 81				300	278	290		
27	**DL-Canaline**	190-5									158 60 (*di*)			γ-Carboben-zyloxy, 208-10
28	**Betaine** (Tri-methyl-glycine)	193						0 43						Formyl, 183
29	**DL-β-Amino-butyric acid**	194				0 78					154			
30	**DL-Glutamic acid**	199				0 31	0 20	0 3	117		153 155			Acetyl, 187
31	**4-Aminophenyl-acetic acid**	199 200									205-6, al			Acetyl, 168 70, Chloroacetyl, 158-60
32	**β-Alanine**	200				0 66	0 22	0 37		168	120	202		Carboben-zyloxy, 106
33	**L-Isoserine**	200				0 39					107-9			
34	**ω-Amino-*n*-caproic acid** (6-Amino-hexanoic acid)	202									45-7			
35	**γ-Aminobutyric acid**	203				0 75								Hydrochloride, 135 Heat → pyrrolidone, 24, pet eth
36	**DL-Proline**	203 (mono-hyd) 191				0 88	0 28	0 43		170		217	135-7	
37	**γ-Amino-*n*-caproic acid** (4-Amino-hexanoic acid)	205-7									150 2			Hydrochloride, 120 1
38	**6-Amino-1-naphthoic acid**	205-6												Acetyl, 170 2, 252-3
39	**1-Amino-2-naphthoic acid**	205 r h											.	Heating with conc HCl → 1-naphthyl-amine, 50

*Derivative data given in order m p , crystal color, solvent from which crystallized

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(Listed in order of increasing decomposition temperatures)* ** (Continued)

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			$[\alpha]_D$	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
40	**L-Arginine**	207	11 8	20	c = 0 87 in 0 5 N-NaOH	0 89	0 17	0 2			298 (*mono*), 235 (*di*)	150	217 (*mono*), 190 (*di*)	Monocarbobenzyloxy, 175
			12 5	20	c = 3 48 in water									
41	**L-Glutamic acid**	211 r h , 197 s h	31 2	22 4	c = 1 0 in 6N-HCl	0 31	0 2	0 3	131					Acetyl, 199, Carbobenzyloxy, 120
			11 5	18	c = 1 47 in water									
42	**5-Amino-1-naphthoic acid**	212												Acetyl, 296, al
43	**Sarcosine**	212				0 78				102	104	153		Acetyl, 135
44	**L-3,5-Di-iodotyrosine**	213	2 9	20	c = 5 08 in 1 1 N-HCl	0 61	0 55							
45	**L-α-Asparagine**	213-5				0 47								Carbobenzyloxy, 164
46	**DL-γ-Amino-n-valeric acid** (DL-4-Aminopentanoic acid)	214 (cor)									132			
47	**L-Canaline**	214				0 77					99 (*di*)		192 3	
48	**β-Aminoisovaleric acid**	217												Hydrochloride, 120
49	**β-Hydroxyvaline**	218								182	153 (*mono*)			2-Naphthalenesulfonyl, 261
50	**L-Proline**	220 2	−93 0	20	c = 2 42 in 0 6 N-KOH	0 88	0 28	0 43	130-3				154	Phenylhydantoin, 144
			−52 6	20	c = 0 57 in 0 5 N-HCl									
51	**L-Citrulline**	222	3 7	20	c = 2 in water	0 63	0 23	0 25					206	
52	**7-Amino-1-naphthoic acid**	223-4												Acetyl, 229
53	**L-Lysine**	224	14 6	20	c = 6 5 in water	0 81	0 11	0 14		184	235 (*mono*), 149 (*di*)		266	Monohydrochloride 235 Dihydrochloride, 193 α,ε-Dicarbobenzyloxy, 150
			25 9	22 9	c = 2 0 in 6 N-HCl									
54	**β-L-Asparagine**	227				0 40	0 21	0 19	175	164	189	196	180	Carbobenzyloxy, 165
55	**3,5-Diaminobenzoic acid**	228												3,5-Diacetyl, 184, Et ester, 84
56	**L-Serine**	228	14 45	25	c = 9 34 in 1 N-HCl	0 36	0 28	0 27						Carbobenzyloxy, 121
			−6 83	20	c = 10 4 in water									
57	**Glycine**	228 30, 262				0 41	0 24	0 26	147	197	187 5	179	202	Carbobenzyloxy, 120
58	**DL-Thyroxine**	230 s h , 250 r h				0 86	0 76				210 5			N-Chloroacetyl, 201, Me ester 156
59	**DL-β-Hydroxynorvaline**	230								156	170			Phenylhydantoin, 154 5

*Derivative data given in order m p , crystal color, solvent from which crystallized

**Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

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			$[\alpha]_D$	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
60	**DL-β-Amino-hydrocinnamic acid**	231									194 6			Hydrochloride, 218, Formyl, 128-9, Acetyl, 161, al
61	**DL-Homo-aspartic acid** (α-Amino-α-methyl succinic acid)	232												Amide, 266
62	**D-β-Amino-hydrocinnamic acid**	234-5	7 0	20	water									N-Formyl, 142-3
63	**L-β-Amino-hydrocinnamic acid**	234-5	−7 5	25	water									N-Formyl, 142 3
64	**3-Amino-salicylic acid**	235									189			Acetyl, 215, N-Benzenesulfonyl, 194
65	**DL-Allo-threonine**	237				0 50	0 34				176 (*mono*), 174 (*di*)			
66	**DL-Arginine**	238				0 89	0 17	0 2			230 (*di*, anh), 176 (*di*, hyd)		200 (*mono*), 196 (*di*)	
67	**4-Dimethyl-aminobenzoic acid**	242												Amide, 206, Anilide, 182 3
68	**β-Amino-β-phenyliso-butyric acid**	243									205			
69	**DL-Isoserine**	246				0 39				184	151			Phenylurethane, 183-4
70	**DL-Serine**	246				0 36	0 28	0 27	213	169	149-50			Carbobenzyloxy, 125
71	**4-Hydroxy-phenylglycine**	248									117			Monoacetyl, 203, Diacetyl, 174 5, Amide, 135
72	**Isoaspartic acid** (α-Amino-α-methylmalonic acid)	250												Diamide, 200 1 Heat → alanine, 295 d
73	**DL-Threonine**	251				0 50	0 34	0 35			177 8	145		Phenylhydantoin, 164
74	**DL-α-Amino-phenylacetic acid**	256 (subl)									175, al			Acetyl, 198 5, Formyl, 180
75	**L-Cystine**	260	−214 4	24 4	c = 1 0 in 1 02 N-HCl			0 1	204 5	160	181 (*di*)	180		Dicarbobenzyloxy, 123
			−70 0	18 5	c = 0 4 in 0 2 N-NaOH									
76	**DL-α-Amino-hydratropic acid** (DL-α-Phenyl-alanine)	260 (subl)												N-Carboethoxy, 191, al

* Derivative data given in order m p , crystal color, solvent from which crystallized

** Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

*** Aqueous phenol 80% w/w for basic amino acids 3 vol —% of a conc aq NH_3 has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

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			$[\alpha]_D$	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol Ac acid						
77	**Glycylglycine**	260				0 39		0 22	178	176	208	210		Carboben-zyloxy, 178
78	**DL-β-Phenyl-alanine**	264				0 85	0 48	0 68	134 5	182	188		173	Carboben zyloxy, 103
79	**DL-Aspartic acid**	270 (>300)				0 19	0 21	0 24			119 (hyd), 176 (anh)			Carboben-zyloxy, 116
80	**DL-α-Amino-octanoic acid**	270				0 89	0 55				128			
81	**L-Aspartic acid**	270	24 6	24	c = 2 0 in 6 N HCl	0 19	0 21	0 24	140	162	185			Carboben-zyloxy, 116
82	**DL-α-Amino-nonanoic acid**	273									128			
83	**L-Hydroxy-proline**	274	−47 3	20	c = 1 31 in 1 N-HCl	0 63	0 28		153	175	100 (*mono*), 92 (*di*)			
			−75 2	22 5	c = 1 0 in water									
84	**DL-Trypto-phane**	275				0 75	0 50	0 50	176			240		N-Benzenesul-fonyl 185 Carboben zyloxy, 169-70
85	**α-Aminoiso-butyric acid**	280				0 74	0 32				198			1-Naphthyl-urea, 198
86	**DL-α-Amino-heptanoic acid**	281									135			
87	**DL-Methionine**	281				0 81	0 42	0 55	105		145			Acetyl, 114, Formyl, 100, Carboben-zyloxy, 112
88	**5-Aminosalicy-lic acid**	283									252			Monoacetyl, 218 Diacetyl, 184
89	**DL-Lanthionine**	283				0 26	0 11				195 8 (*di*)			
90	**L-Methionine**	283	−8 11	25	c = 0 8 in water	0 81	0 42	0 55				94 5 (hyd), 150 (anh)		Acetyl, 98 9 1-Naphthyl-urea, 188
91	**L-(+)-Iso-leucine**		40 6	20	c = 5 1 in 6 1 N-HCl	0 84	0 45	0 72	130-2	121	117			Formyl, 156
			11 29	20	c = 3 1 in water									
92	**L-Phenylala-nine**	283 320	−35 1	20	c = 1 94 in water	0 85	0 48	0 68	164	181	146	93		Carboben-zyloxy, 126 8
93	**L-Hexahydro-tyrosine**	285												N-4-Nitro-benzoyl, 225
94	**D-(−)-Iso-leucine**	285	−40 86	20	c = 4 53 in 6 1 N-HCl	0 84	0 45	0 72	130 2	121	117			Formyl, 156
95	**L-Histidine**	288, 253	13 0	22 7	c = 1 5 in 6 N-HCl	0 69	0 27	0 2	202 4		230 (*mono*)	189	86	Carboben-zyloxy, 209
			−39 0	25	c = 1 13 in water									
96	**L-Cysteic acid**	289 260	8 66	20	c = 1 85 g in 25 ml water									Diphenylacyl ester, 203

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			$[\alpha]_D$	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol Ac acid						
97	**L-Tryptophane**	290 252	−31 5 6 17	22 7 20	c = 1 0 in water c = 2 42 in 0 5 N-NaOH	0 75	0 50	0 5	176	166	183	233		Carboben-zyloxy 126
98	**DL-N-Methyl-α-alanine**	292												Methylamide, 43, Hydro-chloride, 110
99	**DL-Isoleucine**	292, 275 s h				0 84	0 45	0 72	141	120	118			Formyl, 121
100	**L-(+)-α-Aminobutyric acid**	292, 303 s h	18 65	19	c = 4 8 in 6 N-HCl	0 71	0 31	0 45			121			Formyl, 126, 1-Naphthyl-urea, 195
101	**DL-Leucine**	293, s h 332				0 84	0 45	0 73		165	137 41	187		
102	**DL-α-Amino-α-methyl-valeric acid** (DL-α-Amino-α-methyl pentanoic acid)	295, s h												1-Naphthyl-urea 196
103	**DL-Alanine**	295				0 60	0 28	0 38	139		166	177		Carboben-zyloxy, 114 5
104	**D-α-Amino-hydratropic acid**	295 (subl)	70 0	18	water									Formyl 194 5
105	**L-Alanine**	297	14 7 2 7	15 22	c = 5 8 in 0 97 N-HCl c = 10 3 in water	0 60	0 28	0 38	133		151			Carbobenzyl oxy, 84 1-Naphthyl-urea, 220 2
106	**DL-Norleucine**	297 327				0 84	0 45	0 74	124					Formyl, 114
107	**DL-Valine**	298, s h , 282				0 78	0 36	0 6	110	164	132	158		
108	**L-Djenkolic acid**	300-50	−60 5 −47 5	20 5 25	1% in 1N-HCl 2% in 1N-HCl	0 40	0 13				166 (*mono*), 88 (*di*)			
109	**D-N-Methyl-α-alanine**	300	5 6	20	water									Hydrochloride, 165 6
110	**Taurine**	300-5				0 42								N-Me , 241, N-Et , 147
111	**L-(+)-Norleucine**	301	21 3 6 26	20 20	c = 4 25 in 6 N-HCl c = 0 7 in water	0 84	0 45	0 74			53			Formyl, 115-6, 2-Naph-thalenesul-fonyl, 149
112	**DL-Norvaline**	303, s h				0 80	0 39	0 65		117				Formyl, 132, Phenylhy-dantoin, 103
113	**Creatine** (α-Methylguan-idoacetic acid)	303											218 20	Diacetyl, 165
114	**4-Aminocyclo-hexanecar-boxylic acid**	303-4												Heat → lactam, 191-2

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			$[\alpha]_D$	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol Ac acid						
115	**DL-α-Amino-butyric acid**	304				0 71	0 31	0 45		170	147			1-Naphthyl-urea, 194, Phthalyl, 96
116	*meso*-**Lan-thionine**	304				0 26	0 11				198 200			Dicarbo-benzyloxy, 139-40
117	**Creatinine**	305, 260											220	
118	**L-α-Amino-phenylacetic acid**	305 10	−111 0, −157	20, 20	water dil HCl									Acetyl 191, Formyl 190
119	*meso*-**2,3-Di-aminosuccinic acid**	306										(*dl*) 212 hyd		Diacetyl, 235
120	**L-(+)-Norva-line**	307	23 0	20	c = 10 in 10% HCl	0 80	0 39				64			Acetyl, 137
121	**L-Tyrosine**	314-8 r h	−8 64	20	c = 4 4 in 6 3 N HCl	0 51	0 51	0 45	N- 188	104	N- 166 7, 211 2 (*dl*)			N-Acetyl, 148, Diacetyl, 172, N-Carboben-zyloxy, 101
		290 5 s h	−13 2	18	c = 0 91 in 3 N-NaOH									
122	**L-(+)-Valine**	315	28 8	20	c = 3 4 in 6 N-HCl	0 78	0 36	0 60	147		127	157 8		Carboben-zyloxy, 64-5
123	**L-Leucine**	337	15 1	25 9	c = 2 0 in 6 N-HCl	0 84	0 45	0 73	124	115	118	187		
			−10 8	24 7	c = 2 0 in water									
124	**DL-Tyrosine**	340 r h, 295 s h				0 51	0 51	0 45	224 6		N- 197	252 4 (*dl*)		
125	**1-Aminocyclo-hexanecar-boxylic acid**	350, 320 s h											209-10	Hydrochloride, 310
126	**DL-2,3-Di-aminosuccinic acid**										164 (*dl*) hyd			Diacetyl, 235
127	**DL-Ornithine**					0 79	0 11	0 15	188 (*mono*)	192	4 N 285-8, 188 (*dl*)		208 (*dl*)	
128	**L-(+)-Alloiso-leucine**		38 1	20	c = 3 97 in 6 N-HCl					151				Formyl, 126, 1-Naphthylurea, 166, Benzene-sulfonyl, 147
129	**DL-Lysine**					0 81	0 11	0 14		196	249 (*mono*); 146 (*dl*)		225 (*mono*)	Monohydro-chloride, 260 3, Dihy-drochloride, 187-9
130	**L-Cysteine**					0 57								S-Benzyl, 216, Oxid → L-cystine, 260 d Hydrochlo-ride, 175-8, $[\alpha]_D^{25}$ 9 5 (c = 2 in water)

*Derivative data given in order m p , crystal color, solvent from which crystallized

**Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

***Aqueous phenol 80°, w/w for basic amino acids 3 vol —% of a conc aq NH_3 has to be present (in a separate vessel) in the chamber otherwise low values are obtained Collidine-lutidine mixture 2,6-lutidine (100 ml) 2,4 6-collidine (100 ml), water (100 ml) diethylamine (3 ml) Butanol-acetic acid-water 40 ml 10 ml 10 ml

EXPLANATIONS AND REFERENCES TO TABLE XVIII

Acetamide (Acetyl derivative) *

$$RNH_2 + (CH_3CO)_2O \rightarrow CH_3CONHR + CH_3COOH$$

$$RR'NH + (CH_3CO)_2O \rightarrow CH_3CONRR' + CH_3COOH$$

Acetamide

For primary and secondary amines only

From the amine with acetic anhydride without solvent

For directions and examples see Cheronis, pp 591 593, Linstead, p 60, Vogel, p 652, Wild, p 218, J J Sudborough, *J Chem Soc*, **79,** 533 (1901), L C Raiford, R Taft and H P Lankelma, *J Amer Chem Soc*, **46,** 2051 (1924)

From the amine with acetic anhydride in aqueous sodium hydroxide

See F D Chattaway, *J Chem Soc*, 2495 (1931)

From the amine with acetic anhydride in pyridine

See Cheronis, pp 590, 592 593

From the amine hydrochloride with acetic anhydride in aqueous sodium acetate

See Linstead, p 60, Vogel, p 652

From the amine with acetic anhydride in water

See Shriner, p 226

From the amine with acetic anhydride in acetic acid

See Wild, p 218

Benzamide (Benzoyl derivative) *

$$RNH_2 + C_6H_5COCl \rightarrow C_6H_5CONHR + HCl$$

$$RR'NH + C_6H_5COCl \rightarrow C_6H_5CONRR' + HCl$$

Benzamide

For primary and secondary amines only

From the amine with benzoyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 591, 593-594, Linstead, p 60, Vogel, p 652, Wild, p 219

From the amine with benzoyl chloride in a pyridine-benzene mixture

See Shriner, p 226

From the amine with benzoyl chloride in benzene

See Shriner, p 227

From the amine with benzoyl chloride in an aqueous sodium hydroxide-chloroform mixture

See Shriner, p 226

From the amine with benzoyl chloride

See Vogel, p 653

Benzenesulfonamide (Benzenesulfonyl chloride derivative) *

$$RNH_2 + C_6H_5SO_2Cl \rightarrow C_6H_5SO_2NHR + HCl$$

$$RR'NH + C_6H_5SO_2Cl \rightarrow C_6H_5SO_2NRR' + HCl$$

Benzene-sulfonamide

For primary and secondary amines only

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide

For directions and examples see Cheronis, pp 595 596, Shriner, pp 103-104, Vogel, p 653, O Hinsberg, *Chem Ber*, **23,** 2962 (1890), **38,** 906 (1905)

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in methanol

See Cheronis, p 596

From the amine with benzenesulfonyl chloride in benzene

See Wild, p 221

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in acetone

See Wild, p 221

From the amine with benzenesulfonyl chloride in aqueous pyridine

See Wild, p 221

From the amine with benzenesulfonyl chloride in pyridine

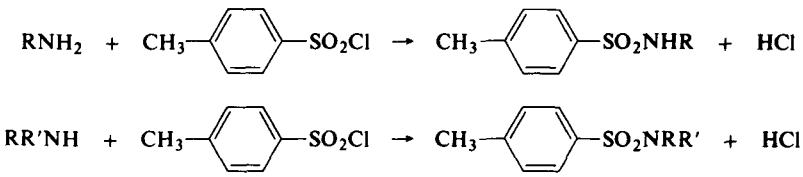
See Vogel, p 653

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide
See Wild, p 221

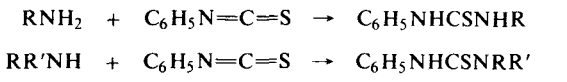
p-Toluenesulfonamide (p-Toluenesulfonyl chloride derivative) *



p-Toluenesulfonamide

For primary and secondary amines only
From the amine with *p*-toluenesulfonyl chloride in aqueous sodium hydroxide
For directions and examples see Cheronis, p 595, Linstead, p 60, Shriner, pp 103 104, Vogel, p 653
From the amine with *p*-toluenesulfonyl chloride in benzene
See Wild, p 221
From the amine with *p*-toluenesulfonyl chloride in acetone
See Wild, p 221
From the amine with *p*-toluenesulfonyl chloride in pyridine
See F Bell, *J Chem Soc*, 2787 (1929)
From the amine with *p*-toluenesulfonyl chloride in aqueous pyridine
See Wild, p 221

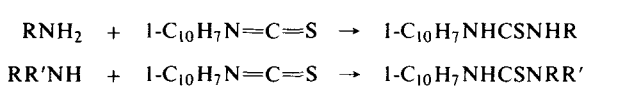
Phenylthiourea *



Phenylthiourea

For primary and secondary amines only
From the amine with phenylisothiocyanate in alcohol
For directions and examples see Cheronis, pp 599–600, Shriner, p 227, Vogel, p 422, Wild, p 227, T Otterbacher and F C Whitmore, *J Amer Chem Soc*, **51**, 1909 (1929)
From the amine with phenylisothiocyanate without solvent
See Vogel, p 422, Wild, p 227, N A Lange, H L Ebert and L K Youse, *J Amer Chem Soc*, **51**, 1911 (1929)

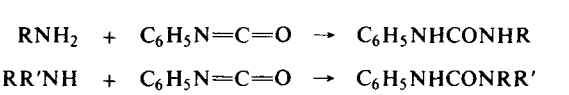
1-Naphthylthiourea *



1-Naphthylthiourea

For primary and secondary amines only
From the amine with 1-naphthylisothiocyanate in ethanol
For directions and examples see Cheronis, pp 600–601, Vogel, p 422, Wild, p 227, C M Suter and E W Moffet, *J Amer Chem Soc*, **55**, 2497 (1933)
From the amine with 1-naphthylisothiocyanate without solvent
See Vogel, p 422, Wild, p 227, C M Suter and E W Moffett, *J Amer Chem Soc*, **55**, 2497 (1933)

Phenylurea



Phenylurea

For primary and secondary amines only
From the amine with phenylisocyanate in petrol ether

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

For directions and examples see Linstead, p 61, Wild, pp 223 224
From the amine with phenylisocyanate without solvent
See N A Lange, H L Ebert and L K Youse, *J Amer Chem Soc*, **51**, 1911 (1929)

1-Naphthylurea *

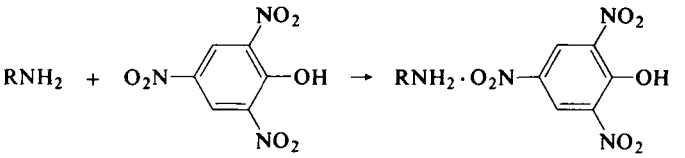
$$RNH_2 + 1\text{-}C_{10}H_7N{=}C{=}O \rightarrow 1\text{-}C_{10}H_7NHCONHR$$

$$RR'NH + 1\text{-}C_{10}H_7N{=}C{=}O \rightarrow 1\text{-}C_{10}H_7NHCONRR'$$

1 Naphthylurea

For primary and secondary amines only
From the amine with 1-naphthylisocyanate without solvent
For directions and examples see Cheronis, p 599, H E French and A F Wirtel, *J Amer Chem Soc*, **48**, 1736 (1926)
From the amine with 1-naphthylisocyanate in petrol ether
See Linstead, p 61, Wild, pp 223 224
From the amine with 1-naphthylisocyanate with water
See Wild, p 224

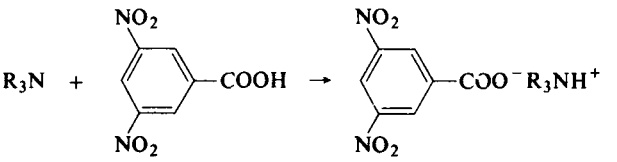
Picrate *



Picrate
(Molecular complex)

For primary, secondary and tertiary amines
From the amine with picric acid in methanol or in ethanol
For directions and examples see Cheronis, pp 603 604, Linstead, p 50, 61, Shriner, p 229, Vogel, pp 422–423, Wild, p 212
From the amine with picric acid in water
See Vogel, p 422
From the amine with picric acid in acetone or benzene
See Wild, p 212
From the amine with picric acid
See Shriner, p 229

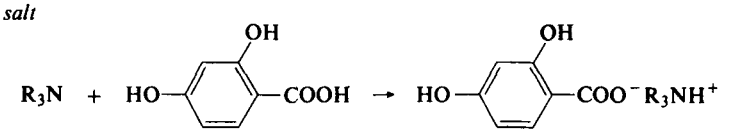
3,5-Dinitrobenzoic acid salt *



Trialkylammonium
3,5-dinitrobenzoate

Especially for tertiary amines
From the amine with 3,5-dinitrobenzoic acid in methanol or ethanol
For directions and examples see Cheronis, pp 602 603, Wild, p 215, C A Buehler, E J Currier and R Lawrence, *Ind Eng Chem, Anal Ed*, **5**, 277 (1933), C A Buehler and J D Calfree, *Ind Eng Chem, Anal Ed*, **6**, 351 (1934)

β-Resorcylic acid salt



β-Resorcylic acid Trialkylammonium resorcylate

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

Especially for tertiary amines.

From the amine with β-resorcylic acid in ether.

For directions and examples see: Cheronis, p. 603; K. W. Wilson, F. E. Anderson and R. W. Donohoe, *Anal. Chem.*, **23**, 1032 (1951).

*Chloroplatinic acid salt.**

$$R_3N + H_2PtCl_6 \rightarrow [R_3NH]_2^+PtCl_6^=$$

Chloroplatinate

Especially for tertiary amines.

From the amine in aqueous hydrochloric acid with aqueous chloroplatinic acid.

For directions and examples see: Shriner, p. 230; Wild, p. 213.

Hydrochloride.

$$RNH_2 + HCl \rightarrow [RNH_3^+]Cl^-$$

Hydrochloride

For primary, secondary and tertiary amines.

From the amine with gaseous hydrogen chloride in ether, benzene or chloroform.

For directions and examples see: Cheronis, p. 601; Shriner, p. 224; Wild, p. 211.

From the amine with dilute aqueous hydrochloric acid.

See: Wild, p. 211.

*Methiodide.**

$$R_3N + CH_3I \rightarrow [R_3NCH_3^+]I^-$$

Methiodide

Especially for tertiary amines.

From the amine with methyl iodide without solvent.

For directions and examples see: Linstead, p. 61; Shriner, p. 228; Vogel, p. 660; Wild, p. 232.

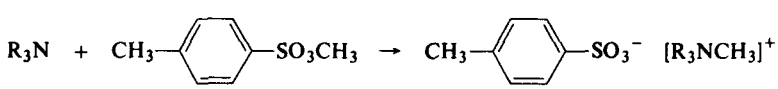
From the amine with methyl iodide in isopropyl ether.

See: Cheronis, p. 604.

From the amine with methyl iodide in ether or benzene.

See: Vogel, p. 660.

*Metho-p-toluenesulfonate (Methyl p-toluenesulfonate).**



Metho-*p*-toluenesulfonate

Especially for tertiary amines.

From the amine with methyl *p*-toluenesulfonate in isopropyl ether.

For directions and examples see: Cheronis, p. 604.

From the amine with methyl *p*-toluenesulfonate in benzene.

See: Linstead, p. 62; Shriner, p. 229; Vogel, p. 660; Wild, p. 233; C. S. Marvell, E. W. Scott and K. L. Amstutz, *J. Amer. Chem. Soc.*, **51**, 3638 (1929).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	**Methylamine**	−6			$0\ 699_4^{-11}$	28	80	30	75	113	207, 215	
2	**Dimethylamine**	7			$0\ 6804_4^0$		41	47	79	135	158	
3	**Ethylamine**	16 5 19			$0\ 7057_4^0$		71	58	63	106 135	165	
4	**Isopropylamine**	33		$1\ 377^{15}$	$0\ 691_4^{18}$			26		101		1-Naphthylurea, 200, 1-Naphthylthiourea, 143
5	**Ethyl methyl amine**	36									196	Chloroplatinate, 207, Hydrochloride, 126–30
6	***tert*-Butylamine**	46		$1\ 3794^{18}$	$0\ 7004^{15}$	101 2	134			120	198	Hydrochloride, 270–80
7	***n*-Propylamine**	49		$1\ 3901^{17}$	$0\ 714_4^{25}$		84	36	52	63	135	1-Naphthylurea, 196
8	**Isopropyl methyl amine**	50			$0\ 7026_4^{19}$					120	135	Phenylurea, 131
9	**Cyclopropylamine**	50		$1\ 421^{20}$	$0\ 824_4^{20}$		99	120 (*di*)			149	Hydrochloride, 100
10	**Ethyleneimine**	56			$0\ 832^{24}$				52		142	Oxalate, 115
11	**Diethylamine**	56		$1\ 3873^{18}$	$0\ 7108_4^{18}$		42	42	60	34	155	1-Naphthylthiourea, 108
12	**Allylamine**	58		$1\ 4194^{22}$	$0\ 7436_{20}^{20}$			39	64	98	140	
13	**DL-*sec*-*n*-Butylamine** (2-Aminobutane)	63		$1\ 395^{17}$	$0\ 718^{20}$		76	70	55	101	139 40	
14	***unsym*-Dimethylhydrazine**	63		$1\ 4075^{22}$	$0\ 7914^{22}$							Hydrochloride, 81–2, Oxalate, 142, Sulfate, 105
15	**Trimethyleneimine** (Azetidine)	63		$1\ 4287^{24}$	$0\ 8436^{20}$						166–7	Chloroplatinate, 203, Chloroaurate, 192
16	**Isobutylamine**	69		$1\ 3988^{17}$	$0\ 724_4^{25}$		57	53	78	82	150	
17	***n*-Butylamine**	77		1 401	$0\ 7401_4^{20}$					65	151	1-Naphthylurea, 149, 1-Naphthylthiourea, 108-9, Hydrochloride, 195
18	**2-Amino-2-methylbutane**	78			$0\ 756_4^0$						183	
19	**DL-*sec*-Butyl methyl amine**	78 9			$0\ 740^{15}$						78	Chloroplatinate, 151
20	**Ethyl propyl amine**	80 1		1 3966	$0\ 773^{24}$							Hydrochloride, 225, Chloroplatinate, 198, Chloroaurate, 86
21	***Sym*-Dimethylhydrazine**	81		$1\ 4209^{20}$	$0\ 8274_4^{20}$						147 50	Oxalate, 119, Hydrochloride, 168
22	**Cyclobutylamine**	82		$1\ 4363^{19}$	$0\ 8328_4^{20}$							Chloroplatinate, 210 5
23	**Di-isopropylamine**	84			$0\ 722^{22}$						140	N-Nitroso, 48, Chloroplatinate, 186 9, Hydrochloride, 216-7
24	**Pyrrolidine**	89		$1\ 4270^{15}$	$0\ 852^{22}$				123		112, yel, 163–4, red	
25	***n*-Butyl methyl amine**	90–1		$1\ 4018^{18}$	$0\ 7367_4^{15}$						111	Hydrochloride, 170, Chloroplatinate, 205
26	**5-Amino-1-pentene**	91–4										Chloroplatinate, 166, Chloroaurate, 195
27	**DL-2-Amino-*n*-pentane** (*sec*-*n*-Amylamine)	92			$0\ 7384_0^{20}$							Hydrochloride, 168, Oxalate, 226, 131 Chloroaurate, 82-3
28	**Isoamylamine**	96		$1\ 4096^{18}$	$0\ 751^{18}$					102	138	1-Naphthylurea, 132

*Derivative data given in order m.p., crystal color, solvent from which crystallized.

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfon amide	*p* Toluene sulfon-amide	Phenyl thiourea	Picrate	Miscellaneous
29	**D-2-Methyl-*n*-butyl-amine** (*active*-Amyl amine)	96			$0\ 7505^{25}_{4}$							$[\alpha]_D^{25}$ −5 86, Hydro-chloride, 176, Chloroplatinate, 240
30	**2-Methylpyrrolidine**	97 8			$0\ 84^{20}_{20}$						88 5 9 5	Oxalate, 178 9, Chloroplatinate, 172 3 (anh), 206-7, rapid htng Picrate of N-methyl deriv , 235
31	**3-Methylpyrrolidine**	103 5		$1\ 4480^{20}$	$0\ 8654^{0}_{4}$						106	Chloroplatinate, 194
32	***n*-Amylamine**	104			$0\ 7614^{20}_{4}$					69	139	2-Naphthylthiourea, 114
33	**2-(Methylamino)-*n*-pentane**	105			$0\ 947^{20}$						77 8	Chloroplatinate, 138
34	**Piperidine**	106		$1\ 4530^{20}$	$0\ 8606^{20}_{4}$		48	93 4	96	101	152	
35	**2-Aminodiethylether**	108 9		$1\ 4101^{20}$	$0\ 8512^{20}_{4}$						122	Picrolonate, 204
36	**Di-*n*-propylamine**	109 10		$1\ 4046^{20}$	$0\ 7384^{20}_{4}$			51		69	75	1-Naphthylurea, 93
37	**2,5-Dimethylpyrrolidine**	110 3		$1\ 4357^{15}$	$0\ 8185^{12}_{4}$						117 8	Hydrochloride, 188 90, Chloroplatinate, 225
38	**2,4-Dimethylpyrrolidine**	115 7		$1\ 4325^{20}$	$0\ 8297^{20}_{4}$						116 7	Chloroplatinate, 210
39	**1,2-Ethylenediamine**	116	8 5	$1\ 454^{26}$	$0\ 898^{25}_{4}$	172 (*dl*)	244 (*dl*)	168 (*dl*)	360 (*dl*)	102	233 (*dl*)	
40	**L-2-Methylpiperidine**	117	50 1								116 7	Hydrochloride, 190, Chloroplatinate, 194
41	**DL-2-Methylpiperidine**	118-9		$1\ 4464^{24}$	$0\ 8436^{24}_{4}$		45		55		164	Hydrochloride, 207, Oxalate, 125
42	**DL-1,2-Diaminopropane**	119-20			$0\ 878^{15}$	139 (*dl*)	192 (*dl*)				135 (*dl*)	
43	**Isohexylamine**	125			$0\ 758^{25}_{4}$						123 5	Hydrochloride, 220, Oxalate, 166, Chloroplatinate, 200
44	**DL-3-Methylpiperidine**	126		$1\ 446^{24}$	$0\ 845^{24}_{4}$						138 (*dl*)	Hydrochloride, 172, N-2,4-Dinitrophenyl deriv , 67
45	**2,6-Dimethylpiperidine**	127-8		$1\ 4366^{25}$	$0\ 816^{25}_{4}$		111	50			162 4	Chloroplatinate, 212
46	***n*-Hexylamine**	130	−19		$0\ 763^{25}_{4}$		40	96		77	126	
47	**3-Amino-*n*-hexane**	130										Hydrochloride, 227, Chloroplatinate, 190 200
48	**Morpholine**	130					75	118	147	136	146	
49	**Cyclohexylamine**	134		$1\ 4372^{20}$	$0\ 8191^{20}_{4}$	101	149	89		148		
50	**Trimethylenediamine** (1,3-Diaminopropane, 1,3-Propylenediamine)	136			$0\ 884^{25}_{4}$	1,3-*dl* 126, 107	1,3-*dl* 140 147	96	148		250	Chloroplatinate, 240
51	**2,2,6-Trimethyl-piperidine**	138 9									195 6	Hydrochloride, 236, Chloroaurate, 128
52	**Di-isobutylamine**	139	−77	$1\ 4093^{20}$	$0\ 745^{20}_{4}$	86		55, 57		113	121	
53	**4-Amino-*n*-heptane**	139 40			$0\ 767^{20}_{4}$							Hydrochloride, 246-7, Chloroplatinate, 235
54	**1,3-Diaminobutane**	141 2									240-5	Hydrochloride, 171 2
55	**2-Amino-*n*-heptane**	142		$1\ 4199^{19}$	$0\ 7665^{19}_{4}$							Hydrochloride, 133, Oxalate, 204-5, Chloroaurate, 63 4
56	***unsym*-Diethylethylene-diamine**	145			$0\ 827^{19}_{19}$					115 (*mono*), 211 (*dl*)		Chloroplatinate, 211
57	**Furfurylamine** (α-Furylmethylamine)	145 6									150	Oxalate, 145, With CO_2 from air → comp , 75, Hydro-chloride, 110

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
58	**Cyclohexyl methyl amine**	145 7					85-6				170	Hydrochloride, 193
59	**2-Ethylpiperidine** (α-Ethylpiperidine)	146 7			$0\ 8651^{0}_{0}$			64-5			133	Hydrochloride, 181, Chloroplatinate, 202
60	**2,2,4-Trimethyl-piperidine**	148			$0\ 832^{15}$							Chloroplatinate, 215, Methiodide, 266
61	***Sym*-Diethylethylene-diamine**	149 50										Hydrochloride, 260, Chloroplatinate, 223, Chloroaurate, 220
62	**4-Ethylpiperidine** (γ-Ethylpiperidine)	151		$1\ 4503^{25}$	$0\ 876^{0}$			74-5				Chloroplatinate, 173, Chloroaurate, 105
63	**3-Ethylpiperidine** (β-Ethylpiperidine)	153			$0\ 871^{16}_{4}$						63	Hydrochloride, 141, Chloroplatinate, 183
64	***n*-Heptylamine**	155	-23	$1\ 41954^{26}_{\alpha}$	$0\ 777^{20}$					75	121	1-Naphthylthiourea, 68 9
65	**Di-*n*-butylamine**	159								86	59	1 Naphthylthiourea, 123
66	**Tetramethylenediamine** (1,4-Diaminobutane, Putrescine)	159	27		$0\ 877^{25}_{4}$	137 (*dl*)	177 (*dl*)		224 (*dl*)		249-50 (*dl*)	
67	**DL-2-Hydroxy-*n*-propylamine** (Isopropanolamine)	163			$0\ 973^{18}$						142	Chloroplatinate, 195, Hydrochloride, 73
68	**Hexahydrobenzylamine**	163 5		$1\ 4646^{18}$	$0\ 87^{20}_{4}$		98, 107				184 6	Hydrochloride, 254
69	**Cyclohexyl ethyl amine**	164			$0\ 868^{0}_{0}$						133	Hydrochloride, 184
70	**2-Ethylcyclohexylamine**	170 1		$1\ 4682^{20}$	$0\ 8744^{20}_{4}$			121-2			190	Chloroplatinate, 239
71	**2-Aminoethyl alcohol** (Ethanolamine)	171		$1\ 4539^{20}$	$1\ 022^{20}_{4}$						160	1-Naphthylurea, 186
72	**3-Amino-2-hydroxy-pentane**	172			$0\ 906^{18}$							N-Chloroacetyl deriv , 52 60, Monooxalate, 166, Dioxalate, 204
73	**2-Aminopropyl alcohol**	173-6										Hydrochloride, 86, Chloroplatinate, 198 9
74	**2-Amino-3-hydroxy-pentane**	174		$1\ 4458$	$0\ 9289^{24}$							Chloroplatinate, 154, Picrolonate, 215
75	**2-Fluoroaniline**	176	-35 -29			80	113					Picrate of N,N-dimethyl deriv , 131
76	**Pentamethylenediamine** (1,5-Diaminopentane, Cadaverine)	178 80			$0\ 9174^{0}_{4}$		135 (*dl*)	119		148	237	
77	***n*-Octylamine**	180			$0\ 777^{20}$						112	1 Naphthylthiourea, 72
78	**5-Methyl-2-pyrazoline**	180					156				126	Phenylurea, 127
79	**Benzyl methyl amine**	181			$0\ 945^{18}_{15}$				95		117-8	Chloroplatinate, 197
80	**Aniline**	184		$1\ 5863^{20}$	$1\ 022^{20}_{4}$	114	160	112	103	54	180	
81	**Benzylamine**	184-5		$1\ 5401$	$0\ 9826^{19}_{4}$	65	105	88	116, 185	156	194	
82	**4-Fluoroaniline**	186	-1	$1\ 5195^{20}$	$1\ 1725^{20}_{4}$	152	185					N-4-Nitrobenzoyl deriv , 181
83	**DL-α-Phenylethylamine** (α-Aminoethyl-benzene)	187, 185			$0\ 9395^{15}$	57	120					Hydrochloride, 158
84	**1,2-Diaminocyclohexane**	187				260 (*dl*)					210 5 (*dl*)	Hydrochloride, 280
85	**3-Fluoroaniline**	187-8, yel			$1\ 160^{16}$	84						
86	**Di-isoamylamine**	187-8	-44	$1\ 4229^{21}$	$0\ 7672^{21}_{4}$					72	94 5	1-Naphthylurea, 95, Methiodide, 221
87	**3-Aminopropyl alcohol**	188		$1\ 457^{26}$	$0\ 982^{26}_{4}$						222	Chloroplatinate, 199

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
88	**1,2,3-Triaminopropane**	190				200–2 (*tri*)	217–8 (*tri*)				>269	
89	**4-Amino-2,6-dimethylpiperidine**	195									220	Chloroplatinate, >250
90	**N-Methylaniline**	196		$1\ 573^{16}$	$0\ 989_4^{20}$	102	63	79	94	87	145	
91	**1-Phenylisopropylamine**	196–7		$1\ 5181^{25}$	$0\ 9424_0^{20}$		159					Oxalate, 131, Hydrochloride, 236
92	**β-Phenylethylamine** (β-Aminoethylbenzene)	198			$0\ 958_4^{24}$	51	116	69		135	174, 167	
93	**Benzyl ethyl amine**	199			$0\ 935_{15}^{17}$				50		118	Hydrochloride, 184
94	**2-Methylaniline** (*o*-Toluidine)	200		$1\ 5688^{20}$	$1\ 0053_{20}^{20}$	110–1	146	124	185 6	136	213	
95	***n*-Nonylamine**	201				34–5	49				111	
96	**3-Methylaniline** (*m*-Toluidine)	203		$1\ 5686^{20}$	$0\ 990_{25}^{25}$	65	125	95	171–2		200	
97	**Di-*n*-amylamine**	205								72		2-Naphthylthiourea 126, Hydrochloride, 275
98	**DL-2-Phenylisopropylamine**	205				64 initially, 93 on standing					143	Hydrochloride 145–7
99	**N-Ethylaniline**	205		$1\ 5559^{20}$	$0\ 9625_4^{20}$	54	60		87	89	132 138	
100	**4-Methylpyrazole**	207		$1\ 4920_{He}^{20}$	$1\ 015_4^{20}$						142	1-*o*-Nitrobenzoyl deriv , 107
101	**3-Methylbenzylamine** (*m*-Xylylamine)	207			$0\ 9654_0^{20}$	235–40	150				198, 156	Hydrochloride, 208 Chloroplatinate, 214
102	**2-Chloroaniline**	209 207		$1\ 5895^{20}$	$1\ 2125_4^{20}$	87	99	129	193, 105	156	134	
103	**N,2-Dimethylaniline** (N-Methyl-*o*-toluidine)	208			$0\ 973^{15}$	56	66				90	
104	**2-Methylbenzylamine** (*o*-Xylylamine)	208	−20	$1\ 5436^{19}$	$0\ 977_0^{19}$	69	88				215	Chloroplatinate, 220–3
105	**4-Methylbenzylamine** (*p*-Xylylamine)	208	13	$1\ 5364^{20}$	$0\ 952_0^{20}$	107–8	137				204	
106	**3-Methylpyrazole**	208		$1\ 497_{He}^{16}$	$1\ 020_4^{16}$	29 30					144	N-*o*-Nitrobenzoyl deriv , 120
107	**1-Phenylpropylamine**	208		$1\ 5173^{25}$	$0\ 9347_0^{25}$		115–6	81				Hydrochloride, 190
108	**2-Phenylpropylamine**	210					85				182	Hydrochloride, 123 4
109	**N,4-Dimethylaniline** (N-Methyl *p*-toluidine)	210				83		67			131	N-Nitroso deriv , 52, Hydrochloride, 119 5
110	**2-Ethylaniline**	210–11	46 6	$1\ 5584^{22}$	$0\ 9810^{20}$	111	147				194–5	
111	**L-Menthylamine**	212, 207				145	156			135	215	$[\alpha]_D^{19}$ −34 2
112	**2,5-Dimethylaniline** (*p*-2-Xylidine)	213 5, pa yel	14 2	$1\ 5591^{21}$	$0\ 9735^{20}$	139	140	138	232–3, 119	148	171	
113	**1-Phenylisobutylamine**	214		$1\ 5123^{20}$	$0\ 920_0^{20}$						166–8	Oxalate, 120–2, Hydrochloride, 275 7
114	**3-Methylpyridazine**	215			$1\ 0486_{26}^{26}$						143–4	
115	**2,6-Dimethylaniline** (*m*-2-Xylidine)	215, 218	11 2	$1\ 5610^{20}$	$0\ 9842^{20}$	177	168		212	204	180	
116	**4-Ethylaniline**	216, 214	−6	$1\ 5550^{20}$	$0\ 9690^{20}$	94	151		104			
117	**2,4-Dimethylaniline** (*m*-4-Xylidine)	217		$1\ 561^{20}$	$0\ 9783_4^{20}$	133, 130	192	130	181	152	209	
118	**2-Chloro-N-methylaniline**	218			$1\ 1735^{11}$						133	
119	**2,4-Dimethylbenzylamine**	218–9									223	Hydrochloride, 212, Chloroplatinate, 226

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfon amide	*p*-Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
120	**2-Amino-N,N-dimethyl-aniline**	219				72	51				138 40	
121	**3,5-Dimethylaniline** (*m*-5-Xylidine)	220	9 8	1 5581^{20}	0 9706^{20}	144, 140	144-5			153	200	N-Formyl deriv , 76
122	**N-Ethyl-3-methylaniline** (N-Ethyl-*m*-toluidine)	221, 215					72					Hydrochloride, 159, Chloroplatinate, 182
123	**3,5-Dimethylbenzyl-amine**	221		1 5305^{20}	0 950$^{20}_{0}$						225	Hydrochloride, 245, Chloroplatinate, 204
124	**2,3-Dimethylaniline** (*o*-3-Xylidine)	221-2	3 5	1 5684^{20}	0 9931^{20}	135	189				221	Hydrochloride, 254, N-Formyl deriv , 102
125	**1-Aminoindane** (1-Hydrindamine)	222					142 3				207	
126	**3-Phenylpropylamine**	222			0 976$^{25}_{4}$		57 8				152 3	Hydrochloride, 218
127	**2-Methyl-4,5,6,7-tetra-hydroindole**	222			0 987$^{10}_{4}$			86-91			141	Methiodide 195, Chloroplatinate, 187
128	**N-*n*-Propylaniline**	222			0 949^{18}	47		54		104		
129	**2-*n*-Propylaniline**	222-4				104-5	119				151	Hydrochloride, 173
130	**2-Chloro-4-methylaniline**	223				113	137					
131	**α-Amino-*n*-butylbenzene**	223			0 9367$^{20}_{0}$		128					Chloroplatinate, 184, Hydrochloride, 288
132	***trans*-9-Aminodecalin**	223	−25	1 492$^{20}_{He}$	0 939$^{20}_{4}$	183	148 9					N-Formyl deriv , 172
133	**γ-Amino-*n*-butylbenzene**	223		1 5152^{20}	0 9289$^{15}_{4}$		108, lgr					Hydrochloride, 144, Chloroplatinate, 220
134	**2-Methoxyaniline** (*o*-Anisidine)	225	5-6			85, 88	60, 84	89	127	136	200	N-Formyl deriv , 84
135	**4-Isopropylaniline** (*p*-Cumidine)	225			0 953$^{20}_{4}$	102	162					
136	**4-*n*-Propylaniline**	225				93-4	115					Hydrochloride, 203 4
137	**N-Isobutylaniline**	227			0 940$^{18}_{4}$				122 3			
138	**α-Methyl-α-phenyl-hydrazine**	227		1 5824^{20}		92	153	132				
139	**4-*tert*-Butylaniline**	228	17			173	140		179-80			N-Formyl deriv , 59 Hydrochloride, 270-4
140	***cis*-9-Aminodecalin**	228	−13 5	1 498$^{21}_{He}$	0 951$^{21}_{4}$	127	147					N-Formyl deriv , 165-6
141	**2-Ethoxyaniline** (*o*-Phenetidine)	229				79	104	102	164	137		
142	**2,4,6-Trimethylaniline** (Mesidine)	229, 232				216	204	137	167	193	189-91	
143	**2-Aminoindane** (2-Hydrindamine)	230				127	155				239	Hydrochloride, 241
144	**3-Chloroaniline**	230 236		1 5931^{20}	1 2225$^{15}_{15}$	72, 78	119-20	121	138, 210	124, 116	177	
145	**2,2'-Diaminodiethyl-sulfide**	231 3									212	Dihydrochloride, 131
146	**1,2,3,4-Tetrahydro-isoquinoline**	233		1 5798^{23}	1 064$^{23}_{4}$	46	129	154			200, 195	
147	**2-*tert*-Butylaniline**	233-5		1 5453^{20}	0 977^{15}	159-61						
148	**3-Amino-4-(dimethyl-amino)toluene**	234									151	Hydrochloride, 192 3
149	**4-Isobutylaniline**	235, pa yel				127			136-7			
150	**4-Aminoindane** (4-Hydrindamine)	236	−3			126	136					
151	**2-Aminoundecane** (2-Aminohendecane, *sec*-*n*-Undecylamine)	237				58					111	Hydrochloride, 84
152	***unsym*-Ethylphenyl-hydrazine**	237			1 018^{15}							Hydrochloride, 137, Reduces warm Fehling

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
153	***sym*-Ethylphenylhydrazine**	238 9		1 55[15]	1 004$^{15}_{15}$		100					Hydrochloride, 164, Oxalate, 167
154	**2-Bromo-4-methylaniline** (3-Bromo-*p*-toluidine)	240	26		1 51[20]	118	149					Hydrochloride, 221
155	**1-Aminoundecane** (1-Aminohendecane, *n*-Undecylamine, *n*-Hendecylamine)	240	15-6			48	60					Hydrochloride, 190
156	**4-Chloro-N-methylaniline**	240			1 169[11 5]	92-4					153	Nitrosamine, 51
157	**4-Chloro-2-methylaniline** (5-Chloro-*o*-toluidine)	241	29			140						
158	**2-Amino-*p*-cymene** (*p*-Cymidine)	241		1 543[19]	0 994[20]	71	102					Hydrochloride, 207
159	**N-Butylaniline**	241		1 5381[20]	0 9358$^{20}_{4}$		56		56			
160	**Phenylhydrazine**	243	19 23	1 6081[20]	1 0978$^{20}_{4}$	128 107 (*di*)	168, 177 (*di*)	148	151	172		
161	**α,α'-Diamino-*m*-xylene** (*m*-Xylylenediamine)	245 8				*di* 134 5, bz	N,N'-*di* 172				185-90	Dihydrobromide, 266
162	**2-Chloro-6-methoxyaniline** (3-Chloro-*o*-anisidine)	246 sl d				123	135					
163	**3-Ethoxyaniline** (*m*-Phenetidine)	248				97	103		157	138	158	
164	**4-Ethoxyaniline** (*p*-Phenetidine)	248, 254	2 3		1 065$^{16}_{4}$	137	173	143	106	136	69	
165	**1,2,3,4-Tetrahydroquinoline**	250	20	1 593[24]	1 054$^{24}_{4}$		75	67				
166	**2-Aminoacetophenone**	250 2d	20			76 7	98		148			Semicarbazone, 290, Oxime, 109, Hydrochloride, 168 d
167	**3-Bromoaniline**	251	18	1 626[20]	1 579$^{20}_{4}$	87	120 136			143	180	
168	**3-Methoxyaniline** (*m*-Anisidine)	251				81			68		169	Hydrochloride, 167 8
169	**3-Bromo-2-methylaniline** (6-Bromo-*o*-toluidine)	254				163	176-7					
170	**4-Amino-1,2,3,5-tetramethylbenzene** (Isoduridine)	255	23 4			215-7					200	
171	**Dicyclohexylamine**	255 sl d	abt 20	1 488[18]	0 925[18]	103	153				173	
172	**6-Methyl-1,2,3,4-tetrahydroisoquinoline**	256			1 0235$^{8}_{4}$						205	Hydrochloride, 195-7, Methiodide, 144 5, N-Nitroso deriv , 98
173	**4-Amino-N,N-diethylaniline**	261				104	172					
174	**4-*n*-Butylaniline**	261			0 945$^{20}_{4}$	105	126					Chloroplatinate, 200-2
175	**1-Amino-5,6,7,8-tetrahydronaphthalene**	261 3		1 5896[23]	1 0625[16]	158						Hydrochloride, 259 61
176	**7-Methyl-1,2,3,4-tetrahydroquinoline**	264					70-2				153-4	Hydrochloride, 175
177	**4-Methylindole**	267	5		1 062$^{20}_{4}$						194 5	
178	**2-Amino-4-chloro-N,N-dimethylaniline**	267 8				90					191	
179	**DL-3-Aminopropyleneglycol** (2,3-Dihydroxypropylamine)	268 part d		1 49[10]	1 175$^{20}_{4}$		O,N-*di* 109 O,O,N-*tri* 113					Chloroplatinate, 185, Picrolonate, 220, O,N-*di*-4-Nitrobenzoyl deriv , 139

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
180	**Diethanolamine** (Di-(2-hydroxyethyl)-amine)	270	28	1 4776^{20}	1 0966$^{20}_{4}$						110	Nitrate, 69, Chloroplatinate, 160
181	**3-(Dimethylamino) aniline**	272			0 995^{25}	87 69 (*di*)	163 4				187	N-Chloroacetyl deriv , 102
182	**1-(N,N-Diethylamino) naphthalene**	290		1 5961^{20}	1 015$^{20}_{20}$						152 4	1,3,5-Trinitrobenzene add comp , 95, scar
183	**1-(Methylamino) naphthalene**	294				94 5	121		164			
184	**Dibenzylamine**	300		1 5743^{22}	1 0256$^{22}_{4}$		112	68	159			Hydrochloride, 256
185	**α-Aminodiphenylmethane** (Benzhydrylamine)	303–4		1 5963$^{21.5}$	1 0635$^{21.5}_{0}$	146 7	172 167				205 6	N-Formyl deriv , 132
186	**1,2-Diphenylethylamine**	313			1 031^{15}						212 3	Oxalate, 158, Chloroplatinate, 188
187	**2,3-Diphenylpropylamine**	315 7				85 (*di*)						Hydrochloride, 188 90, Chloroaurate, 144 5
188	**2-(Methylamino) naphthalene**	317, 309				51	84	107	78		145	Hydrochloride, 182 3
189	**2-(N,N-Diethylamino) naphthalene**	320 2										1,3,5-Trinitrobenzene add comp , 116, blk , Hydrochloride, 177, Chloroplatinate, 95

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acetyl derivative)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	**3-Aminostyrene**	112 5[12]			1 0216$^{20}_{20}$	74 5	90, bz - lgr , 126, al -w					Polymerizes readily
2	**2-Bromo-4-ethoxyaniline** (3-Bromo-*p*-phenetidine)	160[23]				97						
3	**3-Aminothiophenol**	180-90[16]				N,S-*di* 97 *di*)						Hydrochloride, 232
4	**2-*n*-Butylaniline**	122 5[12]			0 953$^{20}_{4}$	100	116 7					Hydrochloride, 137
5	**2-(2-Aminophenyl)ethyl alcohol**	147 8[3 5]		1 5849[19]		103 5						Hydrochloride, 126
6	**6-Amino-3,4'-dimethylbiphenyl**	165 7[4]				104						Hydrochloride, 216-26
7	**2,2-Diphenylpropylamine**	179-82[22]			1 027[18]	106 7	82-3					Hydrochloride, 261
8	**2-Chloro-4-methoxyaniline** (3-Chloro-*p*-anisidine)	156[31]				114						Hydrochloride, 228
9	**2-Aminostyrene**	97 8[8]		1 6130[21]	1 015$^{21}_{21}$	129						Polymerizes readily
10	**2-Aminothiophene**	77 9[11]				161 2	172-3					Oxidizes rapidly, N-2-toluenesulfonyl deriv , 183 4
11	**4,4'-Diamino-2,3'-dimethylbiphenyl**	244[12]				N N'-*di* 253, *tetra* 191	N,N'-*di* 245					

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	**Di-*n*-heptylamine**	1	271						117-20	
2	**4-Aminostyrene**	23 5	98[4]	142	160-1					D_{21}^{21} 1 012 $n_D^{21.5}$ 1 625
3	**3-Bromo-4-methylaniline** (2-Bromo-*p*-toluidine)	25-6	254-7	117-8	132					
4	**2-Amino-3-methylpyridine** (2-Amino-β-picoline)	26	224	64	220				229	
5	**2-Aminothiophenol**	26	234	135 (N,S-*di*)	154 (N,S-*di*)					
6	***n*-Dodecylamine**	27-8	247-9				73			Hydrochloride, 98, Chloroplatinate, 215
7	**DL-2,6-Dimethyl-1,2,3,4-tetrahydroquinoline**	31-2	267		103-5					Hydrochloride, 180 3
8	**5-Bromo-2-methylaniline** (4-Bromo-*o*-toluidine)	32	253 part d	165						
9	**1-Amino-2-methylnaphthalene** (2-Methyl-1-naphthylamine)	32		188	180					
10	**2-Bromoaniline**	32	250	99	116			146 161	129	
11	**4,4'-Dimethyldibenzylamine** (*p*-Dixylylamine)	32 5	220[30]						153	Nitrosamine, 52, Hydrochloride, 272
12	**2-Aminodibenzyl**	33	173-83[11]	117	166				167-8	Hydrochloride, 198
13	**3-Iodoaniline**	33 27	145 6[15]	119	157		128			
14	***unsym* -Diphenylhydrazine**	34	220[40-50]	184	192					
15	**α,α -Diamino-1,4-dimethylbenzene** (*p*-Xylylenediamine)	35		194 (*tetra*)	193 (N,N'-*di*)				232	
16	**3-Bromo-5-methylaniline** (5-Bromo-*m*-toluidine)	36	255 60	171 2						
17	**4-Amino-N-methylaniline**	36	258	63	165				206	
18	**Pentadecylamine**	36, 33	300	72						Hydrochloride, 199
19	**N-Benzylaniline**	37	298	58	107	119	148-9	103	48	
20	**3-Iodo-4-methylaniline** (2-Iodo-*p*-toluidine)	37-8		130						Oxalate, 103
21	**5-Aminoindane** (5-Hydrindamine)	37-8	247-9[745]	106	137					
22	**2-Amino-5,6,7,8-tetrahydronaphthalene** (5,6,7,8-Tetrahydro-2-naphthylamine)	38	275-7[713]	107	167				204	
23	**2-Amino-5-bromonaphthalene** (5-Bromo-2-napthylamine)	38	207 10[16]	165	109				216	N-Benzal, 63
24	**2,2-Diphenylethylamine**	38	180[33]	88	144 5				212 3	Phenylurethane 191 2, Hydrochloride, 256-7
25	**2,3-Dimethyl-1,2,3,4-tetrahydroquinoline**	38-9			92				178	
26	**2-Iodo-4-methylaniline** (3-Iodo-*p*-toluidine)	40		133	161					Oxalate, 120, Hydrochloride, 188
27	**2-Chloro-4,6-dimethylaniline** (5-Chloro-*m*-4-xylidine)	40		205-6	148					2-Naphthylthiourea 154
28	**2-Amino-6-methylpyridine** (6-Amino-α-picoline)	41	208-9	90	90				202	Hydrochloride, 155, Chloroplatinate, 218
29	**4-Amino-N,N-dimethylaniline**	41, 53	262	132-3	228				188	
30	**1,6-Diaminohexane** (Hexamethylenediamine)	42	204-5	125-7 (*di*)	155 (*di*)	154 (*di*)			220	
31	**1,3-Diaminoisopropyl alcohol**	42	235						230	Hydrochloride, 185, Chloroplatinate, 240
32	**4-Amino-3-methylbiphenyl**	43	190[15]	165, 158	189					N-Benzal, 108
33	**2,4'-Diaminobiphenyl**	45	363	202 (*di*)	278 (*di*)					
34	**4-Methylaniline** (*p*-Toluidine)	45	200	147	158	120	118	141	182	
35	**4-Aminothiophenol**	46	140-5[16]	154 (N-), 144 (132) (N,S-*di*)	180 (N-)					Oxidized readily → 4,4 - diaminodiphenyl sulfide, 104 5

*Derivative data given in order m.p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
36	**4-Aminobenzyl cyanide**	46		97 (*mono*) 152-3 (*di*)	176-7				185	N-Formyl, 135
37	**2-Aminopropiophenone**	47	93[0.8]	71	130					Oxime, 88-9, Semicarbazone, 190, N-Propionyl, 51
38	**3-Bromo-4-ethoxyaniline** (2-Bromo-*p*-phenetidine)	47	189[20]	114					178 9	
39	**4-Amino-2-thiocresol**	47		95 (N-), 125 (N,S-*di*)						S-Me , 47
40	**2-Iodo-5-methylaniline** (4-Iodo-*m*-toluidine	48, 38		151, 146						N-Formyl, 129
41	**1-Amino-4-fluoronaphthalene** (4 Fluoro-1 naphthylamine)	48	162[16]		197					Hydrochloride, 280
42	**4-Aminodibenzyl**	48			170 1					Hydrochloride, 210, Chloroplatinate, 286-9
43	**3,4-Dimethylaniline** (*o*-4-Xylidine, 4-Amino-*o*-xylene)	49	224	99		118				N-Formyl, 52, Hydrochloride, 256
44	**2-Ethoxy-6-nitroaniline**	49, yel		64						N-Me , 59
45	**Heptadecylamine**	49	335-40	62	91					
46	**2-Aminobiphenyl**	49	299	121	102					N-Formyl, 75, N-Propionyl, 65
47	**4-Amino-2-methyldiphenylamine**	49 50	196[4]	139 40						Hydrochloride, 185 7
48	**2-Bromo-4,6-dimethylaniline** (5-Bromo-*m*-4-xylidine)	49 50		196 7	186				122	
49	**2,5-Dichloroaniline**	50	251	132	120				86	Hydrochloride, 191 2
50	**1-Aminooxindole**	50		186-7	189					
51	**1-Aminonaphthalene** (α-naphthylamine)	50		159	160	167	157, 147	165	163 181	
52	**1-Amino-1,2,3-triazole**	51			151				130	Hydrochloride, 114
53	**2-Amino-1-methylnaphthalene** (1-Methyl-2-naphthylamine)	51		188 9	222					
54	**1-Amino-3-methylnaphthalene** (3 Methyl-1 naphthylamine)	51-2		175 6	188 9					
55	**1-Amino-4-methylnaphthalene** (4 Methyl-1-naphthylamine)	51-2	176[12]	166 7	238-9					Hydrochloride, 233-4
56	**4-Chloro-2-methoxyaniline** (5-Chloro-*o*-anisidine)	52, 46	260	150					200	N-Formyl, 177 8, Hydrochloride, 238
57	**Indole**	52	253	157 8	68	254				N-Nitroso, 171
58	**2-Aminodiphenylmethane**	52	190[22]	135	116					Hydrochloride, 137
59	**2,2'-Ditolylamine** (Di-*o*-tolylamine)	52 3	318		114-5					
60	**4-Aminobiphenyl**	53	302	171, 120 (*di*)	230		255 160			N-Formyl, 172
61	**1,4-Bis-(methylamino)benzene** (sym-Dimethyl-*p*-phenylenediamine)	53	150[17]						186	N,N'-Dinitroso, 148
62	**Diphenylamine**	53-4		101	180	124	141	152	182	
63	**DL-α-Aminobenzyl cyanide**	55			159 60				160-1	
64	**4-Methoxy-3-nitroaniline** (2-Nitro-*p*-anisidine)	57, or		153						N-Chloroacetyl, 150, N,N-Di-Me , 46, red
65	**5-Bromo-2-ethoxyaniline** (4-Bromo-*o*-phenetidine)	57 53		133					135 7	
66	**2-Amino-5-bromobiphenyl**	57		130	162					
67	**4-Methoxyaniline** (*p*-Anisidine)	58	240	130, 127	154, 157	95	114	157, 171		
68	**1-Amino-7-methylnaphthalene** (7-Methyl-1-naphthylamine)	58-9	162[10]	182-3	204					
69	**4-Bromo-2-methylaniline** (5-Bromo-*o*-toluidine)	59	240	156-7	115					

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point C	Boiling point C	Acetamide	Benzamide	Benzene sulfon amide	*p* Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
70	**2-Amino-1 chloronaphthalene** (1 Chloro 2 naphthylamine)	59		147	98	131				N Formyl 136
71	**2 Aminoazobenzene**	59		126	122					
72	**1-Amino 2-chloronaphthalene** (2 Chloro 1 naphthylamine)	59 60		191 (*mono*) 88 (*di*)						
73	**5-Methylindole**	60	267						151	
74	**2-Aminopyridine**	60 58	204	71	165 (*di*)				216 7	
75	**3-(3 Indolyl)-propylamine**	60 4							146 9 156	Hydrochloride 170
76	**2-Methylindole**	61	271 2						139	1 3 5 Trinitrobenzene add comp 152 N Formyl 75
77	**2-Iodoaniline**	61 58		109	139				112	Hydrochloride 153 4
78	**1 Naphthyl phenyl amine** (N Phenyl 1 naphthylamine)	62	226[4]	115	157					
79	**3-Chloro-4 methoxyaniline** (2 Chloro *p* anisidine)	62		94					186	
80	**1-Amino-3 chloronaphthalene** (3 Chloro 1 naphthylamine)	62		197	162					Hydrochloride 219
81	**2-Amino-4,4 -dimethylbiphenyl**	62 3		118 9	95 6					
82	**8-Amino-6-methylquinoline**	62 4		91 2						1 3 5 Trinitrobenzene add comp 139
83	**2-Amino-1 bromonaphthalene** (1 Bromo 2 naphthylamine)	63		*mono* 140 *di* 105						N Propionyl 139 N Benzal 93 4 1 3 5 Trinitrobenzene add comp 192
84	**1,3-Diaminobenzene** (*m* Phenylene diamine)	63	282 4	191 (*di*) 87 9 (*mono*)	240 (*di*) 125 (*mono*)	194	172		184	
85	**2,4-Dichloroaniline**	63	245	145	117	128	126		106	
86	**2-Amino 5 methylnaphthalene** (5 Methyl 2 naphthylamine)	63 4		123 4	155 6					
87	**3-Bromo-4-methoxyaniline** (2 Bromo *p* anisidine)	64		111						Hydrochloride 255
88	**2,5-Diaminotoluene**	64	273 4	220 (*di*)	307	2 *mono* 147	2 *mono* 150			
89	**3-Aminopyridine**	64	250 2	*mono* 133 *di* 88	119					
90	**9-Aminofluorene**	64		262	260 1					Hydrochloride 255
91	**4-Methylphenylhydrazine** (*p* Tolylhydrazine)	65	240 4d	121	1 N *mono* 68 70 2 N *mono* 146					
92	**4-Aminobenzyl alcohol**	65		188 (O N *di*)	4 *mono* 150					Hydrochloride 217
93	**2-Bromo-6-methoxyaniline** (3 Bromo *o* anisidine)	65			90					Hydrochloride 225
94	**1,3-Diamino-2,6-dimethylbenzene** (2 4 Diamino *m* xylene)	65 6		>260 (*di*)	232 (227) (*di*)					N N Diformyl 220
95	**Aminoacetamide** (Glycineamide)	65 7								Hydrochloride 186 9 Chloroaurate 197 8 Hot $H_2O \rightarrow$ glycine + NH_3
96	**2-Aminocyclohexanol**	66	219							Hydrochloride 175 N Phenyl 150
97	**2-Amino-5-methylbenzophenone**	66 yel		159	118				145	
98	**4-Bromoaniline**	66	245	168	204	134		148	180	
99	**1,8-Diaminonaphthalene**	66		311 2 (*di*)			207 (*di*)			

*Derivative data given in order m p crystal color solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p* Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
100	**3-Amino-5-bromopyridine**	66–7	150[12]	76–8 (hyd) 127 (anh)					212–3	Chloroaurate, 185 7
101	**1-Amino-8-methylnaphthalene** (8-Methyl-1-naphthylamine)	67 8		183–4	195–6					
102	**4-Iodoaniline**	67–8		184	222			153		N 4-Nitrobenzoyl, 269 N-Benzal, 86
103	**1-Amino-2,4,5-trimethylbenzene** (Pseudocumidin)	68		162	167	136				
104	**2,2′-Diaminodibenzyl**	68		249 (*dl*)	255 (*dl*)				225 30	
105	**2-Amino-4-methylnaphthalene** (4-Methyl-2-naphthylamine)	68		172 3	194–5					
106	**3-Nitro-N-methylaniline**	68		95	105	83				
107	**1-Amino-3-bromonaphthalene** (3-Bromo-1-naphthylamine)	70		174	166					Hydrochloride, 247
108	**1-Amino-5-methyl-1,2,3-triazole**	70			158, 138 (*dl*)					N-Benzal, 67 8, Hydrochloride, 138
109	**8-Aminoquinoline**	70, 65, yel		103	98		154–6			Hydrochloride, 208 9
110	**2-Nitroaniline**	71, golden-yel		92, 94	98, 110	104	142		73	
111	**3,4-Diaminotriphenylmethane**	71 2		226 (*dl*)	243 (*dl*)					
112	**4-Chloroaniline**	72		179, 172	192	122	95, 119	152		
113	**8-Amino-6-Chloroquinoline**	73								Hydrochloride 208 Chloroplatinate, 212, Methiodide, 178
114	**4-Aminophenylurethane** (N-carbethoxy-1,4-diaminobenzene)	73–4		202, 181	230					Hydrochloride, 242
115	**4-Aminodiphenylamine**	75 (anh)		158	203					
116	**3,5-Dimethylindole**	75	278						180	
117	**Duridine** (3-Amino-1,2,4,5-tetramethylbenzene)	75	261	207						Hydrochloride, 260
118	**1-Amino-3,4,5-trimethylbenzene**	75	240	163 4						N-Formyl, 98
119	**2-Amino-1,4-dimethylnaphthalene** (1,4-Dimethyl-2-naphthylamine)	75	333	219–20						
120	**4-Nitromesidine** (2-Amino-4-nitromesitylene)	75		191	169	163				
121	**2-Methoxy-6-nitroaniline** (3-Nitro-*o*-anisidine)	76, yel		158–9						N-Me , 58, red
122	**2-Bromo-1,4-diaminobenzene** (2-Bromo-*p*-phenylenediamine)	76		200(*dl*)	235(*dl*)					
123	**4,6-Dimethyl-2-nitroaniline** (5-Nitro-*m*-4-xylidine)	76, 70		176, 173	185					
124	**1-Amino-5-methylnaphthalene** (5-Methyl-1-naphthylamine)	77–8		194–5	173–4				210 d	
125	**2,4,6-Trichloroaniline**	78	263	204, 206	174	152–4			83	
126	**4-Methyl-3-nitroaniline** (2-Nitro-*p*-toluidine)	78		148	172	160	164	171		
127	**2,4-Dibromoaniline**	79		146	134		134		124	
128	**1-Naphthyl 4-tolyl amine**	79		124	140					
129	**2-Aminodiphenylamine**	79–80		121 (2-N-)	136 (2-N-)					
130	**2,4-Diaminophenol** (4-Hydroxy-*m*-phenylenediamine)	79–80		220–2 (2,4-N-) 180–2 (*tri*)	253 (*dl*)				120	
131	**4-Aminopyrazole**	80–2			173 (*dl*)				193–4	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p*-Toluene sulfon-amide	Phenyl thiourea	Picrate	Miscellaneous
132	**4-Bromo-3-methylaniline** (6-Bromo-*m*-toluidine)	81	240	103-4						N,N-Di-Me , 55
133	**2,2'-Diaminodibenzyl sulfide**	81		209 (*di*)					203 4	N,N'-Diformyl, 163
134	**2,2'-Diaminobiphenyl**	81	162[4]	*mono* 89, *di* 161	159 (2-N-) 190 (*di*)					N,N'-Diformyl, 137
135	**3-Aminoacenaphthene**	81		192 3, al	209, al				221	N-Formyl, 151, Alc, $FeCl_3$ → bl -vlt col
136	**2-Aminobenzyl alcohol**	82	270 80 part d	N-*mono* 114	O- 198-9				110	Hydrochloride, 108
137	**1-Amino-1,3,4-triazole**	82 3							194-5	Hydrochloride, 153, N-Formyl, 117, Chloroplatinate, 230
138	**4-Chloro-3-methylaniline** (6 Chloro-*m*-toluidine)	83		91	119					2-Naphthylthiourea, 158
139	**2,6-Dibromoaniline**	83-4	262-4	210					123-4	
140	**5-Chloro-2-methoxyaniline** (4-Chloro-*o*-anisidine)	84		104	77 8				194	
141	**4-Aminotriphenylmethane**	84, bz	248[12]	168	198					N,N-Di-Me , 132
142	**1-Amino-3-iodonaphthalene** (3-Iodo-1-naphthylamine)	84		207	174					
143	**4-Aminobutyrophenone**	84		142						Hydrochloride, 178
144	**4,4'-Diaminodiphenyl disulfide**	85, yel , 106		205 (*di*)						N,N'-Dicarbethoxy, 136-7
145	**7-Methylindole**	85	266		84				176	
146	**2-Amino-4-bromobenzaldehyde**	85								Oxime, 194, Phenylhydrazone, 215
147	**2,2'-Diaminodiphenyl sulfide**	85 6		160 (*di*)	162 3 (*di*)					
148	**4-Aminoveratrol** (3,4-Dimethoxyaniline)	85 6	174 6	133	177					Chloroplatinate, 227
149	**2-Aminophenanthrene**	85, pa yel		225	216					
150	**4-Aminobenzonitrile**	86		205	170				150	N-Formyl, 188-9, N-Propionyl, 169
151	**4-Iodo-2-methylaniline** (5-Iodo-*o*-toluidine)	87 92		170, 162	184				189	N-Benzal, 55, Phenylurethane, 232
152	**4-Aminoacenaphthene**	87		175 6	196				190-200	
153	**3-Aminoacetanilide**	87 9		191			241			
154	**3-Aminophenanthrene**	87 5		200-1	213					
155	**4-Amino-3-methyl-1-phenylpyrazole**	88	312	94 5 (hyd), 120(anh)	181				138	N-Formyl, 112 (anh), 81 (hyd), Chloroplatinate, 226
156	**2-Hydroxy-3-methylaniline** (3-Amino-*o*-cresol)	89		N-*mono* 78-9						N-Acetyl of Me eth , 100
157	**3,4-Diaminotoluene**	89 90	265	210 (*di*), 95 (3-N), 131 (4-N)	263-4 (*di*)	178-9 (*di*)	4-*mono* 140			
158	**2-Nitrophenylhydrazine**	90, red		140 1, *di* 57 8	166					N-Formyl, 177
159	**2,2'-Diaminodibenzyl disulfide**	90-1		202-5 (*di*)						N,N'-Dipropionyl, 190-1
160	**4-Chloro-1,3-diaminobenzene**	91		242 (*di*)	178 (*di*)		215			
161	**1-Amino-2,6-dimethylnaphthalene** (2,6-Dimethyl-1-naphthylamine)	91		211	219-20					
162	**1-Amino-4-mercaptonaphthalene** (4-Amino-1-thionaphthol)	91 3		N-*mono* 173						S-Me , 54
163	**2-Methyl-3-nitroaniline** (6-Nitro-*o*-toluidine)	92 97		158	168					
164	**2-Methyl-6-nitroaniline** (3-Nitro-*o*-toluidine)	92	305d	158	167					1-Naphthylthiourea, 171

*Derivative data given in order m p , crystal color, solvent from which crystallized

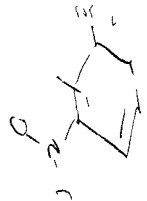


TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p*-Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
165	**3-Bromo-2-hydroxy-5-methylaniline** (3-Amino-5-bromo-*p*-cresol)	93		N-*mono* 129 *di* 169	N-*mono* 185 *di* 166	N-*mono* 157 *di* 230				
166	**4-Chloro-2,6-dibromoaniline**	93		226	194					
167	**2,2′-Diaminodiphenyl disulfide**	93		156 (*di*)					141 (*di*)	
168	**1,18-Diaminooctadecane**	93			150 (*di*)					Hydrochloride >225
169	**4,4 -Diaminodiphenylmethane**	93	232[9]	236 (*di*) (228)						N,N -Dibenzal, 130
170	**3-Nitrophenylhydrazine**	93, yel		145 150 (*di*)	151 153 (*di*)					
171	**7-Aminoquinoline**	93 4 (anh), 73 (hyd)		167	189					Chloroplatinate, 225
172	**2-Aminodibenzfuran**	94		178 83 (*di*)	201					
173	**3-Aminoquinoline**	94 84		172 167					210	
174	**7-Amino-2,4-dimethylquinoline**	94 100	>300	212					215 7	
175	**Skatole** (3 Methylindole)	95	267	68					170 1	Hydrochloride, 167 8, N-Propionyl, 45
176	**2-Chloro-4,6-dibromoaniline**	95		227	192					
177	**4-Hydroxybenzylamine**	95								Hydrochloride, 195, N-Acetyl of Me ether, 96
178	**1-Amino-4,5-dimethyl-1,2,3-triazole**	95							124 5	Hydrochloride 131, Chloroplatinate, 215
179	**1-Amino-8-hydroxynaphthalene** (8 Hydroxy-1-naphthylamine 8 Amino-1-naphthol)	95–7		N-*mono* 181 N O *di* 118	N-*mono* 193, N,O-*di* 206		N *mono* 189		163 4	N-Formyl, 140 50
180	**5-Amino-2-methylpyridine** (5 Amino-α-picoline)	96		126	111				201	Dihydrochloride, 215 8
181	**4,4′-Diamino-3,3′-dimethyldiphenyl sulfide**	96		*di* 220	*di* 233				186 (*di*)	Dihydrochloride, 248–9
182	**6,6′-Diamino-3,3′-dimethyldiphenylmethane**	96		226 (*di*) 152 (*tetra*)					199	Dihydrochloride, 248 9
183	**N-Ethyl-4-nitroaniline**	96		119	98		107			
184	**2,4-Di-iodoaniline**	96		141 171	181					
185	**1-Amino-8-nitronaphthalene** (8-Nitro-1-naphthylamine)	97, red		191		194				
186	**3-Aminobenzyl alcohol**	97		N *mono* 106–7	N-*mono* 115 N,O-*di* 113 4					
187	**5-Bromo-2-methoxyaniline** (4-Bromo-*o*-anisidine)	97–8		160	108					
188	**2-Amino-4-methylpyridine** (2-Amino-γ-picoline)	98		102–3	114, 182 3 (*di*)				227	
189	**2-Aminophenacyl alcohol**	98		N-*mono* 141	N,O-*di* 167					Phenylhydrazone, 198
190	**1-Amino-4-chloronaphthalene** (4-Chloro-1-naphthylamine)	98		186						
191	**1,2-Diaminonaphthalene**	98		234 (*di*)	291 (*di*)	1-*mono* 215				
192	**4-Amino-4′-methylbiphenyl**	99	190[18]	221						Hydrochloride, 280 3
193	**3-Aminoacetophenone**	99		128–9			130			Semicarbazone, 196
194	**2,4-Diaminotoluene**	99		N,N′-*di* 224	224 (*di*)	2-*mono* 138, 2,4-*di* 192	4-*mono* 160, 2,4-*di* 192–3			

*Derivative data given in order, m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p*-Toluene sulfon-amide	Phenyl thiourea	Picrate	Miscellaneous
195	**4-Amino-3,2′-dimethylazobenzene**	100, yel		185 (*mono*), 65 (75) (*di*), lgr						N-Chloroacetyl, 171-2
196	**1,2-Diaminobenzene** (*o*-Phenylene-diamine)	102	256-8	185 (*di*)	301 (*di*)	185	260 (*di*)		208	
197	**1-Amino-4-bromonaphthalene** (4-Bromo-1-naphthylamine)	102, 95		193						N-Formyl, 172, 1,3,5-Trinitrobenzene add comp, 196
198	**2-Naphthyl 4-tolyl amine**	103		85	139					
199	**3,4-Diaminobiphenyl**	103		3-*mono* 211 4-*mono* 155, 3,4-*di* 163	3-*mono* 186, 4-*mono* 221, 3,4-*di* 248					
200	**6,6′-Diamino-3,3′-dimethyl-diphenyl sulfide**	103-4		165 (*di*)	185 (*di*)				179 (*di*)	
201	**2-Amino-8-nitronaphthalene** (8-Nitro-2-naphthylamine)	104, red		196	162					
202	**Piperazine**	104	140	*mono* 52, *di* 144	*mono* 75, *di* 196	282 (*di*)	173		280	
203	**4,4′-Diaminodibenzyl sulfide**	104-5		188 (*di*)	224 (*di*)					
204	**3-Amino-4,4′-dimethylbiphenyl**	104-5		156-7	160 1					Hydrochloride, abt 230
205	**1,3-Diamino-4,6-dimethylbenzene** (4,6-Diamino-*m*-xylene)	105		1-*mono* 165, *di* 295	258 9 (*di*)		221 (*di*)			N,N -Diformyl 182 3
206	**2-Bromo-4-nitroaniline**	105, yel		129	160					N-Me, 118
207	**Triphenylmethylamine**	105		207-8	160-2					N-Benzyl, 110
208	**4-Aminophenanthrene**	105		190	224				216	
209	**2-Aminobenzophenone**	105-6, pa yel		72, 89	80					Oxime (alkali-stable), 156, (acid stable), 127; N Propionyl, 78
210	**3-Amino-6-phenylpyridine**	105-6		148-9	201					
211	**3-Amino-4-methylpyridine** (3-Amino-γ-picoline)	106	260	84	81				179 80	Chloroplatinate, 227, Hydrochloride, 180
212	**4-Bromophenylhydrazine**	106								Acetophenone deriv, 112
213	**4-Aminoacetophenone**	106	294	167	205	128	203			Semicarbazone, 250, Oxime, 148
214	**2,4-Diaminopyridine**	107			191-2 (*di*)					Chloroplatinate, 224
215	**9-Phenanthrylmethylamine**	107		182-5	167				241	N-Benzal, 104
216	**2-Methyl-5-nitroaniline** (4-Nitro-*o*-toluidine)	107		151		172				N-Formyl, 178 9, N-4-Nitrobenzoyl, 214
217	**2,5-Diaminopyridine**	107-10		290 (*di*)	230 (*di*)					
218	**2-Naphthyl phenyl amine**	108		93	148, 136					
219	**2-(4-Aminophenyl) ethyl alcohol**	108		105	O-*mono* 59-60, N,O-*di* 136	93				Hydrochloride, 171
220	**5-Aminoacenaphthene**	108		238 (*mono*), 122 (*di*)	210, 199				190 200	N-Formyl, 172, $FeCl_3$ → bl col
221	**4,4′-Diamino-2,2′-dimethylbiphenyl** (*m*-Tolidine)	108 9		281 (275) (*di*)					225	N,N′-Dibenzal, 172-3
222	**4-Aminoantipyrine** (4-Amino-2,3-dimethyl-1-phenylpyrazolone-5)	109, yel		199					144	
223	**3-Amino-4-methylbenzophenone**	109		108						Hydrobromide, 130, dil HBr
224	**2-Aminobenzamide**	109-11		177	214-5					
225	**1,4-Diamino-2-iodobenzene** (2-Iodo-*p*-phenylenediamine)	110 5		211	254					

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p* Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
226	**5-Aminoquinoline**	110	310	178			203 4			
227	**4-Amino-2-nitrostilbene**	110 1, dk red		192 3						Hydrochloride, 223
228	**3-Aminocamphor**	110 5		121	141				191	Oxime, 145, N-Formyl, 87
229	**4-Bromo-2-nitroaniline**	111, or		104	137-8					N-Me , 102, N-Et , 91
230	**3'-Amino-4-methylbenzophenone**	111		139						Oxime, 146, Hydrochloride, 198
231	**4-Amino-3-methylbenzophenone**	112, pa yel		175	158					N-Propionyl, 128
232	**2-Aminonaphthalene** (β-Naphthylamine)	112		132	162	102	133	129	195	
233	**β-Aminopropiophenone** (1-Aminoethyl phenyl ketone)	112 4 (unst)		90-1	104-5				164 5	Hydrochloride, 187, Chloroplatinate, 205
234	**2-Hydroxybenzylaniline**	113		93						Hydrochloride, 131, Chloroplatinate, 184
235	**4-Ethoxy-2-nitroaniline** (3-Nitro *p*-phenetidine)	113, 108, red		104		72	94			
236	**5-Bromo-2-hydroxy-3-methylaniline**	113		N-*mono* 119 *di* 200	N-*mono* 195					
237	**3-Nitroaniline**	114		*mono* 155, *di* 76	155, 150 (*di*)	136	138	160	143	
238	**6-Aminoquinoline**	114 (anh)		*mono* 138 *di* 75	169		193			Methiodide, 199
239	*cis*-**2,5-Dimethylpiperazine**	114	162		152 (*di*)		146-7 (*di*)			N,N'-Dinitroso, 95
240	**3-Amino-2-phenylquinoline**	115 6	223[3]	*mono* 124 *di* 173	179 80				194 5	Methiodide, 238, Ethiodide, 202
241	**5-Amino-3-methyl-1-phenylpyrazole**	116	333	110					160 2	Hydrochloride, 199 200
242	**4-Aminotriphenylcarbinol**	116		176						N,N-Dimethyl, 92-3
243	**5-Bromo-2-hydroxy-4-methylaniline**	116		N-*mono* 199, *di* 188	N-*mono* 223					
244	**4-Chloro-2-nitroaniline**	116-7, yel		104			110			
245	**4-Methyl-2-nitroaniline** (3-Nitro-*p*-toluidine)	117		99	148	102	146			Hydrochloride, 170 1
246	**5-Amino-2-methylquinoline** (5-Aminoquinaldine)	117 8 (anh), grnsh		205						N-Cinnamoyl, 257
247	*trans*-**2,5-Dimethylpiperazine**	118	162		228 9 (*di*)		225 (*di*)			N,N'-Dinitroso, 174
248	**2,3,4,6-Tetrabromoaniline**	118		228-9						1,3,5-Trinitrobenzene add comp , 108
249	**2-Methoxy-5-nitroaniline** (4-Nitro-*o*-anisidine)	118, or -red		175 6	160-1		128			N-Me , 87
250	**4-Hydroxypyrazole**	118			109 (*di*)				129	
251	**2-Amino-5,4'-dimethylazobenzene**	118-9, or -red		157	135					N-Carbethoxy, 94
252	**1-Amino-5-nitronaphthalene** (5-Nitro-1-naphthylamine)	119, red		220		183				N-Formyl, 199
253	**5-Hydroxy-2,4,6-tribromoaniline**	119		O,N,N-*tri* 136			146 7			
254	**1,4-Diaminonaphthalene**	120		303 (*di*)	*mono* 186, *di* 280		*mono* 187 8			
255	**1,9-Diaminofluorene**	120		293 (*di*)	abt 310 (*di*)				205	
256	**2-(ω-Aminoethyl)-indole** (2-(2-Indolyl)-ethylamine)	120			173 4					N-Benzal, 122
257	**2,2'-Diamino-4,4'-dimethylbiphenyl**	120		189 (*di*)	170 (*di*)					N,N'-Diformyl, 185

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
258	**2,6-Diaminopyridine**	121		203 (*di*)	176 (*di*)				240	
259	***cis*-4,4′-Diaminostilbene**	121, pa yel		172 (*di*)	253 (*di*)					
260	**4-Aminobenzhydrol**	121			145					Hydrochloride, 270 3
261	**3-Amino-6-hydroxyacetophenone**	121 110 yel		N-*mono* 165 *di* 174						Oxime, 201 Et eth , 60
262	**2-Aminotriphenylcarbinol**	121		192					122 3	
263	**3-Hydroxyaniline** (3-Amino-phenol)	122		*mono* 148 *di* 101	N-*mono* 174 198 204		157	156		
264	**2,4,6-Tribromoaniline**	122 119		232						N-Formyl 222
265	**4-Amino-2-hydroxyacetophenone**	122 3		N-*mono* 91						N,N-Di Me 120
266	**1-Aminoisoquinoline**	122 3							290 1	Hydrochloride, 233 Chloroplatinate, >300
267	**3,4,5-Tribromoaniline**	123		255 6	210					
268	**4,4′-Diamino-2,2 -dimethyl-diphenylmethane**	123		228 (*di*)					216	
269	***cis*-2,2′-Diaminostilbene**	123, 107, red		214-5 (*di*)					155-6	Hydrochloride 230
270	**2,4-Dimethyl-5-nitroaniline**	123		159	200	149	192			
271	**2-Amino-4-nitrobenzaldehyde**	124								Oxime, 193 Semicarbazone, 390 Anil, 147, red
272	**4-Aminobenzophenone**	124		153	152					N-Propionyl 139
273	**7-Amino-8-hydroxyquinoline**	124, br		N-*mono* 177					205	
274	**2-Amino-5-nitrobiphenyl**	125, yel		133			169			
275	**3-Hydroxy-4-methoxyaniline** (4-Aminoguaiacol)	125 7		N-*mono* 116 9	N,O-*di* 162 4					
276	**2-Amino-1-nitronaphthalene** (1-Nitro-2-naphthylamine)	126, or - yel		123	168	156	160			
277	**4-Aminoazobenzene**	126		146	211					N-propionyl, 170
278	**Hydrazobenzene**	126 7		*mono* 159, *di* 105	*mono* 126, bz *di* 162					
279	**5-Chloro-2-nitroaniline**	126 5 gold-yel		121						N-Me , 107 N,N-Di-Me , 49
280	**Benzidine**	127		317 (*di*) 199 (*mono*)	352 (*di*) 203 5 (*mono*)	232 (*di*)	243 (*di*)			
281	**2-Aminopyrimidine**	127 8							237-8	Chloroplatinate, 216 Hydrochloride, 196
282	**2-Amino-6-bromonaphthalene** (6 Bromo-2-naphthylamine)	128		192	218					
283	**5-Bromo-2-hydroxyaniline** (2-Amino-4-bromophenol)	128, 88		177 9						Me eth , 97 8
284	**5-Aminoisoquinoline**	128							>200	Methiodide, 228 Ethiodide, 216
285	**2-Aminovanillin** (2-Amino-4-hydroxy-3-methoxybenzaldehyde)	128 9		97						Oxime, 151 2, Phenylhydrazone, 165
286	**2-Amino-3,7-dimethylnaphthalene** (3 7-Dimethyl-2-naphthylamine)	129, 134		231						Hydrochloride, 275
287	**4-Methoxy-2-nitroaniline** (3-Nitro-*p*-anisidine)	129, 123, dk red		117, yel	140					N-4-Nitrobenzoyl, 204
288	**2-Aminotriphenylmethane**	129		154 5						N-Me , 130-2

*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p* Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
289	**2-Aminoquinoline**	129							255-6	Methiodide, 247, Ethiodide, 232, 1,3,5-Trinitrobenzene add comp , 186, red
290	**4,4'-Diamino-3,3'-dimethylbiphenyl** (*o*-Tolidine)	129		*mono* 103 (hyd), *di* 315 *tetra* 211	198 (*mono*), 265 (*di*)					N,N'-Diformyl, 254 1 Naphthylthiourea, 167, 3-Nitrophthalimide, 185
291	**2,4-Diaminodiphenylamine**	130		188 (*di*)	2-*mono* 213					
292	**3-Aminocoumarin**	130, yel		201 2	173					
293	**2-Methyl-4-nitroaniline** (5-Nitro-*o*-toluidine)	130		202		158	174			1-Naphthylthiourea 165
294	**2-Amino-4-chloropyridine**	130 1		115-6	*mono* 120; *di* 165				243	
295	**4-Hydroxy-3-nitroaniline**	131, 127, red		N-*mono* 157 8						N-Me , 113 Et eth , 40
296	**4-Bromo-3-nitroaniline**	131 2		146						N,N -Di-Me , 72
297	**2-Aminobenzothiazole**	132, 129		186	186				256	
298	**2-Amino-4-methylquinoline**	133	320						abt 250	N-Phenyl, 129, Chloroplatinate, 230
299	**2,2'-Diaminobenzophenone**	133, pa yel		168 (154) (*di*)					164	
300	**2,2'-Diaminoazobenzene**	134, red		271 (*di*)						
301	**3,5-Dimethyl-2-hydroxyaniline**	134-5		N-*mono* 96	154 (O,N-*di*)					N-Formyl, 68
302	**2-Hydroxy-5-methylaniline** (4-Hydroxy-*m*-toluidine)	135		N-*mono* 160, N,O-*di* 145	N-*mono* 191, N,O-*di* 190					N-Propionyl, 95 6, N,O-Dipropionyl, 91 2
303	**3-Methyl-4-nitroaniline** (6-Nitro-*m*-toluidine)	135		102						2-Naphthylthiourea, 159
304	**2-Amino-3-methylnaphthalene** (3-Methyl-2-naphthylamine)	135		181-2	190					
305	**2-Aminoacenaphthene**	135							260, yel , eth	Hydrochloride, 270
306	**DL-2,2'-Diamino-6,6'-dimethylbiphenyl**	136		205 (*di*)	182 (*di*)		162 3 (*di*)			
307	**1,4-Diamino-2-nitrobenzene** (2-Nitro-*p*-phenylenediamine)	137, blk		1-*mono* 162, 4-*mono* 189, *di* 186	4-*mono* 236					1,4-Di-4-nitrobenzoyl, >305
308	**9-Aminophenanthrene**	137 8, 104		207 8	199				190	
309	**4,4'-Diamino-3,3'-dimethoxybiphenyl** (Dianisidine)	137-8		242 (*di*)	236 (*di*)				225 (*di*)	
310	**3,5-Dimethyl-4-hydroxyaniline** (5-Amino-2-hydroxy-*m*-xylene)	137-8		160 (*di*)						Me eth , 66
311	**2,6-Dinitroaniline**	138		197						
312	**2-(4-Aminophenyl)-quinoline**	138		*mono* 189, *di* 154	234					Methiodide, 220, N-Me , 82, N-Formyl, 160
313	**2-Amino-3,6-dimethylnaphthalene** (3,6-Dimethyl-2-naphthylamine)	139		207						Hydrochloride, 283
314	**2-Methoxy-4-nitroaniline** (5-Nitro-*o*-anisidine)	139-40, pa yel		153-4	150	181	175, 170			
315	**4-Aminopropiophenone**	140		161	190					Oxime, 153
316	**4-Amino-3-nitrobenzophenone**	140, 135, yel			154 5					N,N-Di-Me , 116, N-Et , 100

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p*-Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
317	**2-Amino-4-methyldiphenylamine**	140			161					Hydrochloride, 200
318	**1,4-Diaminobenzene** (*p*-Phenylenediamine)	140, 147	267	*mono* 162 3 *di* 304	*mono* 128 *di* 300	247 (*di*)	266 (*di*)			3,5 Dinitrobenzoate, 178
319	**2-Hydroxy-5-nitroaniline**	142 3 (anh) 80–90 (hyd), or		220	>200		122 (O-)			Me eth 118 Et eth , 99
320	**2-Amino-4-nitrostilbene**	142 3, red		N-*mono* 220 yel , al						Hydrochloride, 219
321	**5-Amino-8-hydroxyquinoline**	143		N-*mono* 221 2, al , N,O-*di* 206 7, al	205 (O, N-*di*)					Me eth , 156, yel
322	**1-Amino-2-nitronaphthalene** (2-Nitro-1-naphthylamine)	144, red-yel		199	175					N-Et , 77, red
323	**2-Amino-5-nitronaphthalene** (5-Nitro-2-naphthylamine)	144, red		186	182					
324	**5-Hydroxy-2-methylaniline** (4-Hydroxy-*o*-toluidine)	144		N-*mono* 178 N,O-*di* 128		183 (N-)				
325	**2,5-Dimethyl-4-nitroaniline** (5-Nitro-*p*-2-xylidine)	144–5		168–9		162	185			
326	**4-Amino-4′-bromobiphenyl**	145		247			174			
327	**1-Aminophenanthrene**	146		220					204	
328	**3,5-Dihydroxyaniline** (5-Aminoresorcinol)	146–52		119 21 (*tri*)						Di Me eth , 46 Picrate of Di-Me eth , 167–70
329	**4-Amino-2-chlorobenzaldehyde**	147, yel		152						N,N′-Di-Me , 82, N-Et , 101
330	**4-Nitroaniline**	147 8, yel		215	199, 203 (*di*)	139	191		100	1-Naphthylthiourea, 187
331	**5-Amino-3-methyl-1,2,4-triazole**	148		>270	285 90				225	
332	**2,2′-Dihydroxyhydrazobenzene**	148			186 (*di*)					Di-Me eth , 102
333	**7-Amino-2-methylquinoline**	148 (anh)			172 3				213–4	
334	**4,4′-Diamino-2,2′-dimethyl azoxybenzene**	148, gold-yel		281 (*di*)	290					
335	**4-Bromo-3-hydroxyaniline**	150		210–2			135–6 (O-)			
336	**3-Amino-1-phenyl-1,2,4-triazole**	150		3-*mono* 168, 3,3-*di* 118					220	Hydrochloride, 187
337	**4-Aminochalcone** (4-Aminobenzalacetophenone)	151, golden		179						Oxime, 139
338	**4-Aminopyrimidine**	151–2		202					226	N-Me , 74–5, N-Phenyl, 142–3
339	**Pentamethylaniline**	151–2	277–8	213						N-Formyl, 217, N-Me , 60, N,N-Di-Me , 53–4
340	**N-Methyl-4-nitroaniline**	152		153	112	121				
341	**5-Bromo-2-nitroaniline**	152, red-yel		139						N-Me , 115, N-Et , 90
342	**3-Chloro-4-hydroxyaniline**	153		N-*mono* 144, *di* 124			116–7 (O-)			Me eth , 62

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	*p* Toluene sulfon-amide	Phenyl thiourea	Picrate	Miscellaneous
343	**4-Chloro-2-hydroxyaniline**	154		140 (*di*)						Hydrochloride, 226 7, Benzyl eth , 46 7 Me eth , 52
344	**4-Aminoquinoline** (γ-Amino-quinoline)	154 (anh)		178					274	Methiodide, 224, Ethio-dide, 232
345	**3-Aminobenzopyrazole**	154		177 8 (*di*)	182 (*di*)					
346	**2,5-Dihydroxy-4-nitroaniline** (2-Amino-5 nitrohydroquinone)	154, red		*mono* 226 *di* 183 4						Di Me eth , 158
347	**4-Hydroxy-2-nitroaniline**	154, red		N-*mono* 218 N O-*di* 146						Me eth , 129 123
348	**3-Aminotriphenylcarbinol**	155		164						O,N,N-Trimethyl, 81
349	**L-2,2'-Diamino-6,6-dimethyl-biphenyl**	156		205 (*di*)	172 (*di*)					
350	**3,3'-Diaminoazobenzene**	156 140, or -yel		272 (*di*)	286 (*di*)					
351	**5-Amino-1-phenyl-1,2,4-triazole**	157							175	Chloroplatinate, 197
352	**4-Nitrophenylhydrazine**	157, or -red		205	193				119 20	
353	**4-Aminopyridine** (γ-Amino pyridine)	158		150 (anh)	202				215 6	
354	**4,4'-Diamino-3,3'-dimethyl-diphenylmethane**	158 9		224 (*di*) 119 (*tetra*)	215 (*di*)				192-3	
355	**2-Amino-8-nitroquinoline**	159		211	166				257	
356	**3-Amino-1,2,4-triazole**	159							231	Hydrochloride, 153
357	**2-Amino-4'-nitrobiphenyl**	159, or -red		199			163			
358	**3-Amino-2-methylquinoline**	159 60	270	165	161				235	N-Formyl, 163
359	**1-Amino-4-hydroxy-3-nitro-naphthalene** (4-Hydroxy-3-nitro-1-naphthylamine)	160, ma-roon		250, 238	330					
360	**2,4-Dihydroxy-5-nitroaniline**	160-1, red		N-*mono* 261 *tri* 176						Di-Me eth , 136 7
361	**1,3-Diamino-4-nitrobenzene** (4-Nitro-*m*-phenylenediamine)	161 157, yel red		1-*mono* 200 1,3-*di* 246	222 (*di*)		169 (*di*)			N,N,N',N'-Tetramethyl, 81
362	**3-Hydroxy-4-methylaniline** (2-Hydroxy-*p*-toluidine)	161		N-*mono* 225 *di* 132 3			111-2 (O-)			N-Chloroacetyl, 154 5
363	**2-Hydroxy-4-methylaniline** (3-Hydroxy-*p*-toluidine)	162		N-*mono* 171	N-*mono* 169, N,O-*di* 162					
364	**4-Aminoacetanilide**	162		304						
365	**3-Hydroxy-4-nitroaniline**	162, 158, or -yel		N-*mono* 221, N,O-*di* 149						Me eth , 169, 161
366	**2,4-Dimethyl-6-hydroxyaniline**	163		*mono* 186 7, *di* 87 8	N-*mono* 211, N,O-*di* 148 9					Me eth , 150
367	**2-Aminofluorenone**	163, vlt -red		227						Hydrazone, 209, N-Carbethoxy, 167 8
368	**1-(2-Aminoethyl)-4-hydroxybenzene** (4-(2-Aminoethyl)phenol, Tyramine)	164			N-*mono* 162, *di* 172				206	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
369	**4-Aminophenacyl alcohol**	165, yel		N-*mono* 176 7, O-*mono* 130 N,O-*di* 162	188 (O-)					Phenylhydrazone, 199
370	**3-Bromo-4-hydroxyaniline**	165 155, pa br		N-*mono* 157	N-*mono* 184 5, *di* 192					
371	**2,7-Diaminonaphthalene**	166		261 (*di*)	267 (*di*)				210 (*di*)	
372	**4-Amino-4′-iodobiphenyl**	166-7, 159 yel								N-Benzal, 209, N-Piperonylidine, 150 1, Hydrochloride, 295
373	**4-Amino-3-nitrobiphenyl**	167, red		132	143					N-Me , 112
374	**1,2-Diamino-4-hydroxybenzene** (3,4-Diaminophenol)	167-8		1,2-*di* 205 7	1,2-*di* 203 *tri* 225					
375	**4,4′-Diaminotriphenylcarbinol**	168 s h , 175 r h		4,4′-*di* 267						Me eth , 162
376	**4-Amino-2-phenylquinoline**	168		108, 117 (*di*)	182					Methiodide, 274, Ethiodide, 244, N-Formyl, 275
377	**2,6-Dinitro-4-methylaniline**	168, 172		195	186					
378	**4-Amino-2-methylquinoline**	168	333						197 9	N-Phenyl, 150, Chloroplatinate, 223
379	**6-Aminocoumarin**	168-70, yel		216-7	173	159				N-Formyl, 175-6
380	**Picramic acid** (3,5-Dinitro-2-hydroxyaniline)	169, red		N-*mono* 201, O- 193	N-*mono* 300 O- 218		191			
381	**3,3 -Diaminobenzophenone**	173, yel		226-7 (*di*)						Oxime, 177-8
382	**4,5-Dimethyl-2-hydroxyaniline**	173 5		N-*mono* 191, N,O-*di* 157	N-*mono* 195 6, N,O-*di* 152 3					
383	**2-Hydroxyaniline**	174		*mono* 209 201, *di* 124	N-*mono* 165 O- 185	141	146			
384	**4-Hydroxy-3-methylaniline**	175		N-*mono* 179	N,O-*di* 194		109-10 (O-)			
385	**6-Amino-5,7-dimethylquinoline**	175	>300	212					182	
386	**4,4′-Diaminodiphenyl sulfone**	175-6		286 (*di*)						N,N′-Di-Me , 179-80, N,N-Tetramethyl, 260
387	***trans*-2,2′-Diaminostilbene**	176, 168, gold-yel		304 (*di*)					209	Hydrochloride, 267
388	**6-Amino-5-nitroquinoline**	178, 174, yel					168		270	
389	**6-Aminothymol**	178 9		N-*mono* 74, *tri* 91	N-*mono* 178-9, N,O-*di* 166 7					Oxid → thymoquinone, 45 5
390	**4-Hydroxy-2-methylaniline** (5-Hydroxy-*o*-toluidine)	179		N-*mono* 130	92 (O-)					Hydrochloride, 215
391	**2,4-Dinitroaniline**	180, 188		120	202, 220		219			
392	**1-Amino-4-chloroanthraquinone**	180, red		203-4						N,N-Di-Me , 172
393	**2,6-Dimethyl-4-hydroxyaniline**	181		178-80						N-Benzal, 104-5, N-Me , 43, N-Et , 161-2
394	**4-Amino-2,6-dimethylpyrimidine**	183							214	N-Phenyl, 104
395	**4-Aminobenzamide**	183, yel		275						N-Chloroacetyl, 241 3

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
396	**4-Hydroxyaniline** (4-Aminophenol)	184, 186		150 (*dl*), 168 (*mono*)	N-*mono* 216-7, N,O-*di* 234	125	N-*mono* 252-4, O- 142	150		3,5-Dinitrobenzoate, 178
397	**1-Amino-3-hydroxynaphthalene** (3-Hydroxy-1-naphthylamine)	185		N-*mono* 179	309 (O,N-*di*)		137 (O-)			
398	**5-Hydroxy-2-nitroaniline**	185 6, or		N-*mono* 266						Me eth , 131, br , Et eth , 105, yel
399	**6,6'-Diamino-3,3'-dimethyl triphenylmethane**	185-6	430, part d	217 (*dl*)	196 (*dl*)					
400	**4-Amino-2,6-dimethylpyridine**	186	246	113					194 5	Chloroplatinate, 250
401	**4-Amino-4'-hydroxyazobenzene**	186		N-*mono* 203 *dl* 236 7						N,N-Di-Me , 203
402	**4-Amino-4'-methylbenzophenone**	186 7		155						Phenylhydrazone, 163
403	**6-Amino-2-methylquinoline**	187-8		168 9						N-Cinnamoyl, 257
404	**4-Amino-2,6-diethyl-5-methylpyrimidine** (Cyanethine)	189	280 d	59						
405	**2,4,6-Trinitroaniline** (Picramide)	190		230	196	211				
406	**1-Amino-6-hydroxynaphthalene** (6-Hydroxy-1-naphthylamine)	190 185		N-*mono* 218, N,O-*di* 187	N-*mono* 152 N,O-*di* 223				170	
407	**4,4'-Diaminoazoxybenzene**	190, yel		275						Sn + HCl → 1,4-Diaminobenzene, 147
408	**4-Amino-3-nitrobenzaldehyde**	191, yel		155						Phenylhydrazone, 202, Oxime, 207 4-Nitrophenylhydrazone, 270-2
409	**2-Amino-1,5-dinitronaphthalene** (1,5-Dinitro-2 naphthylamine)	191		201			182			
410	**DL-2,2'-Diamino-1,1'-dinaphthyl**	193		235 6 (*dl*)	235 (*dl*)				185	
411	**8-Amino-6-nitroquinoline**	194, red		224						Chloroplatinate, 180, Methiodide, 176
412	**1-Amino-4-nitronaphthalene** (4-Nitro-1-naphthylamine)	195		190	224	173, 158	185			
413	**2-Amino-4,6-dimethylpyrimidine**	197							230	Hydrochloride, 181, Chloroplatinate, 225, N-Me , 98
414	**4,6-Diamino-2-methylquinoline**	197		6-*mono* 250						6-N-Cinnamoyl, 253-4, 4-N-Et , 195, 6-N-Et , 232
415	**1,2-Diamino-4-nitrobenzene** (4-Nitro-*o*-phenylenediamine)	198, red		1 *mono* 205 2 *mono* 195	235 (*dl*)					N,N'-Di-Me , 172
416	**2,4-Dinitrophenylhydrazine**	199 200		197 8	206-7					
417	**2-Hydroxy-5-methyl-4-nitroaniline**	200, yel		N-*mono* 242						Me eth , 132, N-Acetyl of Me eth , 156
418	**4-Amino-3-nitropyridine**	200, yel							197 8	Hydrochloride, 258-9, Chloroplatinate, 256
419	**4-Amino-4'-nitrobiphenyl**	200, red		264, 240, yel		174, yel				
420	**2-Amino-5-nitrobenzaldehyde**	200, yel		160-1			181-2			Oxime, 203 N,N-Di-Me 105, yel
421	**2-Amino-7-hydroxynaphthalene** (7-Hydroxy-2-naphthylamine)	201		N-*mono* 232, N,O-*di* 156	N-*mono* 243 6, N,O-*di* 181					
422	**2-Amino-1-bromo-3-methylanthraquinone**	202, 204			*dl* 243 4, pa yel , al					

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Acetamide	Benzamide	Benzene sulfon amide	*p*-Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
423	**4,4'-Diamino-1,1'-dinaphthyl**	202		363 (*di*)	320 (*di*)				147	
424	**4,4',4''-Triaminotriphenylmethane**	203		201 (*tri*)						1,3,5-Trinitrobenzene add comp , 140, blk
425	**Isatin**	204		141						Oxime, 201 2
426	**3-Amino-5-phenylacridine**	204		256	246					
427	**2-Amino-1,4-naphthoquinone**	204 5, or -red		202						N-Phenyl, 191
428	**1-Amino-2-methylanthraquinone**	205, red		*mono* 176 7, *di* 203-6			218			
429	**4,4',4''-Triaminotriphenylcarbinol** (Pararosaniline)	205		192 (*tri*)						Me eth , 135
430	**1-Amino-7-hydroxynaphthalene** (7-Hydroxy-1-naphthylamine)	205 7		N-*mono* 165	N-*mono* 208-9, N,O-*di* 208					
431	**4,6-Diaminoisophthaladehyde**	208		270 (*mono*), 280 (*di*)						Dioxime, 220, Diphenylhydrazone, 337
432	**N-4-Hydroxybenzylaniline**	208								Me eth , 65, Et eth , 65
433	**6-Aminobenzopyrazole**	210		248 (6-N-), 184-5 (*di*)						Dihydrochloride, 230
434	**4,4'-Diamino-2,5,2',5 -tetramethyltriphenylmethane**	210		217 (*di*)	250 (*di*)					
435	**3-Indolylpyruvic acid**	211, grey								4-Nitrophenylhydrazone, 153-4, Oxime, abt 175
436	**2-Amino-6-hydroxynaphthalene** (6-Hydroxy-2-naphthylamine)	212 3			N,O-*di* 228 30					Me eth , 78 Et eth , 91
437	**5-Amino-1,4-dihydroxyanthraquinone** (5-Aminoquinizarin)	212 3, br red								N-Phenyl, 223, Di-Me eth , 242-3
438	**2-Amino-4,5-dimethylpyrimidine**	214 5							250	Chloroplatinate, 227
439	**5-Bromo-4-hydroxy-2-methylaniline**	215, 205		171 2 (*di*)	229 (*di*)					
440	**4-Amino-4'-nitroazobenzene**	216 205		245						N-Me , 206 7, bl
441	**2-Hydroxy-6-nitroaniline**	216, red		N-*mono* 172			136 (O-)			Me eth , 76
442	**3,4-Diaminopyridine**	218 9			222 3 (*di*)				235-7	Chloroplatinate, 231
443	**1-Amino-5-chloroanthraquinone**	219, red		219	218					
444	**3,6-Dimethylcarbazole**	219		129					192	N-Nitroso, 106
445	**3-Aminothioxanthone**	221-2, yel -br		236 7						Hydrochloride, 230
446	**2-Amino-10-hydroxyphenanthrene**	221		182 (O, N-*di*)	225 (O, N-*di*)					
447	**5-Amino-4-nitroacenaphthene**	222, red		252	233					N-Formyl, 227
448	**5-Chloro-4-hydroxy-2-methylaniline**	223 5, 204 5		162 (*di*)	220 (*di*)					
449	**2,6-Dimethylcarbazole**	224							162	N-Nitroso, 113
450	**2-Amino-1,8-dinitronaphthalene** (1,8-Dinitro-2-naphthylamine)	226		238			221			
451	***trans*-4,4'-Diaminostilbene**	231, yel		353 (*di*)	352 (*di*)					
452	**2-Amino-3-hydroxynaphthalene** (3-Hydroxy-2-naphthylamine)	234		188 (O,N-*di*)	N-*mono* 233-5					
453	**1-Amino-2,4-dinitronaphthalene** (2,4-Dinitro-1-naphthylamine)	242		259	252		166			
454	**2,5-Dimethyl-4-hydroxyaniline**	242		177-9						Et eth , 69 70
455	**1-Amino-3-bromoanthraquinone**	243, red		214			227			
456	**4,4'-Diaminobenzophenone**	244		237 (*di*)						Phenylhydrazone, 240
457	**Carbazole**	246		69	98				185	
458	**1-Amino-2-hydroxyanthraquinone**	250, br		N-*mono* 170						Et eth , 182, red

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	*p*-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
459	**1-Aminoanthraquinone**	252, 243		218	255		228 9			
460	**3-Aminocarbazole**	254		3-*mono* 217, *di* 200, *tri* 175	3-*mono* 250					
461	**2,7-Diaminocarbazole**	260		320 (*di*)						N,N'-Dibenzal, 290
462	**1,8-Diaminoanthraquinone**	262, red		284 (*di*)	324 (*di*)					
463	**1,4-Diaminoanthraquinone**	268, vlt		271 (*di*)	284 (*di*), 280 (*mono*)					
464	**2-Amino-3-nitrofluorenone**	269, vlt		245 6						N-Carbethoxy, 204
465	**1,1'-Diamino-2,2'-dinaphthyl**	281		230 (*di*)	278 (*di*)					
466	**1,7-Diaminoanthraquinone**	290, red		283 (*di*)	325 (*di*)					
467	**2,7-Diaminofluorenone**	290, vlt		222 (*di*)					230 (*di*)	Oxime, 255, Phenylhydrazone, 230, 4-Nitrophenylhydrazone, 280
468	**1,6-Diaminoanthraquinone**	292, red		295 (*di*)	275 (*di*)					
469	**1-Amino-5-nitroanthraquinone**	293, red		275	237					N-Me, 250 2, vlt- blk, N-Et, 238
470	**1-Amino-4-nitroanthraquinone**	296, yel - red		256 8						N-Me, 250
471	**5,8-Diaminoquinizarin** (1,4-Diamino-5,8-dihydroxyanthraquinone)	>300, br -vlt		5,8-*di* 284		5,8-*di* 275				
472	**2-Aminoanthraquinone**	305 8, 302		*mono* 262, *di* 258	228	271	304			
473	**2-Amino-3-bromoanthraquinone**	307, or -yel		259 2J7	279					N-Benzal, 174
474	**2-Aminoquinizarin** (2-Amino-1,4-dihydroxyanthraquinone)	313 4, grn -yel								N-Phenyl, 255 6, N-4-Tolyl, 220
475	**1,5-Diaminoanthraquinone**	319, red		317 (*di*)	>350 (*di*)					
476	**2,7-Diaminoanthraquinone**	>330, or		>350	300 (*di*)					
477	**2,5-Dianilino-1,4-benzoquinone**	345, red-br								Anil, 203, Dianil, 240, red
478	**2,8-Diaminoacridone**	>350		>350 (*di*)	>250 (*di*)					N,N'-Dibenzal, 370

*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	Melting point, °C	n_D	Density g/ml	Methyl *p*-toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	**Trimethylamine**	3			$0\ 6709^{0}_{4}$		230	216, 225		*p*-Toluenesulfonate salt, 162
2	**Dimethyl ethyl amine**	37 5						193		Hydrochloride, 221
3	**N-Methylpyrrolidine**	78 80						221	233	
4	**Triethylamine**	89		$1\ 400^{20}$	$0\ 7255^{15}_{4}$			173		2,4-Dinitrobenzoate salt, 81 3, β-Resorcylic acid salt, 120
5	**1,2-Dimethylpyrrolidine**	96		$1\ 4252^{20}$	$0\ 7994^{20}_{4}$			235	223	
6	**1,3-Dimethylpyrrolidine**	96-7			$0\ 792^{15}_{4}$			dimorphous, 181 or 110-5	58 9	$HgCl_2$ add comp , 200
7	**Pyridine**	116		$1\ 5092^{21}$	$0\ 978^{25}_{4}$	139	117	167	241, 262 4	*p*-Toluenesulfonate salt, 160, Ethiodide, 91
8	**1,2,5-Trimethylpyrrolidine**	116		$1\ 4335^{9.2}_{\alpha}$	$0\ 815^{9}_{4}$		310	163		
9	**2-Dimethylaminodiethyl ether**	121		$1\ 406^{20}$	$0\ 806^{20}$		160 5	119-21		
10	**Dimethylaminoacetone**	123							176, s h	Oxime, 99
11	**1-Methylpyrazole**	127		$1\ 4787^{11}_{He}$	$0\ 993^{14}_{4}$		190	148	196 8	
12	**N-Ethylpiperidine**	128		$1\ 4416^{20}_{\alpha}$	$0\ 8237^{20}_{4}$			167 5	202	
13	**2-Methylpyridine** (α-Picoline)	129		$1\ 503^{17}$	$0\ 9497^{15}_{4}$	150	230	169	216, 195	*p*-Toluenesulfonate salt, 161, Ethiodide, 123
14	**β-Dimethylaminoethyl alcohol** (2-Dimethylaminoethyl alcohol)	135		$1\ 43^{20}$	$0\ 8866^{20}_{4}$			96 7		
15	**1,3-Dimethylpyrazole**	136		$1\ 467^{15}_{\alpha}$	$0\ 9628^{15}_{4}$		256	138		
16	**2-Methylpyrazine**	136-7			$1\ 029^{20}_{4}$		129 30	133		
17	**4-Methylpyrimidine**	141 2			$1\ 031^{16}_{16}$			131 4		$HgCl_2$ double salt, 198
18	**2,6-Dimethylpyridine** (2,6-Lutidine)	142 3					233	168	208	
19	**3-Methylpyridine** (β-Picoline)	143		$1\ 504^{24}$	$0\ 9515^{25}_{4}$			150	202	Styphnate, 154, Oxid → nicotinic acid, 228
20	**4-Methylpyridine** (γ-Picoline)	143		$1\ 506^{19}$	$0\ 957^{15}_{4}$			167	231	β-Resorcylic acid salt, 125
21	**4-Chloropyridine**	147 8							202	
22	**2-Ethylpyridine**	149			$0\ 9371^{17}$			187 9	165 7	
23	**3-Chloropyridine**	149						135	168	
24	**Tri-*n*-propylamine**	156 5		$1\ 4176^{20}$	$0\ 753^{20}_{4}$		207 8	116		Ethiodide, 238
25	**2,4-Dimethylpyridine** (2,4-Lutidine)	157, 159		$1\ 503^{14}$	$0\ 9273^{25}_{4}$			183	216	β-Resorcylic acid salt, 143
26	**2,5-Dimethylpyridine** (2,5-Lutidine)	160						169	192 4	
27	**1,3,4-Trimethylpyrazole**	160		$1\ 4866^{18}_{He}$	$0\ 956^{18}_{4}$			164		
28	**3-Ethylpyridine**	162-4			$0\ 954^{0}$			128-30	208-9, 196	
29	**β-Diethylaminoethyl alcohol** (2-Diethylaminoethyl alcohol)	163		$1\ 440^{25}$	$0\ 8601^{25}_{25}$					4-Nitrophenylurethane, 60
30	**Tropidine** (2-Tropene)	163		$1\ 4884^{19}_{\alpha}$	$0\ 953^{20}_{4}$		abt 300	285	217	
31	**2,3-Dimethylpyridine** (2,3-Lutidine)	164						188	195	
32	**3,4-Dimethylpyridine** (3,4-Lutidine)	164						163	205	
33	**4-Ethylpyridine**	164-5			$0\ 9417^{20}$			168	213	
34	**2,4,5-Triethylpyridine** (2,4,5-Collidine)	165-8						128-31	205	
35	**1,4-Bis-dimethylaminobutane**	167						199		
36	**Tropane**	167			$0\ 931^{20}_{4}$		>300	281	230	
37	**1-Diethylaminoisopropyl alcohol**	167 72			$0\ 8511^{20}_{0}$			89		
38	**2-Chloropyridine**	170, 166			$1\ 205^{15}$	120				
39	**3-Bromopyridine**	170		$1\ 5694^{20}$	$1\ 645^{9}_{4}$	156	165		175	
40	**3,5-Dimethylpyridine** (3,5-Lutidine)	170-1						245	255	

*Derivative data given in order. m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Methyl *p* toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
41	**2,4,6-Trimethylpyridine** (2,4,6-Collidine)	172			$0\ 917^{20}$			156	223	
42	**1,4,5-Triethylpyrazole**	176–7		$1\ 4848^{18}_{He}$	$0\ 9685^{18}_{4}$			175 6		
43	**2,3,6-Trimethylpyridine** (2,3,6-Collidine)	176 8						146	250 2	
44	**Benzyl dimethyl amine**	181						93	192	Picrolonate, 151
45	**2,3,5-Trimethylpyridine** (2,3,5-Collidine)	184						183, 179	227 8	
46	**N,N,2-Trimethylaniline** (N,N-Dimethyl *o*-toluidine)	185		$1\ 515^{20}$	$0\ 9286^{20}_{4}$			122, 116		1,3,5-Trinitrobenzene add comp , 113
47	**2,6-Dimethyl-4-ethylpyridine**	186			$0\ 916^{14}_{14}$			119-20	210	
48	**2,4-Diethylpyridine**	187-8			$0\ 9338^{0}$			98 100	170-1	
49	**3-Diethylaminopropyl alcohol**	190					175			
50	**Methyl 2-pyridyl ketone**	192					161	131	220	Oxime, 121 Phenylhydrazone, 155, Ethiodide, 205
51	**2,3,4-Trimethylpyridine** (2,3,4-Collidine)	192-3			$0\ 912^{15}$			163 4	259	
52	**N,N-Dimethylaniline**	193	2 2 5	$1\ 5582^{20}$	$0\ 9557^{20}_{4}$	161	228, 220	163	173	*p*-Toluenesulfonate salt, 133, 3,5-Dinitrobenzoate salt, 115
53	**2-Bromopyridine**	194			$1\ 657^{15}$	127				
54	**3-Ethyl-4-methylpyridine**	195 6			$0\ 9656^{0}$			148 50	234, 205	
55	**3,5-Dimethyl-2-ethylpyridine**	198						152	189	
56	**N,N,2,6-Tetramethylaniline** (N,N-Dimethyl-*m*-2-xylidine 2-Dimethylamino-*m*-xylene)	199-200		$1\ 513^{20}$	$0\ 912^{20}_{4}$					1,3,5-Trinitrobenzene add comp , 108
57	**N-Ethyl-N-methylaniline**	201			$0\ 919^{55}_{4}$		125	134 5		Hydrochloride, 114
58	**N,N,2,5-Tetramethylaniline** (N,N-Dimethyl-*p*-2-xylidine, 2-Dimethylamino-*p*-xylene)	204						158	196	
59	**N,N,2,4-Tetramethylaniline** (N,N Dimethyl-*m*-4-xylidine, 4-Dimethylamino-*m*-xylene)	205		$1\ 5201^{20}$	$0\ 9164^{20}_{4}$			123 4	219	1,3,5-Trinitrobenzene add comp , 114
60	**N,N-Diethyl-2-methylaniline** (N,N-Diethyl-*o*-toluidine)	206, 210					224	180		
61	**2-Chloro-N,N-dimethylaniline**	207					152	132		
62	**N,N,4-Trimethylaniline** (N,N-Dimethyl-*p*-toluidine)	210		$1\ 536^{20}$	$0\ 929^{20}_{4}$	85	219	129		1,3,5-Trinitrobenzene add comp , 124, vlt
63	**3,4-Diethylpyridine**	211						139	221	
64	**Tri-*n*-butylamine**	211, 216			$0\ 778^{20}_{20}$		180	106		*β*-Resorcylic acid salt, 121
65	**N,N,3-Trimethylaniline** (N,N-Dimethyl-*m*-toluidine)	212		$1\ 5492^{20}$	$0\ 941^{20}_{4}$		177			
66	**Methyl 4-pyridyl ketone**	212-4						130	205	Oxime, 142, Phenylhydrazone, 150, $HgCl_2$ double salt, 183-4
67	**N,N-Diethylaniline**	218, 216			$0\ 9351^{20}_{4}$		102	142		
68	**Methyl 3-pyridyl ketone**	220								Oxime, 133, Phenylhydrazone, 137, $HgCl_2$ double salt, 158
69	**N,N-Diethyl-4-methylaniline** (N,N-Diethyl-*p*-toluidine)	229			$0\ 924^{16}$		184			
70	**2,3,4,5-Tetramethylpyridine**	232 4						170 2	210	
71	**Quinoline**	239	−15 6	$1\ 6268^{20}$	$1\ 0929^{20}_{4}$	126	133	203	227, 218	*p*-Toluenesulfonate salt, 155, Ethiodide, 159, Styphnate, 207 8
72	**Isoquinoline**	243	26, 24	$1\ 615^{20}$, $1\ 622^{25}$	$1\ 0986^{20}_{4}$	163	159	222	263	Ethiodide, 148

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Methyl *p*-toluene sulfonate	Methiodide	Picrate	Chloro platinate	Miscellaneous
73	**DL-Nicotine** (DL-1-Methyl-2-(3-pyridyl)-pyrrolidine)	243			$1\ 008_4^{20}$		219	218	abt 280	
74	**2-Dimethylaminobenzaldehyde**	244, yel					164		205 6	Oxime, 87, *p*-Nitrophenylhydrazone, 191
75	**Tri-isoamylamine**	245, 237			$0\ 786_4^{20}$			125		
76	**N,N-Dipropylaniline**	245			$0\ 9104^{20}$		156	261		
77	**2-Ethylquinoline** (α-Ethylquinoline)	245-6		$1\ 598^{23}$	$1\ 050^{17}$		180	148	188	
78	**2-Methylquinoxaline**	245-7						215	>250	
79	**1-Methylindole**	247, 239			$1\ 0707^{0}$			150		
80	**2-Methylquinoline** (Quinaldine)	247		$1\ 6126^{20}$	$1\ 0585_4^{20}$	161, 134	195	191, 195	228	β-Resorcylic acid salt, 145 Ethiodide, 233
81	**8-Methylquinoline**	248		$1\ 616^{20}$	$1\ 072_4^{21}$			200		
82	**L-Nicotine** (L-1-Methyl-2-(3-pyridyl)-pyrrolidine)	248		$1\ 528^{20}$	$1\ 0097_4^{20}$			218	275	$[\alpha]_D^{20}$ −167-8
83	**1-Ethylisoquinoline**	250						207 10	200	
84	**2,4-Dimethyl-5,6,7,8-tetrahydroquinoline**	250	20	$1\ 5415^{20}$	$1\ 0043_4^{20}$		157	144		Hydrochloride, 195
86	**N-Methyl-2-pyridone**	255						145	141	Styphnate, 162
87	**4,6-Dimethylquinoline**	255 6, 280						236-7	238	
88	**3-Ethylisoquinoline**	257						171 2	180	
89	**Tri-*n*-amylamine** (Tri-*n*-pentylamine)	257, 245				80				
90	**3-Methylquinoline** (β-Methylquinoline)	257 9	16 7	$1\ 6171^{20}$	$1\ 0673_4^{20}$		221	187	249	Ethiodide 220
91	**6-Methylquinoline**	258		$1\ 6157^{20}$	$1\ 0654_4^{20}$	154	219, 216	229		
92	**3-Chloroquinoline** (β-Chloroquinoline)	258 60					276 subl	182	>300	
93	**3-Bromo-N,N-dimethylaniline**	259	11					135		
94	**5-Methylquinoline**	260					105	210 3		
95	**4-Methylquinoline** (γ-Methylquinoline)	261-3	-		$1\ 0862^{20}$		173 4	210-1	226 30	Ethiodide, 141 3
96	**2,4-Dimethylquinoline**	264-5			$1\ 061^{15}$		263 5	193-4	229	Ethiodide, 214
97	**2-Phenylpyridine**	268-9						175	204	
98	**6,8-Dimethylquinoline**	269			$1\ 066^{4}$			288-9	235	
99	**N,N-Di-*n*-butylaniline**	271				180		125		
100	**4-Ethylquinoline** (γ-Ethylquinoline)	272-4					149	178-80	204	
101	**N,N-Dimethyl-1-aminonaphthalene** (N,N-Dimethyl-α-naphthylamine)	273		$1\ 624^{15}$	$1\ 0446_{15}^{15}$			145		1,3,5-Trinitrobenzene add comp , 105 7
102	**5,8-Dimethylquinoline**	273 5	4 5		$1\ 07^{21}$			198	234	
103	**3-Bromoquinoline** (β-Bromoquinoline)	274 6	12					190		Oxalate, 107
104	**3,5-Dimethyl-1-phenylpyrazole**	275					190	103	186	
105	**6-Bromoquinoline**	278	19, 24				278	217		
106	**2,4,7-Trimethylquinoline**	280-1		$1\ 5973^{24}$	$1\ 0337^{20}$		322	232	272	
107	**4,7-Dimethylquinoline**	283						224	227	
108	**3,4-Dimethyl-1-phenylpyrazole**	285		$1\ 5724^{20}$	$1\ 0574_4^{20}$			122 5	180	
109	**8-Chloroquinoline**	288					165		235	
110	**2,3'-Bipyridyl**	289, 298						150, *di* 165-8		
111	**8-Bromoquinoline**	302-4					281		230	
112	**6-Methoxyquinoline**	305d	20, 28				236	305		
113	**N-Benzyl-N-methylaniline**	306		$1\ 601^{30}$	$1\ 0422_{26}^{26}$		164	127		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

2. Tertiary amines a) Liquids (b.p. at reduced pressure only)

2) (Listed in order of increasing m.p. of the corresponding picrate derivative)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Methyl *p*-toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	**N,N-Dimethyl-2-nitroaniline**	151 3^{30-3}, or -yel		1 6102				102 3		Hydrochloride, 174, 1,3,5-Trinitrobenzene add comp , 112
2	**2,6-Diethylpyridine**	71 3^{17}					142	115	211 2	
3	**2-Iodopyridine** (α-Iodopyridine)	93^{13}		$1\ 6366^{20}$	$1\ 9735_0^{40}$		207	120	210	
4	**1,3-Dimethyl-1,2,3,4-tetrahydroquinoline**	130 2^{17}					204	131		
5	**β,β-Diethylphenylhydrazine**	110 2^{14}						131		Reduces Fehling's and Tollen's reagent Zn + AcOH → aniline, b p 184 + diethylamine b p 56
6	**3-Dimethylaminobenzaldehyde**	138^{9}, yel					185 6	147	168 r h	Oxime, 75-6, Semicarbazone, 229 *p*-Nitrophenylhydrazone, 188
7	**4-Methyl-5,6,7,8-tetrahydroquinoline**	122^{11}					183	170		Hydrochloride, 203
8	**3-Methyl-5,6,7,8-tetrahydroquinoline**	126 7^{17}					162	171	219	
9	**3-Ethylquinoline** (β-Ethylquinoline)	135 8^{12}		$1\ 603^{18}$	$1\ 0508_4^{20}$		191	197		Hydrochloride, 173
10	**4-Bromopyridine** (γ-Bromopyridine)	27 5 $30^{0\ 3-0\ 5}$	0-1	$1\ 5679^{20}$				223		Decomposes to yel -br solid on standing

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

2. Tertiary amines b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Methyl *p*-toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	**Pyrimidine**	21	123 4			156		Chloroaurate, 226
2	**4,6-Dimethylpyrimidine**	25	160			12 34	103 4	
3	**2,8-Dimethylquinoline**	27	252		221	180		n_D 1 6022, Ethiodide, 229
4	**4-Bromoquinoline** (γ-Bromoquinoline)	29 30, 25	270d		265 70			
5	**Quinoxaline** (Benzopyrazine)	30	230		176			D_4^{48} 1 1334, n_D^{48} 1 6231, Oxalate, 169, Ethiodide, 146
6	**5-Methylpyrimidine**	30 5	154			141		$HgCl_2$ double salt, 246, Chloroaurate, 209
7	**4-Chloroquinoline** (γ-Chloroquinoline)	31	263			212	278	
8	**7-Chloroquinoline**	31-2	267-8		250		253	
9	**8-Iodoquinoline**	36			200		251	
10	**1,3,5-Trimethylpyrazole**	37	170			147	187 91	n_{He}^{68} 1 4589
11	**2-Chloroquinoline** (α-Chloroquinoline)	38	267			122		
12	**2,3-Dimethyl-5,6,7,8-tetrahydroquinoline**	38	125[14]		117	169		
13	**7-Methylquinoline**	39	252			237	223-4	
14	**4-Bromoisoquinoline**	40	280 5		233			
15	**6-Chloroquinoline**	41	262	143	248			Ethiodide, 168 9
16	**4-(Diethylamino)benzaldehyde**	41, yel						Oxime, 93, Semicarbazone, 214 Phenylhydrazone, 103, Anil, 108-9
17	**3-Nitropyridine**	41	216				254	Hydrochloride, 154
18	**2,4,8-Trimethylquinoline**	42	270		229	193		
19	**4-Chloro-2-methylquinoline** (4-Chloroquinaldine)	42 3			212	178		
20	**5-Chloroquinoline**	45	256		231, 172		255	
21	**2,6,8-Trimethylquinoline**	46	264 5			187-9	206-7	Hydrochloride, 207
22	**2-(Dimethylamino)naphthalene** (N,N-Dimethyl-β-naphthylamine)	47	305			206		
23	**2,4,5,8-Tetramethylquinoline**	48, pa yel	168-72[12]			161		Hydrochloride, 254
24	**5-Bromoquinoline**	48, 52	280		205			Hydrochloride, 225
25	**2-Bromoquinoline** (α-Bromoquinoline)	49			210			
26	**8-Methoxyquinoline**	50	283		160	143		
27	**7-Bromoquinoline**	52, 34	290		240, yel			Hydrochloride, 213
28	**2-Iodoquinoline** (α-Iodoquinoline)	52-3			211-2			Ethiodide, 220
29	**3-Iodopyridine** (β-Iodopyridine)	53, 50					211	Clinice cold $CHCl_3$ → chloride, 128 30, yel
30	**4,8-Dimethylquinoline**	54 5	258 9			216 7	226	
31	**2,3,8-Trimethylquinoline**	55-6	281			242 5		Hydrochloride, 260
32	**2,6-Dimethylquinoline**	60	266	175	236-7	186, 178		Styphnate, 200
33	**N,N-Dimethyl-3-nitroaniline**	60, red			205	119		
34	**3,4'-Bipyridyl**	62	297			215		
35	**2,4,6-Trimethylquinoline**	65 5 (anh), 39 5 (hyd)	281 2		245-7, 225	200-1		Hydrochloride, 268-72
36	**3,3'-Bipyridyl** (β,β-Bipyridyl)	68	291-2			232		
37	**2,3-Dimethylquinoline**	68 9	263		218	230 1	230	
38	**2,2'-Bipyridyl** (α,α'-Bipyridyl)	69				158		
39	**5-Nitroquinoline**	72 (anh)			215			Hydrochloride, 214
40	**N,N-Dibenzylaniline**	72, 70			135	131		
41	**2,2'-Bis-(dimethylamino)-biphenyl**	72-3			190-2			Hydroiodide, 256-7
42	**3,4-Dimethylquinoline**	73-4, 65	293		191	215, 205		Hydrochloride, 290
43	**8-Hydroxy-2-methylquinoline** (8-Hydroxyquinaldine)	74	266					Me eth, 125, b p 282
44	**4-Dimethylaminobenzaldehyde**	74						Semicarbazone, 222, *p*-Nitrophenylhydrazone, 182, 2,4-Dinitrophenylhydrazone, 325, Anil, 100, grn -yel
45	**8-Hydroxyquinoline**	75			143	204		Benzoate, 120, 1,3,5-Trinitrobenzene add comp, 124
46	**N,N-Dimethyl-4-aminophenol** (N,N-Dimethyl-4-hydroxyaniline)	76						Acetate, 78, Me eth, 49, *p*-Toluenesulfonyl, 130
47	**8-Bromoisoquinoline**	80 5			274			Nitrate, 193

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES
2. Tertiary amines b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Methyl *p*-toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
48	**3,4'-Biquinolyl**	83-4				244		Diethiodide, 198
49	**2,2'-Dipyridylamine**	84, 95 after resolidification	307-8			227-8	160	
50	**N,N-Dimethyl-4-nitrosoaniline** (4-Nitroso-N,N-dimethylaniline)	85				140		Hydrochloride, 177
51	**N,N-Dimethyl-3-aminophenol** (N,N-Dimethyl-3-hydroxyaniline)	85						Benzoate, 95, Me urethane, 87
52	**2,3,6-Trimethylquinoline**	86-7	285			212		
53	**6,6'-Dimethyl-2,2'-bipyridyl**	89-90				170 1		$HgCl_2$ add comp , 238
54	**4,4'-Bis-(dimethylamino)-diphenylmethane**	91	390		214 (*dl*)	185 (*mono*), 178 (*dl*)		1,3,5-Trinitrobenzene add comp , 114, vlt
55	**6-Iodoquinoline**	91			>300		265	Hydrochloride, 210
56	**Tribenzylamine**	91			184	190		Ethiodide, 190, β-Resorcylic acid salt, 141
57	**2,3,4-Trimethylquinoline**	92	285		260	216	215	Hydrochloride, 274
58	**4-Dimethylaminobenzophenone**	92			188-90			Anil, 151, Phenylhydrazone, 105
59	**N-Methyl-4-pyridone**	92-4 hyg					176 (anh)	$HgCl_2$ double salt, 177-80
60	**1,5-Dimethylbenzimidazole**	95	300			255		Hydrochloride, 215
61	**1-Phenylisoquinoline**	95-6	300			165	242	Hydrochloride, 235
62	**6-Bromo-2-methylquinoline** (6-Bromoquinaldine)	96 7			237			Ethiodide, 218
63	**4-Iodoquinoline** (γ-Iodoquinoline)	97			251		185	
64	**4,4'-Bis-(dimethylamino)-benzhydrol**	98, 102, grn			195 (*dl*)			Me eth , 71 2, 1,3,5-Trinitrobenzene add comp , 76
65	**5-Iodoquinoline**	100			245		263	
66	**4,4'-Bis-(dimethylamino)-triphenylmethane** (Leuco-malachite green)	102, bz , 93, al			231 (220) (*dl*)			1,3,5-Trinitrobenzene add comp , 89
67	**2,2'-Biquinolylmethane**	103			205	239, 210 (*dl*)		
68	**2-Hydroxypyridine** (α-Hydroxypyridine, α-Pyridone)	106-7	280-1					Benzoate, 42, $HgCl_2$ comp with Me eth , 200, $HgCl_2$ comp with Et eth , 141-2
69	**Acridine**	111			224	208		
70	**3,5-Dibromopyridine**	112	222	219	274			
71	**1,2-Dimethylbenzimidazole**	112 (anh), 65(hyd)	290		254	238		
72	**Antipyrine** (2,3-Dimethyl-1-phenyl-5-pyrazolone)	113	319			188		Salicylate, 92
73	**4,4'-Bipyridyl**	114 (anh), 73 (hyd)				257		Nitrate, 256
74	**4-Dimethylaminoazobenzene**	117, yel			174, al			Methochloride, 194
75	**Triphenylamine**	127	365					Hydrochloride, 214, Fuming HNO_3 in ac a → trinitro deriv , 280
76	**3-Hydroxypyridine** (β-Hydroxypyridine)	129						Oxalate, 177, Chloroplatinate of Et eth , 192
77	**Methyleneaminoacetonitrile**	129	210			127		Acid hydrolysis → glycine
78	**7-Nitroquinoline**	132 3			231-2			Ethiodide, 220
79	**6,8'-Biquinolyl**	148			126 (*mono*)	268		
80	**4-Hydroxypyridine** (γ-Hydroxypyridine)	149 (anh)						Acetate, 140 50, Benzoate, 81, Zn → pyridine, b p 116
81	**6-Nitroquinoline**	154, 149			245			Styphnate, 190, Hydrobromide, 245
82	**Quinuclidine**	158 (sealed tube)				275-6	238-40	Ethiodide, 270-1
83	**2,7'-Biquinolyl**	160			263	240		

*Derivative data given in order m p , crystal color, solvent from which crystallized

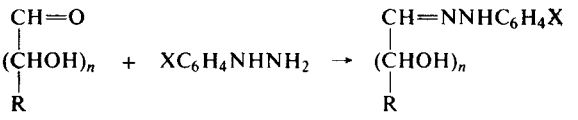
TABLE XVIII. ORGANIC DERIVATIVES OF AMINES
2. Tertiary amines b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Methyl *p*-toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
84	**2,2'-Biquinolyl ketone**	164				179		Oxime, 201, Phenylhydrazone, 199
85	**6-Hydroxypyrimidine**	164–5				190		Acetyl, 180, 215–20 after resolidification
86	**7,7'-Biquinolyl**	171–2			310 (*mono*)	300		
87	**4,4'-Bis-(dimethylamino) benzophenone** (Michler's ketone)	174			105	156		Oxime, 233
88	**5,5'-Biquinolyl**	175			272	>300		Hydrochloride, 292
89	**2,3'-Biquinolyl**	176			286		278	
90	**6,6'-Biquinolyl**	181			>290 (*dl*)			Diethiodide, 270
91	**6-Hydroxyquinoline**	193				236		1,3,5-Trinitrobenzene add comp, 193–5
92	**2,2'-Biquinolyl** (α,α'-Biquinolyl)	196				210, 215		
93	**3-Hydroxyquinoline** (β-Hydroxyquinoline)	198				240–5		
94	**1,2-Di(2-pyrrolyl)ethanedione** (2,2'-Bipyrroyl)	200, pa yel						*o*-Phenylenediamine → dipyrrylquinoxaline, 158, Monoxime, 147, Diphenylhydrazone, 146
95	**4-Hydroxyquinoline** (γ-Hydroxyquinoline)	201 (anh)						Hydrochloride, 187 (anh), $KMnO_4$ → kynuric acid, 200 (anh)
96	**6-Hydroxy-2-methylquinoline** (6-Hydroxyquinaldine)	213						Et eth, 71, Picrate of Et eth, 192, Ethiodide of Et eth, 182
97	**5-Hydroxyquinoline**	224			224		230	Hydrochloride, 240
98	**4-Hydroxy-2-methylquinoline** (4-Hydroxyquinaldine)	232 (anh)			201 (anh)	200	215	Me eth, 82
99	**7-Hydroxyquinoline**	235			251	244–5		Benzoate, 88–9
100	**5-Hydroxy-2-methylquinoline** (5-Hydroxyquinaldine)	246, 232–4						Picrate of Me eth, 217, Picrate of Et eth, 213, 206
101	**4,4'-Dipyridylamine**	273–5				235, 174	>280	Hydrochloride, > 300
102	**Hexamethylene tetramine**	280		205	190	179		Dil acid → formaldehyde, semicarbazone, 169

*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XIX

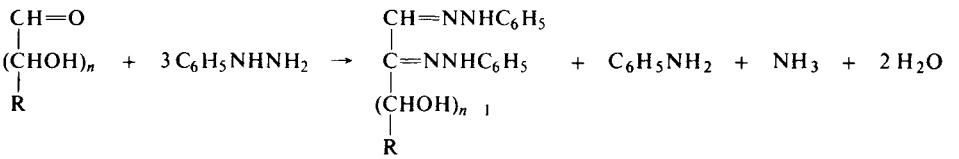
Substituted phenylhydrazones *



Substituted phenylhydrazone

From the carbohydrate and one equivalent of phenylhydrazine in aqueous acetic acid
For directions and examples see Cheronis, p 520, Wild, p 77
From the carbohydrate, phenylhydrazine hydrochloride and sodium acetate in water
See Wild, p 77
From the carbohydrate with *p*-nitrophenylhydrazine hydrochloride and sodium acetate in methanol
See Cheronis, p 523
From the carbohydrate and *p*-nitrophenylhydrazine in alcohol
See Vogel, p 456
From the carbohydrate and benzylphenylhydrazine in aqueous alcohol
See Shriner, p 77

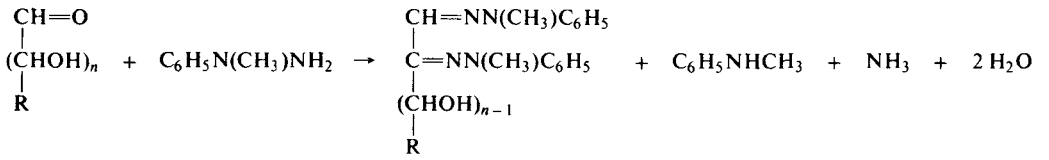
Phenylosazone *



Phenylosazone

From the carbohydrate and excess of phenylhydrazine in glacial acetic acid
For directions and examples see Cheronis, pp 523, 524
From the carbohydrate, excess of phenylhydrazine hydrochloride and sodium acetate in aqueous acetic acid
See Cheronis, pp 524, 525 Linstead p 38 Shriner, p 132 Vogel, p 455
From the carbohydrate and excess of phenylhydrazine in methyl cellosolve-glacial acetic acid mixture
See W T Haskins, R M Hann and C S Hudson, *J Amer Chem Soc*, **68**, 1766 (1946)

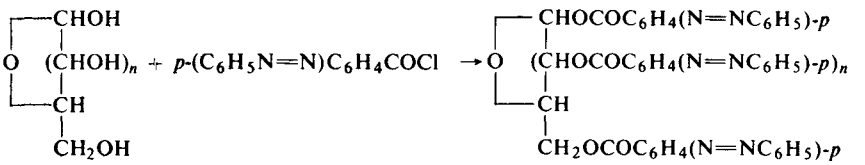
Methylphenylosazone



Methylphenylosazone

From the carbohydrate and *as*-methylphenylhydrazine in aqueous alcohol
For directions and examples see Vogel, p 456

p-Phenylazobenzoate (azoate) *



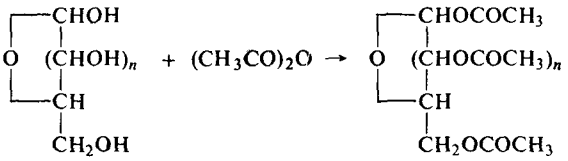
Azoyl chloride Carbohydrate azoate

From the carbohydrate and azoyl chloride (*p*-phenylazobenzoyl chloride) in anhydrous pyridine
For directions and examples see Cheronis, p 526, G H Coleman, A G Farnham and A Miller, *J Amer Chem Soc*, **64**, 1501 (1942), G H Coleman and C M McClosky, *J Amer Chem Soc*, **65**, 1588 (1943)

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE XIX (Continued)

Acetate



Carbohydrate acetate

From the carbohydrate, acetic anhydride and sodium acetate
For directions and examples see Linstead, p 39, Shriner, p 212, Vogel, p 451, Wild, p 78

Specific rotation

Specific rotation can be used as means for identification
For directions and examples see Cheronis, p 578, Wild, p 78

General references

C A Browne and F W Zerban, *Physical and Chemical Methods of Sugar Analysis*, 3rd edition, John Wiley and Sons, New York, 1941, J Stanek, M Carny, J Kocourek and J Pacak, *The Monosaccharides*, Academic Press, New York, 1963, pp 865 955, G R Pigman in *The Carbohydrates*, (Ed W Pigman), Academic Press, New York, 1957, pp 602 640

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

a) Liquids (Listed in order of increasing m.p. of the corresponding phenylosazone derivatives)*

No	Name	Melting point, °C	Specific rotation			Rf-Values in *n*-butanol-acetic acid-water (4 1 5)	Phenylosazone		Azoate (*p*-Phenyl-azobenzoate)		*p*-Nitro-phenyl-hydrazone	*p*-Bromo-phenyl-hydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc, Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{438}^{25}$, chl			
1	**DL-Methyl-tetrose**						140-2						Phenylbenzylhydra-zone, 99 100
2	**Apiose**		+3 8, +5 6	20 15	c = 3 4, water		156						*p*-Bromophenyl-osazone, 210 2
3	**DL-Gulose**						157 9						Phenylhydrazone, 143, *p*-Bromophenyl-osazone, 183
4	**L-Erythrose**		+11 5 → +15 2 → +30 5	24	c = 3, water		164						Benzylphenylhydra-zone, 105, $[\alpha]_D^{20}$ +32 8, c = 5, 95% al, Triacetyl, 134
5	**D-Erythrose**		−14 5	20	c = 11, water		164, 166	0 5, pyr - al					Benzylphenylhydra-zone, 105 6 $[\alpha]_D^{20}$ +32 8, c = 5, 95% al, *p*-Bromophenylosa-zone, 195 Phenyl-hydrazone, 116
6	**DL-Erythrose**						164, 166 8						Benzylphenylhydra-zone, 83
7	**DL-Erythrulose**						164						Methylphenylosazone, 158 9
8	**L-Erythrulose**		+12	20	water		164						*p*-Bromophenyl osazone, 195
9	**L-Idose**		+52 7	20	c = 6 2, water		168, 160						
10	**D-Gulose**		−20 4 → +61 6	20	water		168, 160	+6, c = 0 4, me al					Phenylhydrazone, 143 *p*-Bromophenyl osazone, 186 Benzylphenylhydra-zone, 124, $[\alpha]_D$ −24, c = 0 5, me al
11	**β-Methylglycer-aldehyde**						171						Benzylphenylhydra-zone, 116
12	**L-Methyltetrose**		−30 5 → −16 5	20	c = 9 47, 96% al		172-3						Benzylphenylhydra-zone, 96 7 Diethyl mercaptal, 109
13	**D-Rhamnose** (6-Desoxy-D-mannose)		−8 25	16 5	c = 10, water		185, 191	−95 2, pyr					*p*-Bromophenylosa-zone, 225, 222-3
14	**3-Amino-3-desoxy-D-glucose**		−61 → −78	18	water		207						N-Benzoyl, 128 30
15	**DL-Xylulose** (DL-Xylo-ketose)						210 5						Methylphenylosazone, 173

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Specific rotation			Rf-Values in *n*-butanol-acetic acid-water (4 1 5)	Phenylosazone		Azoate (*p*-Phenylazobenzoate)		*p*-Nitrophenylhydrazone	*p*-Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc, Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{6438}^{25}$, chl			
1	**1,3-Dihydroxyacetone**	65–71 (*monomer*), 80 (*dimer*)					132				156, 160		Phenylhydrazone, 115, Me phenylosazone, 127 130 Diacetate, 46 7 Dibenzoate, 120, Di-*p*-nitrobenzoate, 198, Oxime, 84
2	**β-Melibiose dihydrate** (6-[α-D-Galactosido]-D-glucose)	82–5	+111 7 → +129 5	20	c = 4, water		176–8	+43 2, pyr	280	+172			*p*-Bromophenylosazone, 181 2, Phenylhydrazone, 145 160 Oxime, 186, Octaacetate, 177 5, $[\alpha]_D^{20}$ +102 5
3	**D-Ribose**	87, 95	−21 5, −23 7	20	c = 4, water	0 31	164 160					170, ($[\alpha]_D^{20}$ −5 7, al)	*p*-Bromophenylosazone, 180 5, β-Me glucoside, 83 4, $[\alpha]_D^{20}$ −113 6
4	**L-Ribose**	87	+20 3 → +20 7	20	c = 4, water		166					164 5	Phenylhydrazone, 154 5
5	**2-Desoxy-D-ribose**	90	+2 88 → +2 13	23	water								Benzylphenylhydrazone, 127 9
6	**Glycollic aldehyde** (Glycoaldehyde)	95 7					179						*p*-Nitrophenylosazone, 311, Diphenylosazone, 207, Benzylphenylosazone, 198, Monoacetate, 157 8, Phenylhydrazone, 162
7	**D-Fructose**	102 4	−132 2 → −92 4	20	c = 4, water	0 23	210		125	−440	176, ($[\alpha]_D$ +16, pyr -al)		*o*-Nitrophenylhydrazone, 156 7 α-Me phenylosazone, 161 2, Pentaacetate α-form, 70, $[\alpha]_D^{20}$ +34 7, chl β-form, 108–9, $[\alpha]_D^{20}$ −120 5, chl
8	**Lactic aldehyde** (Lactaldehyde)	105					154, 145				128 9		Phenylhydrazone, 93
9	**α-L-Rhamnose** (6-Desoxy-L-mannose)	105, 93–4 (hyd)	−8 6 → +8 2	20	c = 4, water	0 37	222, 182	+94, pyr			186 191		*p*-Nitrophenylosazone, 208, 2-Naphthylhydrazone, 170, $[\alpha]_D$ +8 4, me al , Semicarbazone, 183, $[\alpha]_D^{20}$ +75 → +57, w
10	**L-Altrose**	105, 107–9	−32 3	20	water		165 178						Benzylphenylhydrazone, 148
11	**D-Altrose**	105	+32 6	20	c = 7 6, water		178						Benzylphenylhydrazone, 148–50
12	**2-Amino-2-desoxy-D-glucose** (Glucosamine)	105–10	+48, +44		water		210						Phenylurea, 210, N-Acetyl, 190, Oxime, 127, Semicarbazone, 165
13	**α-D-Lyxose**	106–7, 101	+5 5 → −14 0		c = 8, water		164				172	162, 156 7	Benzylphenylhydrazone, 116, 128, $[\alpha]_D^{20}$ +26 4, c = 4 9, abs al

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in *n*-butanol-acetic acid-water (4 1 5)	Phenylosazone		Azoate (*p*-Phenyl azobenzoate)		*p* Nitro phenyl-hydrazone	*p*-Bromo phenyl-hydrazone	Miscellaneous
			$[\alpha]_D$	T °C	Conc Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{643.8}^{25}$ chl			
14	**Raffinose** (2-[6-(α-D Galactosido)-α-D-glucoside] β-D-fructose)	118 9, (anh) 80 (hyd)	+123, +105 2	20	water c = 4, water	0 05			145	+146			Tritrityl, 130, α-Methylphenylhydrazone, 190, Emulsin → sucrose + galactose
15	**β-L-Rhamnose**	122 6	+9 1	20	water		222 185	+94 pyr			190 1, ($[\alpha]_D^{20}$ +21 4)		α-Methylphenylhydrazone, 124, *p*-Bromophenylosazone, 222
16	**D-Tagatose**	124	+1 0	22	c = 1, water		196 7 201						Diacetone deriv , 65 6, $[\alpha]_D^{20}$ +71 8, w
17	**D-Threose**	126 32	+29 → +19 6	22	water		164						Benzylphenylhydrazone, 194, bz , Acetone deriv , 84, Triacetate, 113 4, $[\alpha]_D^{20}$ +35 5, chl
18	**D-1-Amino-fructose**	127 8					210						
19	**β-D-Allose**	128	+0 58 → +14 41	20	c = 5, water		178, 174					145, ($[\alpha]_D^{20}$ −6 7, al)	
20	**β-L-Allose**	128 9	−1 9	20	water		165					141 5, ($[\alpha]_D^{20}$ +6 4, al)	
21	**D-Talose**	128 30	+30 → +20 6	21	water		201 197					205	Phenylhydrazone, 178, Benzylphenylhydrazone, 199
22	**DL-Xylose**	129 31					210 5						
23	**α-D-Mannose**	133	+29 3 → +14 2	20	c = 4 water	0 20	210				194 5, ($[\alpha]_D^{20}$ +56, pyr -al (1 1))	208 10	Phenylhydrazone, 199 200, $[\alpha]_D^{20}$ +26 3 → +33 8, pyr , α-Methylphenylhydrazone, 178, $[\alpha]_D$ +8 6, c = 0 5, me al , Benzylphenylhydrazone, 165
24	**β-D-Mannose**	132	−17 0 → +14 2	20	c = 4, water		210				194 5	208 10	Phenylhydrazone, 199 200, α-Methylphenylhydrazone, 178, $CaCl_2$ add comp , 101 2
25	**L-Mannose**	132	+14 0 → −14 0		water		208						Phenylhydrazone, 195, $[\alpha]_D$ +1 2, HCl
26	**DL-Mannose**	132 3					217 9						Phenylhydrazone, 195
27	**α-D-Manno-heptose**	134 5	+85 05 → +68 64	20	c = 11 water		200					207-8	Phenylhydrazone, 197, Hexaacetate, 106, 50% al , 139 40, eth
28	**DL-Glyceraldehyde** (*dimer*)	139, 142					132						*p*-Bromophenylosazone, 168, Dibenzoate, 231, Di-*p*-nitrobenzoate, 247, Semicarbazone, 160, 2,4-Dinitrophenylhydrazone, 166-7
29	**D-Isorhamnose** (6-Desoxy-D-glucose	139-40	+72 3 → 29 7	20	c = 10, water		185, 187 9						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf-Values in *n*-butanol-acetic acid water (4 1 5)	Phenylosazone		Azoate (*p*-Phenyl-azobenzoate)		*p*-Nitro phenyl hydrazone	*p* Bromo-phenyl-hydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc., Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{643s}^{25}$ chl			
30	**α-L-Glucose**	141 3	−95 5 → −51 4	20	c = 4, water		208						Diphenylhydrazone, 162
31	**L-Xylose**	144, 141 3	−79 3 → −18 6	20	c = 9 94, water		159 61						Tetraacetate, 126 (β-form)
32	**α-D-Xylose**	145, 143	+93 6 → +18 8	20	c = 4, water	0 28	164 155	−40 9, al	157	+244	155	128	Me phenylhydrazone, 108, Benzylphenyl-hydrazone, 95, $[\alpha]_D$ −33, c = 0 57, al 2-Naphthylhydra-zone, 124, $[\alpha]_D$ +18 6, me al
33	**D-Fucose** (6-Desoxy-D-galactose, D-Rhodeose)	145	+89 3 → +75 7	22	water		177						Methylphenylosazone, 181, Oxime, 188 9, $[\alpha]_D$ +13 2, w
34	**L-Fucose** (6-Desoxy-L-galactose, L-Rhodeose)	145	−152 6 → −75 9	20	c = 4 water	0 27	178				210 1	181 4	Phenylhydrazone, 170, α-Methylphenylhy-drazone, 174, $[\alpha]_D^{20}$ −17 0, pyr Oxime, 188 9, α-Me gluco-side, 158, $[\alpha]_D^{20}$ −197 5, w β-Me glucoside, 119, $[\alpha]_D^{20}$ +16 04, w
35	**α-D-Glucose**	146 (anh.), 83 (hyd.)	+112 2 → +52 7	20	c = 4, water	0 18	210	−1 5, c = 2, pyr -al (1 1)	266	+223	88, 196 ($[\alpha]_D$ +21 5, me al)	164 6, ($[\alpha]_D$ −43 6 → +18 9 c = 4, pyr)	2-Naphthylhydrazone, 178 *p*-Nitrophenyl-osazone, 257, 2,4-Dinitrophenylosa-zone, 256 7, α-Penta-acetate, 112
36	**2-Desoxy-D-glucose**	148	+46 6	18	water								Benzylphenylhydra-zone, 158 9
37	**β-D-Glucose**	148 50	+18 7 → +52 7	20	c = 4, water		210						*p*-Nitrophenylosa-zone, 257 2,4-Di-nitrophenylosazone, 256 7 β-Penta-acetate, 132
38	**Melezitose** (2-[3-(α-D-Glucosido)-D-fructosido]-α-D-glucose)	153-4 (+2 H_2O)	+88 2	20	c = 4, water				130 (sin-teres)	+188			
39	**Turanose** (3-[α-D-Glucosido]-D-fructose)	157 (anh.), 60 5 (hyd.)	+27 3 → +75 8	20	c = 4, water		215 20						Heptaacetate, 140 1, eth., $[\alpha]_D^{20}$ +37, chl
40	**β-D-Arabinose**	158-9	−175 → −105		c = 9 45, water	0 21	162 3, 160						Oxime, 136, Benzyl-phenylhydrazone, 173
41	**β-L-Arabinose**	160	+190 6 → +104 5	20	water		166		262	+755	186	155	Benzylphenylhydra-zone, 174, Me phenylhydrazone, 165, Oxime, 139, Tetraacetate, α-form 94 6, eth., β-form 86, w., Tetraben-zoate, 160 1, 173, Semicarbazone, 190, 163

*Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in *n*-butanol-acetic acid-water (4 1 5)	Phenylosazone		Azoate (*p*-Phenylazobenzoate)		*p*-Nitrophenylhydrazone	*p*-Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc, Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{4358}^{25}$, chl			
42	**β-D-Galacturonic acid**	160	(+55 3)	20	water							151 ($[\alpha]_D$ +11 5, me al)	Phenylhydrazone, 140, Brucine salt, 180
43	**β-Maltose** (4-[α-D-Glucosido]-β-D glucose)	160 5, 102 3 (+1 H_2O)	+111 7 → +130 4	20	c = 4, water	0 11	205-6		275	+2			Phenylhydrazone, 130, *p*-Nitrophenylosazone, 261, *p*-Bromophenylosazone, 198, 2-Naphthylhydrazone, 176, Octaacetate, 160 1, $[\alpha]_D^{20}$ +62 59, chl
44	**DL-Fucose** (6-Desoxy-DL-galactose, DL-Rhodeose)	161					187						Diacetone deriv, 41
45	**DL-Sorbose**	162 3				0 20	169 70						
46	**L-Galactose**	162-3	−120 → −73 6 →		c = 10, water		192 5						Phenylhydrazone, 158 60, $[\alpha]_D$ +21 6, w
47	**DL-Galactose**	163, 144					206						Phenylhydrazone, 158 60, α-Methylphenylhydrazone, 183
48	**β-D-Glucuronic acid**	163	+36 3	20	water						225		Semicarbazone, 188, Cinchonine salt, 204, $[\alpha]_D^{20}$ +139 9, w
49	**DL-Arabinose**	164					169					160	Diphenylhydrazone, 204, *p*-Bromophenylosazone, 200-2
50	**L-Sorbose**	165, 159 61	−43 7 → −43 4	20	c = 12, water	0 20	156, 168	−6, me al					*p*-Bromophenylosazone, 181 *o*-Nitrophenylosazone, 211 2, β-Me glucoside, 120-2, $[\alpha]_D^{20}$ −88 5, w, Pentaacetate, 97, $[\alpha]_D$ +2 9, chl
51	**D-Sorbose**	165	+42 9	20	c = 1, water		168, 160						β-Me glucoside, 119, $[\alpha]_D$ +88 5, w
52	**3-(β-D-Galactosido)-D-arabinose**	166-8	−50 3 → +63 1	19	water		242						Benzylphenylhydrazone, 223-5
53	**α-D-Galactose**	167	+150 7 → +80 2	20	c = 5, water	0 16	196, 201		276	+436	154, 197	168	α-Methylphenylhydrazone, 190-1, Benzylphenylhydrazone, 157, Diphenylhydrazone, 157, α-Pentaacetate, 95
54	**Stachyose** (α-Galactosyl 1→6′ α-galactosyl 1′→4 α-glucosyl 1→2′ β-fructoside)	167-70	+148	20	water								Tetradecaacetate, 95-6, $[\alpha]_D^{22}$ +120, al, Tetradeca-*p*-nitrobenzoate, 166
55	**Sucrose** (2-[α-D-Glucosido]-β-D-fructose)	169 70, me al, 185, w-al	+66 53	20	c = 26, water	0 14			125	+35			Nonreducing, Octaacetate, 72, 69, $[\alpha]_D^{20}$ +59 6, chl, Tritrityl, 128

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in *n*-butanol-acetic acid-water (4 1 5)	Phenylosazone		Azoate (*p*-Phenylazobenzoate)		*p*-Nitrophenylhydrazone	*p*-Bromophenylhydrazone	Miscellaneous
			$[\alpha]_D$	T, °C	Conc, Solvent		M P	$[\alpha]_D^T$ Solvent	M P	$[\alpha]_{435as}$, chl			
56	**D-Glucoheptulose**	171	+67 4	20	water		209-10						Hexaacetate, 112, $[\alpha]_D^{20}$ +87 0, α-Me glucoside, 138 40, $[\alpha]_D^{22}$ +108 5 w
57	**4-[β-D-Glucosido]-β-D-mannose**	176 (anh), 139 40 (hyd)	+15 1 → +10 7	16	water		198						
58	**α-L-Rhamnohexose**	180 1	−80 → −61 4	20	c = 9 67, water		200						Benzylphenylhydrazone, 183 4
59	**L-Ascorbic acid**	190, 187	+49	18	me al	0 38					262 (*dl*)	170 (*dl*)	Diphenylhydrazone, 187 Di-2,4 dinitrophenylhydrazone, 282
60	**Gentiobiose** (6-[β-D-Glucosido] D-glucose)	190-5 (anh), 86 (hyd)	+21 4 → +8 7	20	c = 5, water		163 4, 170, 179	−42 9^{20}, 95% al					Octaacetate (α) 188 9, $[\alpha]_D^{20}$ +52 3, chl, (β) 192 3, $[\alpha]_D^{20}$ −5 3, chl
61	**α-D-Glucoheptose**	193	−20	20	water		194-5						β-Me glucoheptoside, 169, $[\alpha]_D$ −75, w, Hexaacetate, 164 (α form), 135 (β-form)
62	**α,α-Trehalose** (1-[α-D-Glucosido]-α-D-glucose)	210 203 (anh) 97 (+2 H_2O)	+178 3	20	c = 7, water				134 5	+210			Nonreducing Octanitrate, 124 Octaacetate, 100 2, $[\alpha]_D^{20}$ +162, chl Hexaacetate, 93-6, $[\alpha]_D^{19}$ +158 3, chl
63	**Primeverose** (6-[β-D-Xylosido]-D-glucose)	210, 208	+24 1 → −3 3		c = 2 5, water		220						β-Heptaacetate, 216, $[\alpha]_D^{20}$ −23 5, chl
64	**Lactose** (4-[β-D-Galactosido]-D glucose)	α-form, 223 (anh), 201 (hyd), β-form, 252 (anh)	+90 → +55 3 (+52 3)	20	c = 4, water	0 09	200, 210-2						*p*-Nitrophenylosazone, 258, Octaacetate, 100 Benzylphenylhydrazone, 128, 2-Naphthylhydrazone, 203
			+35 → +55 3 (+52 3)	20	c = 4, water								
65	**β-Cellobiose** (4-[α-D-Glucosido]-β-D-glucose)	225	+14 2 → +34 6	20	c = 8, water		208 10, 198	−6 5^{20}, pyr-al (1 1)	273	+105			Phenylhydrazone, 90, Octaacetate, (α) 229 30, $[\alpha]_D^{20}$ +42, chl, Semicarbazone, 183 5, Octaacetate (β), 192, 202, $[\alpha]_D^{20}$ −14 5, chl, Oxime, 123 5
66	**6-[β-Cellobiosido]-α-D-glucose**	247-52 (anh), 200 (hyd)	+15 0 → +8 4		water		224						
67	**6-[-β-Lactosido]-α-D-glucose**	257	+34 7 → +22 6	24	water		233						

*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XX

Formation of amine by reduction *

$$RNO_2 + 6[H] \rightarrow \underset{\text{Amine}}{RNH_2} + 2\,H_2O$$

From the nitro compound and tin in hydrochloric acid

For directions and examples see Cheronis, p 625, Linstead, p 69, Shriner, p 262, Vogel, p 529, Wild, p 247

From catalytic hydrogenation (Raney nickel, platinum oxide and palladium on charcoal) of the nitro compound in ethanol, methanol or dioxane

See Cheronis, p 626, Linstead, p 70, N D Cheronis and M Koeck, *J Chem Ed*, **20**, 488 (1943), K Johnson and E F Degering, *J Amer Chem Soc*, **61**, 3194 (1939), S V Voris and P E Spoerri, *J Amer Chem Soc*, **60**, 935 (1938), E R Blout and D C Silverman, *J Amer Chem Soc*, **66**, 1442 (1944)

From the nitro compound and lithium aluminum hydride in ethers

See N G Gaylord, *Reduction with Complex Metal Hydrides*, Interscience, New York, 1956, pp 762–773

For partial reduction of polynitro compounds with sodium or ammonium polysulfide *see* Linstead, p 71, Vogel, p 551

NOTE For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitro compounds see explanations and references to Table XVIII, p 291, 292, 293, 294

Polynitro derivative *

$$ArNO_2 \xrightarrow{HNO_3} Ar(NO_2)_n \qquad n > 1$$

From the aromatic nitro compound with concentrated or fuming nitric acid and sulfuric acid

For directions and examples see Cheronis, pp 580, 627, Shriner, p 249, Vogel, pp 526, 527

From fuming nitric acid in acetic acid or acetic anhydride

See Wild, pp 24, 247, 248, J Reilly and W J Hickinbottom, *J Chem Soc*, **117**, 135 (1920), O L Brady and W H Gibson, *J Chem Soc*, **119**, 102 (1921)

Molecular compounds of aromatic polynitro compounds with aromatic hydrocarbons

$$Ar(NO_2)_n + Ar'H \rightarrow \underset{\substack{\text{Molecular}\\ \text{compound}}}{Ar(NO_2)_n \cdot Ar'H} \qquad n > 1$$

Molecular addition compounds are formed from the aromatic polynitro compound and aromatic hydrocarbons

For directions and examples see Table IV, p 32, 33, 34 Wild, p 248, T Asahina and C Shinomiya, *J Chem Soc Japan*, **59**, 341 (1938), O C Dermer and R B Smith, *J Amer Chem Soc*, **61**, 748 (1939)

Nitroaromatic acids from side-chain oxidation

$$Ar(NO_2)R \rightarrow \underset{\substack{\text{Nitroaromatic}\\ \text{acid}}}{Ar(NO_2)COOH}$$

From the alkylaromatic nitro compound and basic aqueous potassium permanganate

For directions and examples see Cheronis, p 627, Vogel, p 629

From the alkylaromatic nitro compound and sodium bichromate and sulfuric acid in water

See Cheronis, p 628, Vogel, p 629

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point °C	n_D	Density g/ml	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
						Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point, °C	Position of nitro groups	
						Boiling point, °C	Melting point, °C							
1	**Nitroethylene**	98 9			$1\ 073^{14}$	16 5			71	58	165			Polymerizes readily on contact with base
2	**Nitromethane**	101	−17	$1\ 3797^{25}$	$1\ 1297^{25}_{4}$	−6		28	80	30	207 215			
3	**Nitroethane**	114		$1\ 392^{20}$	$1\ 0497^{20}_{4}$	16 5			71	58	165			
4	**2-Nitropropane**	120		1 394	$1\ 024^{0}$	33			26					Phenylthiourea deriv of amine, 101, 1-Naphthylurea deriv of amine, 200
5	**3-Nitropropylene** (3 Nitropropene)	125 30			$1\ 051^{21}$	58				39	140			
6	**1-Nitropropane**	132		$1\ 4002^{24}$	$1\ 008^{24}_{4}$	49			84	36	135			
7	**DL-2-Nitrobutane**	140		1 4013	$0\ 9877^{0}$	63			76	70	139-40			
8	**2-Methyl-1-nitropropane**	140 1			0 987 ?	69			57	53	150			*p* Toluenesulfonamide deriv of amine, 78
9	**2-Methyl-2-nitrobutane**	150				78					183			
10	**DL-2-Nitropentane**	152 4				92								Hydrochloride of amine, 168, Oxalate, 226 131 Chloroaurate, 82 3
11	**1-Nitrobutane**	153		$1\ 4103^{20}$	$0\ 9710^{20}_{4}$	77					151			Phenylthiourea deriv of amine, 65, 1-Naphthylurea deriv of amine, 149
12	**1-Nitroisobutylene** (1-Nitroisobutene)	154-8			$1\ 052^{0}_{0}$	69			57	53	150			
13	**3-Methyl-1-nitrobutane**	164				96					138			Phenylthiourea deriv of amine, 102, 1-Naphthylurea deriv of amine, 132
14	**1-Nitropentane**	173		1 4175	$0\ 9525^{20}_{4}$	104					139			Phenylthiourea deriv of amine, 69, 2-Naphthylthiourea deriv of amine, 114
15	**2-Nitrohexane**	176			$0\ 9357^{20}_{0}$	116-8								
16	**1-Nitrohexane**	193		1 4234	$0\ 9396^{20}_{4}$	130			40	96	126			
17	**1-Nitroheptane**	193 5			$0\ 9476^{17}$	155					121			Phenylthiourea deriv of amine, 75
18	**2-Nitroheptane**	194 8			$0\ 9466^{0}$	142								Hydrochloride of amine, 133 Oxalate, 204 5, Chloroaurate, 63-4
19	**Nitrocyclohexane**	205 6	−34	$1\ 4612^{19}$	$1\ 068^{19}_{4}$	134		104	147					$SnCl_2 + HCl \rightarrow$ Cyclohexanone oxime 89 90
20	**1-Nitrooctane**	206 10 part d			$0\ 9346^{20}$	180					112			1 Naphthylthiourea deriv of amine, 72
21	**Nitrobenzene**	210 1		$1\ 553^{20}$	$1\ 20314^{20}_{4}$	184		114	160	112		90	1,3	
22	**2-Nitrotoluene**	222		$1\ 5474^{20}$	$1\ 1622^{19}_{15}$	200		110 11	146, 143	124	213	70 1	2,4	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

a) Liquids (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
						Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point, °C	Position of nitro groups	
						Boiling point, °C	Melting point, °C							
23	**1-Ethyl-2-nitrobenzene**	224		$1\ 5407^{19}$	$1\ 126^{24}$	210 11; 214		111-2	147		194 5			
24	**1,3-Dimethyl-2-nitrobenzene** (2-Nitro-*m*-xylene)	226	13		$1\ 112^{15}$	215 218		177	168		180	182	1,3,5	*p*-Toluenesulfonamide deriv of amine, 212
25	**Phenylnitromethane**	226d		$1\ 5323^{20}$	$1\ 1598_0^{20}$	184-5		60	105	88	194			
26	**3-Nitrotoluene**	233	16	$1\ 5470^{21}$	$1\ 1571_4^{20}$	203		65	125	95	200			Oxid → 3-nitrobenzoic acid, 140
27	**1,4-Dimethyl-2-nitrobenzene** (2-Nitro-*p*-xylene)	241 2			$1\ 132^{15}$	213-5		139	140	138	171	139	1,2,4	
28	**1-Ethyl-4-nitrobenzene**	241		$1\ 5458^{19}$	$1\ 124^{25}$	216 214		94	151			37	2,4,6	*p*-Toluenesulfonamide deriv of amine, 104
29	**1,3-Dimethyl-4-nitrobenzene** (4-Nitro-*m*-xylene)	246	2		$1\ 126^{17.5}$	217		133 130	192	129-30	209	182	1,3,5	
30	**1,2-Dimethyl-3-nitrobenzene** (3-Nitro-*o*-xylene)	250	15			221-2		135	189		221	82	1,2	
31	**2-Nitro-*p*-cymene**	264		$1\ 5309^{20}$	$1\ 0744_4^{20}$	241		71	102			54	2,6	
32	**2-Nitroanisole**	265	10	$1\ 5620^{20}$	$1\ 2540_4^{20}$	225	5-6	85 88	60 84	89	200	68	2,4,6	
33	**1-*tert*-Butyl-4-nitrobenzene**	267				230	17	169-70	134-6					Dil HNO_3 → 4-nitrobenzoic acid, 240
34	**2-Nitrophenetole**	268	5-6	$1\ 5425^{20}$	$1\ 1903^{15}$	229		79	104	102		86	2,4	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
1	**2-Methyl-2-nitropropane** (*tert*-Nitrobutane)	25 6	127	46			134		198			Phenylthiourea deriv of amine, 120
2	**4-Fluoro-1-nitrobenzene**	25–7		184 6		152	185					N-*p*-Nitrobenzamide deriv of amine, 181
3	**1-Nitro-2,3,6-trimethyl-benzene**	30		235		186						
4	**3,4-Dimethyl-1-nitro-benzene** (4-Nitro-*o*-xylene)	30		226	51, 47 8	99				82	1,2	N-Formyl deriv of amine, 52 N-Chloroacetyl, 109
5	**2-Chloro-1-nitrobenzene**	32		209		87	99	129	134	50 52	2,4	
6	**2,4-Dichloro-1-nitro-benzene**	33	258		63	143–6	115	128	106			N-Formyl deriv of amine, 154
7	**4-Bromo-3-nitrotoluene**	33		136[16]		121, 114						
8	**3-Nitrophenetole** (3-Ethoxy-1-nitro-benzene)	34		248		97	103		158			*p*-Toluenesulfonamide deriv of amine, 157
9	**2-Nitrobiphenyl**	37, 33			49–50	121	102					N-Formyl deriv of amine, 75
10	**6-Chloro-2-nitrotoluene**	37	238		245	157-9 136	173					Oxid → 6-chloro-2-nitro-benzoic acid, 161
11	**3-Iodo-1-nitrobenzene**	38, 35			33, 27	119	157					*p*-Toluenesulfonamide deriv of amine, 128
12	**3-Nitroanisole** (3-Methoxy-1-nitro benzene)	38	258	251		81			169	106	3,5	*p*-Toluenesulfonamide deriv of amine, 68
13	**4-Chloro-2-nitrotoluene**	38	240		21–2	139 40, 131						Oxid → 4-chloro-2-nitro-benzoic acid, 142
14	**5-Nitroindane**	40, yel	152[14]	250	37–8	106	137					
15	**2-Bromo-1-nitrobenzene**	43		250	32	99	116		129	72	1,3	
16	**4-Nitroindane**	44	139[10]	236	−3	126	136					
17	**Nitromesitylene**	44		232 3		216–7	204		189 91	86	*di*	*p*-Toluenesulfonamide deriv of amine, 167
18	**3-Chloro-1-nitro-benzene**	45		230		72, 78	119 20	121	177			
19	**2-Nitroazoxybenzene**	49, yel			98	156						
20	**2-Iodo-1-nitrobenzene**	49			61, 58	109	139		112			
21	**4-Nitrotoluene**	52	234	200	45	147	158	120	182	70	2,4	
22	**4-Chloro-1,3-dinitro-benzene** (1-Chloro-2,4-dinitrobenzene)	52			91	142 (*di*)	178 (*di*)			183	2,4,6	NaOH → 2,4-Dinitrophenol, 114, Hydrazine → 2,4-di-nitrophenylhydrazine, 199
23	**4-Nitroanisole** (4-Methoxy-1-nitro-benzene)	53		240	58	130, 127	154	95		89	2,4	
24	**2,5-Dichloro-1-nitro-benzene**	54			50, lgr	132	120			104	1,3	
25	**4-Iodo-3-nitrotoluene**	55			48, 38	151, 136						N-Formyl deriv of amine, 129, NaOH → 3-Nitro-*p*-cresol, 36–7
26	**3-Bromo-1-nitrobenzene**	56		251	18	87	120, 136		180	59	1,2	
27	**1-Nitronaphthalene**	57, 60			50	159	160	167	163, 181			
28	**β-Nitrostyrene**	58, yel	250–60d									Irradiation → dimer, 180–7
29	**1-Methyl-2-nitro-naphthalene**	58–9, yel			51	188–9	222					

*Derivative data given in order m p , crystal color, solvent from which crystallized.

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet-amide	Benz amide	Benzene sulfon-amide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
30	**4-Nitrophenetole** (1-Ethoxy-4-nitro-benzene)	60 58		248 254	3 4	137	173	143	69	86	2,4	
31	**3,4-Dinitrotoluene**	61		265	89 90	4 *mono* 131 2, *di* 210	3-*mono* 193 4 *di* 263 4	178 9 (*di*)				Oxid → 3,4-dinitrobenzoic acid, 165, 161
32	**3-Nitrobiphenyl**	61, 59			30	148						
33	**2,3-Dinitrotoluene**	63		255	63 4							$(NH_4)_2S$ → 2-Nitro-*m*-toluidine, 108, red HNO_3 → 2,3-Dinitrobenzoic acid, 201
34	**1-Methyl-8-nitro-naphthalene**	63 4			67 8	183-4	195 6					
35	**2,6-Dinitrotoluene**	66			105	202 3				80, 82	2,4,6	Oxid → 2,6 Dinitrobenzoic acid, 202 3
36	**2,4,6-Trinitroanisole** (1-Methoxy-2,4,6-trinitro-benzene)	68										Naphthalene adduct, 69-70, NH_3 in al → picramide, 188
37	**2,4-Dinitrotoluene**	70, 72		292	99	224 (*di*)	224 (*di*)	2 *mono* 138 *di* 191		80 82	2,4,6	Naphthalene adduct, 60, Oxid → 2,4-dinitrobenzoic acid 182-3 $SnCl_2$ + HCl → 4-Nitro-*o*-toluidine, 107 vel
38	**2-Nitroazobenzene**	71, or-red			59	126	122					
39	**1-Methyl-4-nitro-naphthalene**	71-2, pa yel			51 2	166 7	238 9					Dil HNO_3 → 4-nitro-1-naphthoic acid, 220-1
40	**4-Bromo-1,3-dinitro-benzene** (1-Bromo-2,4-dinitrobenzene)	75, 72										NaOH → 2,4-Dinitrophenol, 114 Al NH_3 → 2,4-dinitro-aniline, 180 188, yel Sn + HCl → 1,3-Diaminobenzene 63, Hydrazine → 2,4-dinitro-phenylhydrazine, 199
41	**3,5-Dimethyl-1-nitro-benzene**	75	273	220-1		144, 140						N-Formyl deriv of amine, 76 7
42	**4,5-Dimethyl-1,3-dinitrobenzene**	76										$(NH_4)_2S$ → 1-Amino-3,4-dimethyl-5-nitrobenzene, 75 Acetyl deriv of this, 209-10, Benzoyl deriv of this, 223-4
43	**5-Methyl-2-nitro-naphthalene**	76 7			63 4	123-4	155-6					
44	**2-Nitronaphthalene**	78			112	132	162	102	195			
45	**2,4,6-Trinitrophenetole** (1-Ethoxy-2,4,6-tri-nitrobenzene)	78										Naphthalene adduct, 39, NH_3 in al → picramide, 188
46	**2,4,6-Trinitrotoluene** (T N T)	80, 82										Naphthalene adduct, 97; CrO_3/conc H_2SO_4 → 2,4,6-trinitrobenzoic acid, 220
47	**2-Methyl-1-nitro-naphthalene**	81, yel			32, pet eth	188	180					
48	**4-Nitrophenanthrene**	81			105	190	224					
49	**3,4-Dimethyl-1,2-dinitrobenzene**	82										Reduct → 1-amino-3,4-dimethyl-2-nitrobenzene, 66, red , Acetyl deriv of this, 115 6, Benzoyl deriv of this, 199-200

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
50	**5-Methyl-1-nitro-naphthalene**	82 3			77 8	194 5	173 4					
51	**Picryl chloride**	83				208 (*tri*)		211				NaOH → Picric acid, 122 NH_3 → 2,4,6-Trinitroaniline, 188 192 5
52	**4-Chloro-1-nitrobenzene**	84			72	179 172	192	122				NaOH → 4 Nitrophenol, 114
53	**2,5-Dibromo-1,4-dinitro-benzene**	127										2,5-Dibromo-*p*-nitroaniline, 175, yel
54	**2,4-Dimethyl-1,3-dinitrobenzene**	84 82			65 6, lgr	>260 (*di*)	232 (227) (*di*)					Reduct → 1 amino-2,4-dimethyl 3-nitrobenzene 84 N N Diformyl, 219 20
55	**2,4-Dinitromesitylene**	85								232	2,4,6	Reduct → 2-amino-4 nitro mesitylene, 75 Acetyl deriv of this 191 Benzoyl deriv of this, 169 Benzenesulfonyl deriv of this, 163
56	**2,5-Dibromo-1-nitro-benzene**	85			51 2	171 2						
57	**4-Bromo-1-nitro-naphthalene**	85			102	193						N-Formyl deriv of amine, 172
58	**2,4-Dinitrophenetole** 1 3-Dinitro-4-ethoxybenzene	86			67 8	193 (*di*)				78	2,4,6	Reduct → 2-nitro *p*-phenetidine, 40
59	**4-Chloro-1-nitro-naphthalene**	87 85			98	186						
60	**1,3-Dinitrobenzene**	90			63	191 (*di*), 87 9 (*mono*)	240 (*di*), 125 (*mono*)	194	184			$(NH_4)_2S$ → 3 Nitroaniline, 114 Naphthalene adduct, 52
61	**2,3-Dimethyl-1,4-dinitrobenzene**	90			116	275 6 (*di*)						1-amino-2,3-dimethyl-4-nitrobenzene, 114
62	**3,5-Dinitrotoluene**	92		283 5		235 6 (*di*)						Oxid → 3,5-dinitro-benzoic acid 204 5 $(NH_4)_2$ S → 5-Nitro-*m* toluidine 98
63	**3,6-Dimethyl-1,2-dinitrobenzene**	93			75							Oxid → 2,3-dinitro-*p*-toluic acid, 249
64	**4,6-Dimethyl-1,3-dinitrobenzene**	93			105	1-*mono* 165 *di* 295	258 9 (*di*)			125	4,5,6	N,N'-Diformyl deriv of amine, 182 3
65	**2,4'-Dinitrobiphenyl**	93		363	45	202 (*di*)	276 8 (*di*)					
66	**8-Chloro-1-nitro-naphthalene**	94			88 9 96	137						
67	**2,4-Dinitroanisole** 1,3-Dinitro-4 methoxybenzene	95										2,4 Dinitrophenol, 114, Naphthalene adduct, 50, Reduct → 2 amino-4-nitroanisole, 118, or -red, Acetyl deriv of this, 175 6
68	**3-Nitroazobenzene**	96, or			56 7	130–1						
69	**4-Chloro-2-nitroanisole** (5-Chloro-2-methoxy-1-nitrobenzene)	98			84	104	77 8		194			
70	**2-Nitrophenanthrene**	99, pa yel			85, pa yel	225	216					CrO_3 → 2-Nitrophenanthraquinone, 260, golden yel
71	**8-Bromo-1-nitro-naphthalene**	99–100			90	138 9						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
72	**3,5-Dimethyl-1,4-dinitro-benzene**	101			104							Reduct → 1-amino-2,6-dimethyl-4-nitrobenzene, 158
73	**1,2-Dinitronaphthalene**	102–3, br			98	234 (*dl*)	291 (*dl*)	1-*mono* 215				
74	**5-Nitroacenaphthene**	106, 101, yel			108	238	210, 199		190 200			
75	**2,β-Dinitrostyrene**	106–7, yel										Alk $KMnO_4$ → 2-nitro-benzoic acid, 146–8
76	**5-Chloro-1-nitro-naphthalene**	111			85	128						
77	**3-Nitrodurene** (3-Nitro-1,2,4,5-tetramethyl-benzene)	112 3		261 2	75	207						
78	**4-Nitrobiphenyl**	114		302	53	171	230					N-Formyl deriv of amine, 172
79	**9-Nitrophenanthrene**	116–7			137 8, 104	207–8	199		190			Picrate, 78–9
80	**1,2-Dinitrobenzene**	118			102	185 (*dl*)	301 (*dl*)	185				$(NH_4)S$ → 2-Nitroaniline, 71, Hot aq NaOH → 2-nitro-phenol, 45
81	**2,4'-Dinitrodiphenyl-methane**	118, yel			88–9	224 5 (210) (*dl*)						Oxid → 2,4'-dinitrobenzo-phenone, 197
82	**4,5-Dimethyl-1,2-dinitro-benzene**	118, 115			126	227–8 (*dl*)						Reduct → 1-amino-4,5-dimethyl-2-nitrobenzene, 140
84	**3-Methyl-2-nitro-1,4-naphthoquinone**	121–2, 125, yel										Dil $KMnO_4$ → phthalic acid, 200–6, Na_2SO_3 Reduct or Fe + ac a → 2-amino-3-methyl-1,4-naphthoquinone, 167, red
85	**1,3,5-Trinitrobenzene**	122										Anthracene adduct, 164, Naphthalene adduct, 156, Fluorene adduct, 105
86	**5-Bromo-1-nitro-naphthalene**	122			69, 63–4	215						
87	**Picric acid**	122										Naphthalene adduct, 149, Fluorene adduct, 84, Anthracene adduct, 138, *n*-Butylammonium picrate, 151
88	**2,5-Dimethyl-1,3-dinitro-benzene**	123 4			102–3							Reduct → 1-amino-2,5-dimethyl-3-nitrobenzene, 98
89	**1-Nitro-2,4,6-tribromo-benzene**	125			122	232	198					Formyl deriv of amine, 222
90	**4-Bromo-1-nitrobenzene**	126			66	168	204	134	180			NaOH → 4-Nitrophenol, 114
91	**2,2'-Dinitrobiphenyl**	124, 128			81	*mono* 89 90, *dl* 161	*mono* 158–60, *dl* 190 1					N,N'-Diformyl deriv of amine, 137
92	**1,4-Dinitronaphthalene**	131–2, yel			120, yel	303 4 (*dl*)	280 (*dl*)					
93	**3,5-Dimethyl-1,2-dinitro-benzene**	132			78							Reduct → 1-amino-2,4--dimethyl-6-nitrobenzene, 76
94	**4-Nitroazobenzene**	135, or		>360	126	144–6	211, 205					

*Derivative data given in order m.p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet amide	Benz-amide	Benzene sulfon amide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
95	**4-Chloro-1,5-dinitro-naphthalene**	138										NaOH → 4 8-Dinitro-1-naphthol, 235 Sn + HCl → 1,5-Diaminonaphthalene, 190, PCl_5 → 1,4,5-Trichloronaphthalene, 131
96	**2-Nitroindene**	141										Zn + Ac a → 2-indanone oxime, 155
97	**4-Bromo-1,5-dinitro-naphthalene**	143										NaOH → 4,8 Dinitro-1-naphthol, 235, HNO_3 At 180 → 3-nitrophthalic acid, 218
98	**2,4-Dinitrostilbene**	143 5, yel			119 20, pa yel							
99	**1,3-Dinitronaphthalene**	144 5, yel			96	263 5 (*dı*)						
100	**9-Nitroanthracene**	146, yel			145 50	273 4						CrO_3 Oxid of amine → anthraquinone 273 286, yel
101	**4-Chloro-1,3-dinitro-naphthalene**	146 7										Warm dil NaOH → 2,4 dinitro 1 naphthol, 140
102	**2,5-Dimethyl-1,4-dinitrobenzene**	147, 142			150							Reduct → 1 amino 2 5 dimethyl-4-nitrobenzene, 144 5
103	**3-Nitroacenaphthene**	151–2, yel			81 2	192 3	209 10		221			
104	**4-Nitroazoxybenzene**	153, pa yel			138	151 172						
105	**3,8-Dinitroacenaphthene**	155–6, br -yel			167 8, yel							
106	**2-Nitrofluorene**	156, 154			129	191						
107	**3-Nitro-1,2-naphtho-quinone**	156, red										$SnCl_2$ + HCl → 3-Amino 1,2-naphthohydroquinone, 164 Dil HNO_3 → phthalic acid, 200 6
108	**2,2′-Dinitrodiphenyl-methane**	159			160							Oxid → 2,2′-dinitrobenzophenone, 188 9
109	**1,6-Dinitronaphthalene**	161 2, 166, pa yel			85–6, 77	257 (263) (*dı*)	265 (*dı*)					
110	**1,8-Dinitronaphthalene**	170, 173			66		311 2 (*dı*)			218	1,3,8	
111	**4-Bromo-1,8-dinitro-naphthalene**	170, yel										NaOH → 4,5-Dinitro 1 naphthol, 235, HNO_3 At 180 → 3-nitrophthalic acid, 218, Al NH_3 → 4-amino-1,8-dinitronaphthalene, 246, red, Acetyl deriv of this, 245
112	**3-Nitrophenanthrene**	170–1			87 8	200 1	213					
113	**4-Iodo-1-nitrobenzene**	173			67 8	184	222					
114	**1,4-Dinitrobenzene**	173, 171			140, 147	304 (*dı*), 162 3 (*mono*)	300 (*dı*), 128 (*mono*)	247 (*dı*)				Aq NaOH → 4-nitrophenol, 114
115	**3,3′-Dinitrodiphenyl-methane**	175			53–4	193 (*dı*)						Oxid → 3,3′-dinitrobenzophenone, 155

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
116	**4-Nitrophenanthrene-quinone**	179 80, pa yel										CrO_3 → 6-Nitrodiphenic acid, 248 50, *o*-Phenylene diamine → quinoxaline deriv, 217-8, Monoxime, 169-70, Dioxime, 210, Monosemicarbazone, 210-11
117	**4-Chloro-1,8-dinitro-naphthalene**	180, pa yel										NaOH → 4,5-Dinitro-1-naphthol, 235, PCl_5 → 1,4,5-Trichloronaphthalene, 131
118	**9-Nitrofluorene**	181 2			64 47	262	260-1					
119	**4,4'-Dinitrodiphenyl-, methane**	183			93	236 7 (*di*)						Oxid → 4,4'-dinitrobenzophenone, 189
120	**4-Chloro-3-nitro-1,2-naphthoquinone**	184, red										Aniline → 2-anilino-3-nitro-1,4-naphthoquinone-4-anil, 250
121	**2-Nitroanthraquinone**	185			303-6	262	227-8					
122	**2,2'-Dinitrostilbene**	196, yel			176, golden yel	304 (*di*)			209			
123	**4,β-Dinitrostyrene**	199, yel										Acid $K_2Cr_2O_7$ → 4-nitrobenzoic acid, 240
124	**3,3'-Dinitrobiphenyl**	200, yel			94	257 8 (*di*)						
125	**2,5-Dinitrofluorene**	207, yel			175	289 (*di*)						
126	**2,2'-Dinitroazobenzene**	209-10, 194-5 yel			134, red	271 (*di*), or						
127	**1,5-Dinitronaphthalene**	214 217			190	360 (*di*)				154	1,4,5	
128	**4,4'-Dinitroazobenzene**	222 3 216, or -red			250-1	212 (*mono*)						
129	**2,5-Dinitrophenanthrenequinone**	228, yel - red										Monoxime, 190 1, *o*-Phenylenediamine → quinoxaline deriv, 262-4
130	**1-Nitroanthraquinone**	230			252, 243	218	255					
131	**2,7-Dinitronaphthalene**	234, yel			166 159	261 (*di*)	267 (*di*)		210 (*di*)			
132	**4,4'-Dinitrobiphenyl**	237 240			128	317 (*di*), 199 (*mono*)	352 (*di*), 203-5 (*mono*)					
133	**1,3-Dinitroanthraquinone**	240, yel			290		>300					
134	**1,6-Dinitroanthraquinone**	255-7, yel			262, red	295 (*di*)	275 (*di*)					
135	**2-Nitrophenanthrenequinone**	258-60, yel			205-10, dk vlt							CrO_3 → 4-Nitrodiphenic acid, 217, Monoxime, 213, Monothiosemicarbazone, 234 5
136	**3-Nitrophenanthrenequinone**	279-80, or										CrO_3 → 5-Nitrodiphenic acid, 268, Monoxime, 240, Dioxime, 200, Monosemicarbazone, 254, red
137	**2,7-Dinitroanthraquinone** (Fritzsche's reagent)	280, 262, pa yel			>330	>350 (*di*)	300 (*di*)					

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of *all* nitro groups						Nitration product		Miscellaneous
				Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
138	*trans*-4,4 -Dinitro-stilbene	288, yel			231, yel	353 (*dl*)	352 (*dl*)					
139	**9,10-Dinitroanthracene**	294 263 yel										Oxid → anthraquinone, 273 286 yel
140	**1,7-Dinitroanthra-quinone**	295			290, red	283 (*dl*)	325 (*dl*)					
141	**2,7-Dinitrophenanthrene-quinone**	301 3, pa yel			>360, dk vlt							CrO_3 → 4,4 Dinitrodiphenic acid, 257 8, Monoxime, 246–8, *o*-Phenylenediamine → quinoxaline deriv , 356, Fluorene adduct, 270, red -yel
142	**1,8-Dinitroanthra-quinone**	311 2			262, red	284 (*dl*)	324 (*dl*)					
143	**1,5-Dinitroanthra-quinone**	384–5, pa yel			319, red	317 (*dl*)	>350 (*dl*)					Monoxime, 253

* Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XXI

Hydrolysis to the corresponding acid *

$$RCN + 2H_2O \xrightarrow{H_2SO_4} \underset{\text{Acid}}{RCOOH} + NH_4HSO_4$$

$$RCN + H_2O \xrightarrow{NaOH} \underset{\substack{\text{Sodium salt}\\ \text{of the acid}}}{RCOONa} + NH_3$$

From the nitrile and 75% sulfuric acid, or 4 1 phosphoric acid-sulfuric acid

For directions and examples see Cheronis, pp 618, 619, Linstead, p 65, Shriner, p 258, Vogel, p 410, Wild, p 250

From the nitrile and potassium hydroxide in aqueous methanol, ethanol or benzyl alcohol

See Linstead, p 65, Vogel, pp 410, 805, Wild, p 250, L Palfray, S Sabetai and S Rovira, *Compt Rend*, **209**, 483 (1939)

From the nitrile and potassium hydroxide in ethylene glycol or glycerol

See Cheronis, pp 618, 620, S Rovira and L Palfray, *Compt Rend*, **211**, 396 (1940)

NOTE For the directions and examples for the preparation of the derivatives of the carboxylic acid formed on hydrolysis see the explanations and references to Tables XII, XIII and XIV, pp 186, 187, 188, 189

Partial Hydrolysis to the corresponding amide *

$$RCN + H_2O \xrightarrow{H_2SO_4} \underset{\text{Amide}}{RCONH_2}$$

From the nitrile with sulfuric acid

For directions and examples see Cheronis, pp 619, 620 Vogel, p 411

Reduction to the corresponding amine *

$$RCN + 4[H] \rightarrow \underset{\text{Amine}}{RCH_2NH_2}$$

From the nitrile and sodium in absolute ethanol

For directions and examples see Cheronis, p 621, Shriner, p 259, Vogel, p 411, Wild, p 254, H B Cutter and M Taras, *Ind Eng Chem, Anal Ed*, **13**, 830 (1941)

From the nitrile and lithium aluminum hydride in ether

See W G Brown in *Organic Reactions*, Vol 6 (Ed R Adams), John Wiley and Sons, New York, 1951, p 469, N G Gaylord, *Reduction with Complex Metal Hydrides*, Interscience, New York, 1956, pp 731-750

For summary of reduction methods see V Migrdichian, *Organic Cyanogen Compounds*, Reinhold Publishing Corp, New York, 1947, pp 151-172

NOTE For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitrile see explanations and references to Table XVIII, pp 291, 292, 293, 294

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point, °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P , °C	M P °C				B P °C					
1	**Cyanoacetylene**	42 5	5	1 38699[1]	0 8159[1]	144d , 83 4 [0]	18	61 2	87							$HgNO_3$ → Wh precipitate, Dimer, 64 5-5 0
2	**Cyanoacetaldehyde**	71 2			0 881[1]						45 6[1]					HNO_3 → Cyanoacetic acid, 66, 2,4-Dinitro phenylhydrazone, 170 1, aq al , *p*-Nitrophenylhydrazone, 153-4
3	**Acrylonitrile**	77 8		1 393[20]	0 797$_4^{20}$	140	13	85	105							Gives solid polymer on addition of conc NaOMe sol
4	**Fluoroacetonitrile**	80				165	33	77								
5	**Acetonitrile** (Cyanomethane)	81-2		1 3442[20]	0 7828$_4^{20}$	118		82	114	135	16 5	71	58	106, 135	165	
6	**Trichloroacetonitrile**	86, 83 4			1 439[12]	196 7	58	141	95-7							
7	**Methacrylonitrile** (α-Methylacrylonitrile)	90 1		1 399[25]	0 7991[18]	160	15 6	102 6								Gives solid polymer on heating with benzoyl peroxide
8	**Propionitrile** (Cyanoethane)	97, 103 5		1 3659[25]	0 777$_4^{25}$	141		79	106	151	49	84	36	63	135	
9	**Isobutyronitrile**	104, 107 8			0 773	154 3	−47	129	109 10	143	69	57	53	82	150	
10	**Trimethylacetonitrile** (*tert*-Butylcyanide)	106	15-6	1 3792			35	153 4	127-9							
11	**2-Ethylacrylonitrile**	111		1 4132		180		84, bz								
12	**Dichloroacetonitrile**	113			1 374[11 5]	194	5 6	98								Me ester of acid, 143-4
13	**α-Chloroisobutyronitrile**	116		1 4045[25], 1 435[14]	1 064$_{14}^{14}$		31		69 70							
14	***n*-Butyronitrile** (1-Cyanopropane)	117		1 3812[24]	0 796[1]	162		116	96	146	77			65	151	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B.P., °C	M.P., °C				B.P., °C					
15	*trans*-**Crotononitrile**	119		1.4217		189	72	158	115		83.4			109.5–10.5	131.5–2.5	n_D^{29} of amine 1.4263, 1-Naphthylthiourea of amine, 129–30
16	**Allylcyanide**	119		1.4060^{20}	0.835^{15}	169, 163		73	58	75.7				123.7, 56.7	136.8 7.4	n_D^{25} of amine 1.4191, Al KOH → crotonic ac., 72 1-Naphthylthiourea of amine, 109–10
17	**Methoxyacetonitrile**	120		1.380^{28}	0.9373_4^{28}	203–4		96	58							
18	**2-Hydroxyisobutyronitrile** (Acetone cyanohydrin)	120d	−19	1.3996^{20}	0.93_4^{20}		79	98	136							
19	**3-Hydroxy-4-methoxybenzonitrile**	124 131.5–2.0					255.7									Acetate, 116, Acetate of acid, 206–7, Me ester of acid, 83.4, 66–7
20	**2-Methylbutyronitrile**	125.6		1.380^{25}	0.8061_4^0	177		112	110		95.5–6.0					HCl salt of amine, 176, H_2PtCl_6 salt of amine, 240
21	**Chloroacetonitrile**	127			1.193^{20}	189	63	120	137						142–3	Addition comp with $AlCl_3$, 38, HCl salt of amine, 144
22	**Isovaleronitrile**	130			0.7884_0^{20}	176		136	113, 109–10	153	96			102	138	3-Nitrohydrogen phthalate of amine, 108
23	**2,4-Pentadienonitrile**	135–8		1.4880	0.8444		72	124								Me ester of acid, 50 2^{20}

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzenesulfonamide	Phenylthiourea	Picrate	
						B.P., °C	M.P., °C				B.P., °C					
24	**2-Chlorocrotononitrile**	136				212, 85 95^{10}	99	212			128 31				191	Me ester of acid, 161, HCl salt of amine, 220
25	**Ethoxyacetonitrile**	136 7^{753}				156 7^{16}		80 2			108^{750}				121 3	n_D^{25} of amine 1 4108, Et ester of acid, b p 152
26	**2-Methylcrotononitrile**	138		1 4319	0 8313	198 5	64	75 6	77							*p*-Toluidide of acid, 70 5–1 5
27	**2-Bromoisobutyronitrile**	139–40		$1\ 445^{25}$			48–9	148	83							
28	**4-Pentenonitrile**	140		$1\ 4213^{14}$	$0\ 848^{14}_{15}$	188–9		94		91 4, 98						H_2PtCl_6 salt of amine, 166, Thiourea deriv of amine, 43 5–4 0
29	**Thiophene-2,3-dicarbonitrile** (2,3-Dicyanothiophene)	140					272–4	*dt* 228								Di-Me ester of acid, 32 3
30	**3,3-Dimethylacrylonitrile**	140 2			$0\ 8292^{14}$	199	70	107–8, 65 6	126 7		105 8			105 0 5 5	139–40d	HCl salt of amine, 193–4
31	**Valeronitrile** (1-Cyanobutane)	141		$1\ 3991^{15}$	$0\ 8035^{15}_4$	186		106	63		104			69	139	
32	**2-Chlorobutyronitrile**	143				189^{627}		75 5 6 0	74 5						142, 124	
33	**Diethylacetonitrile**	145				190		107			71 5				168–9	
34	**2-Furanecarbonitrile** (α-Furonitrile, 2-Cyanofuran)	147		$1\ 4798^{20}$	$1\ 0822^{20}_4$		133 4	142	124	211	145 6				150	
35	**2-Methylacetoacetonitrile**	147, 145 6		$1\ 4239^{20}$	$0\ 9794^{20}_4$	224^{34}	73	138–40								Semicarbazone, 153, *p*-Nitrophenylhydrazone, 147
36	**Cyclobutanecarbonitrile** (Cyanocyclobutane)	150				195		152–3, 155	112 5–3 0		110^{753}					HCl salt of amine, 235 5

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P , °C	M P , °C				B P , °C					
37	**2-Chloro-3-methylbutyronitrile**	154–5			$0\ 9922^{12}$	210–2, 126^{32}	37 9							-	137–8, 160	Et ester of acid, b p 178–9, HCl salt of amine, 190d , H_2PtCl_6 salt of amine, 193 5
38	**Isocapronitrile** (4-Methylpentanonitrile)	155		$1\ 4085^{14}$	$0\ 807_4^{14}$	199 4	−33	119, 121	111–2		125				123 5	
39	**2,2-Dimethylacetoacetonitrile**	163 4			$1\ 008^{13}$	103^{1}		121								Oxime, 99–100
40	**2-Methylhexanonitrile**	165		1 4070	0 7985	210		72	98		45–54^{15}					
41	**3-Methoxypropionitrile**	165		1 4032	$0\ 9367_4^{25}$	107^{10}		50			120					
42	***n*-Capronitrile** (*n*-Hexanonitrile)	165	−80 31	$1\ 4115^{20}$	$0\ 8093_{20}^{20}$	205		100	95		130	40	96	77	126	HCl salt of amine 219
43	**(Ethylamino)acetonitrile** (N-Ethylglycinonitrile)	166 7 81 3^{29}					180–2				126–9	*dl* 117–8			*dl* 194 5	HCl salt, 141 2
44	***d,l*-3-Methylhexanonitrile**	$171–2^{749}$		1 4143	0 8109	212 3 55		99 100			148 9^{706}					*p*-Toluidide of acid, 73 4, n_D^{20} of amine, 0 7787
45	**Chlorofumaronitrile**	172 64^{10}		$1\ 49571^{20}$	$1\ 2499^{20}$		191 2		*dl* 186							Di-Me ester of acid, b p 113 4^{1}
46	**2-Acetoxypropionitrile** (O-Acetyl lactonitrile)	172 3				167 70^{28}	57 60									H_2PtCl_6 salt of amine, 207 9
47	**3-Ethoxypropionitrile**	173		1 4068	$0\ 9189_4^{25}$	119^{19}		50			138					n_D^{20} of amine, 1 4242, D_4^{20} of amine, 0 8697
48	**3-Chlorobutyronitrile**	176			$1\ 0772^{9}$	101^{13}	43 4 5		89 90						147	H_2PtCl_6 salt of amine, 212
49	**3-Chloropropionitrile**	178			$1\ 1443^{18}$	204	41		119, w							*p*-Toluidide of acid, 121 HCl salt of amine, 146–8

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P °C	M P °C				B P °C					
50	**Indole-3-carbonitrile** (3 Cyanoindole)	178 rose				208 10										N Acetyl deriv 202 Et ester of acid 82 M p of amine 84
51	**5-Methylhexanonitrile**	178 80				216		104	75	149 5						Me ester of acid, b p 166 7
52	**Thiophene-3-carbonitrile** (3 Cyanothiophene)	179 203 5		1 5565[21]	1 1956$_{20}^{20}$		138	180								
53	***d l*-4-Methylhexanonitrile**	180		1 4144	0 8141	217 8		98			152 3[50]					n_D^{20} of amine, 1 4238, D_4^{20} of amine, 0 7802
54	***d l*-Lactonitrile** (Acetaldehyde cyanohydrin)	182 4		1 4058[18]	0 9877$_4^{20}$	122[1]	18	79 75 6	59	153	161 2				142	
55	**Glycolonitrile** (Formaldehyde cyanohydrin)	183 sl d					80	120	97	141 146 7	171				160	Benzoyl deriv 195 6
56	**Heptanonitrile**	183 187			0 8107$_6^{20}$	223		95	71		155			75	121	
57	**4-Cyanoheptane**	183-4				221 2		123 4			167					Et ester of acid b p 183 H_2PtCl_6 salt of amine, 211 d
58	**Benzonitrile**	190	−13	1 5289[20]	1 0102$_{15}^{15}$		122	129	162	167	184 5	105	88	156	194	
59	**Thiophene-2-carbonitrile** (2-Cyanothiophene)	192		1 5641[15]	1 1800$_4^{15}$		129 30 192	180	140		58[5]				181 2	HCl salt of amine, 193 4
60	**2-Octynonitrile**	194 6				148 9[19]	f p 2 5	91	44							
61	**4-Chlorobutyronitrile**	196 7			1 162[10]	196[22]	16	88 9	60 70, bz - pet eth							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P , °C	M P , °C				B P , °C					
62	**Methyl cyanoacetate**	200, 115^{36}	−22 5	$1\ 4170^{25}$	$1\ 0962_4^{25}$						58^{15}					Hydrolysis → malonic acid, 135, HCl salt of amine, 102 5, H_2PtCl_6 salt of amine, 192, NH_3 → Cyanoacetamide, 118
63	**Dibenzyl acetonitrile**	200 15					89	128 9	155							
64	**2-Tolunitrile** (2-Methylbenzonitrile)	205	−13	$1\ 5272^{45}$	$0\ 9912_{45}^{45}$		104	140	125	146	208	88			215	Acetyl deriv of amine, 69
65	**2,3,3-Trimethyl-1-cyclopentene-1-carbonitrile** (β-Campholytonitrile)	205, 225			$0\ 9127^{15}$	255-6	135	130, al	104, aq al		205 5 6 5				178	Et ester of acid, 222 5, HCl salt of amine, 175-6
66	**Caprylonitrile** (Octanonitrile)	206, 199		$1\ 4224_{He}^{15}$	$0\ 8172_4^{15}$	239	16	110	57		180				112	
67	**1,1-Dicyanopropane** (Ethyl malononitrile)	206^{756}, $90-1^{20}$			$0\ 9515^{11}$		111 5	*dl* 216								Dihydrazide of acid, 168, al
68	**Ethyl cyanoacetate**	207		$1\ 4179^{20}$	$1\ 056_4^{25}$				198 9							NH_3 → Cyanoacetamide, 118
69	**1,1-Dicyanobutane** (Propyl malononitrile)	210^{750}			$0\ 9224^{18}$		96	*dl* 184	*dl* 198							
70	**3-Tolunitrile** (3-Methylbenzonitrile)	212	−23		$1\ 0316^{20}$		113, 110	95	126	140	207				198, 156	Acetyl deriv of amine, 150
71	**Cyclohexylacetonitrile**	215		$1\ 457^{18}$	$0\ 913^{18}$	244 6	33	171-2			188-9	79-81			155 6	HCl salt of amine, 252-3, n_D^{25} of amine, 1 4625
72	**4,4-Dicyano-1-butene** (Allyl malononitrile)	217-8	f p −12				105, eth									Di-Et ester of acid, b p 222 3, *p*-Nitrobenzyl ester of acid, 46, al

*Derivative data given in order: m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzenesulfonamide	Phenylthiourea	Picrate	
						B P °C	M P °C				B P, °C					
73	**3-Isopropylidene-1-methylcyclopentane-1-carbonitrile** (β-Fencholenonitrile)	217 9			0 9203[1]	259	72 3	86 5 7 5								Me ester of acid, 97 9
74	**3-Hydroxypropionitrile**	220			1 059[a]	d	syrup				188				222	Sodium salt of acid, 143, P_2O_5 → acrylonitrile, b p 77
75	**1,1-Dicyano-3-methylbutane** (Isobutyl malononitrile)	222					108, bz	*di* 195 6, al								
76	**Nonanonitrile**	224	−34 2	1 42522	0 8221[4]	255	15	99	57		201	49			111	Acetyl deriv of amine, 34 5
77	**2-Phenylcrotononitrile**	224 6		1 5555	1 013		136	98 9								
78	**Ethylenecyanohydrin**	229 7 220			1 059[a]						107 8 [ab]				130, 222	Me ester of acid, b p 177 84 H_2PtCl_6 salt of amine, 199
79	**2-Phenylpropionitrile**	232				265 8		97 5		210					182	Me ester of acid, 221, M p of amine, 85 HCl salt of amine, 123 4, H_2PtCl_6 salt of amine, 229d
80	**Phenylacetonitrile** (Benzyl cyanide)	234		1 5211[4]	1 0214[4]		76 7	157	118	163	198	116	69	135	174, 167	
81	**Phenoxyacetonitrile**	239 40			1 09[1]	285	98 9	101 5			228 9 [1]				167 8	HCl salt of amine, 215, HBr salt of amine, 192-3

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P °C	M P , °C				B P , °C					
82	**4-Hydroxybutyronitrile**	240			1 029[25]	204					205 6					Acid forms readily butyrolactone, b p 204, CrO_3 + butyrolactone → succinic acid, 186
83	**(3-Tolyl)acetonitrile** (*m*-Xylylcyanide)	240 1			1 0022[22]	120-3[26]	61	141			214 5[33]				176	Et ester of acid, b p 237 8, HCl salt of amine, 159
84	**(4-Tolyl)acetonitrile** (*p*-Xylylcyanide)	242 3	18	1 5153[2]	0 9922[22]	265-7	94	185			214 5	95 6			155	Et ester of acid, b p 240, HCl salt of amine, 216-7
85	**4-Isopropylbenzonitrile**	243-4[34]					117 8, al	153, 133			227[23]					Et ester of acid, b p 263 4 HCl salt of amine, 239-40
86	**(2-Tolyl)acetonitrile** (*o*-Xylyl cyanide)	244			1 0156[22]		88 9	161			215 5 7 0				177	HCl salt of amine, 227-8
87	**Decanonitrile**	245		1 4320$^{t}_{He}$	0 8294$^{t}_{4}$	269	31	100, 108	70							
88	**3-Methyl-2-phenylbutyronitrile**	245 9[4]		1 5038[2]	0 967[1]	159 60[14]	61 2	111 2	132 3		155-6[24]					HCl salt of amine, 128
89	**1,2-Dicyanopropane** (Methyl succinonitrile)	252 4	12				115	*dl* 225	*dl* 200		172 3	154				HCl salt of diamine, 144 5
90	**1-Undecanonitrile** (1-Hendecanonitrile)	253 4				164[1]	28 2 6	98 0 7	71							Hydrazide of acid, 101-2, Phenylhydrazide of acid, 110
91	**2-Phenylvaleronitrile**	254-5[30]		1 5000	0 960[15]	280	58	83 5			90[3]					
92	**10-Undecenonitrile** (10-Hendecenonitrile)	257, 129-30[14]		1 4442[20]	0 8443$^{20}_{4}$	274	24 5	87								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzenesulfonamide	Phenylthiourea	Picrate	
						B P °C	M P °C				B P °C					
93	**3-Phenylpropionitrile**	261			1 0014[18]	280[754]	48 5	105	98		221 5[755]	57 8			152–3	HCl salt of amine, 218, H_2PtCl_6 salt of amine, 233
94	**2-Cyanobenzal chloride** (α,α-Dichloro-*o*-tolunitrile)	261					155, bz	117								
95	**N-Methylanilinonitrile** (N-Cyano-N-methylaniline)	266	13				95 100	163								Picrate, 195
96	**3-(2-Chlorophenyl)propionitrile**	267 8		1 5390	1 1390[20]		96 5, w	119 bz								Me ester of acid, 255 HCl salt of amine, 167
97	**1,3-Dicyano-2-methylpropane** (2-Methylglutaronitrile)	269 71				205 8[12]	79	*dl* 175 6			78[11]					Di-*p*-toluidide of acid, 174 5, n_D^{45} of amine, 1 4585
98	**O-Benzoyl lactonitrile** (Lactonitrile benzoate)	269–70					112	124								Di-*p*-nitrobenzyl ester of acid, 119 5
99	**3-Cyanobenzal chloride** (α,α Dichloro-*m*-tolunitrile)	272 5					132									
100	**4-Cyanobenzal chloride** (α,α-Dichloro-*p*-tolunitrile)	273 6[770]					151 8									Et ester of acid, 45 6
101	**Dodecanonitrile** (Lauronitrile)	276 7	4	1 43595	0 8273[15]	225	44	110 102, aq al	78	141	247 9					M p of amine, 28 3 Acetyl deriv of amine, 68 5 9 5, bz , *p*-Toluenesulfonyl deriv of amine, 73
102	**1,3-Dicyanopropane** (Glutaronitrile)	286		1 4365[25]	0 9951[15]		97	175	224		178 80	*dl* 135	119	148	237	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1) (Listed in order of increasing atmospheric b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfon amide	Phenyl thiourea	Picrate	
						B P °C	M P °C				B P °C					
103	**4-Methoxyhydrocinnamonitrile** (3-(4-Methoxyphenyl)-propionitrile)	290–300					104–5	125			118 20^2					Me ester of acid, 38, M p of amine, 65 7–6 3, HCl salt of amine, 220 5
104	**1,4-Dicyanobutane** (Adiponitrile)	295	0–1	1 4597^{20}	0 951$^{19}_{19}$		153, 150	220	239		204 5	*dl* 155	*dl* 154		220	M p of amine, 42

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)*

No	Name	Boiling point, °C	Melting point, °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzenesulfonamide	Phenylthiourea	Picrate	
						B.P., °C	M.P., °C				B.P. °C					
1	**1,2,2,3-Tetramethyl-3-cyclopentene-1-acetonitrile** (5-Methyl-α-camphelenonitrile)	115 9^{18}		1.47221[18]	0.9217[18]$_4$	150–1 5^{12}	35.6 7.0	99 100, lgr								
2	**1-Cyanocyclohexene**	81^{12}		1.4818[25]	0.954[25]	238 40^{638}	38	127.8			55 7^{12}				181	
3	**2-Hydroxybutyronitrile** (Propanal cyanohydrin)	102–3^{23}		1.4150	0.9621	225 60d	43.4		89–90		172^{755}	112.1 3.1				N,O-Di-*p*-nitrobenzoyl deriv of amine, 119.2, Acetate, 43, CS_2
4	**Hydnocarponitrile**	155 6^{2-3}		1.4559[25]	0.8580[25]		59–60	108.5d								
5	**α-Chloro-α-phenylacetonitrile**	131–5^{13}					60.1	116								
6	**Butyl cyanoacetate**	115^{15}		1.4243[25]	0.998[25]		66	119–20	198–9							
7	**3-Bromopropionitrile**	69^{7}		1.4789[25]			62								154, yel	Nitrile + alkali → acrylic acid, *p*-toluidide of which, 141
8	**2,4-Diphenylbutyronitrile**	152 6^{1}				190[1]	72.3, 76	96								
9	**Thiophene-2-acetonitrile**	115 20^{22}		1.5399[25]	1.153[25]$_4$		76, 63–4	146.7			72–4[3]	61, bz-lgr		109.5 10		HCl salt of amine, 202.4, N-Acetyl deriv of amine, 45.5 6.5
10	***trans*-4-Chlorocrotononitrile**	61–1.4[11]		1.4705	1.1207	117 8^{13}	83	130–2								
11	**2-Cyanopentanoic acid**	125–30^{9J}					96	*di* 184	*di* 198							Amide of nitrile, 124.5, Anilide of nitrile, 88–9
12	**Azelaonitrile** (1,7-Dicyanoheptane)	183[11], 160^{3}		1.4426[25]			106	*di* 175	*di* 186–7		258–9					M.p. of amine, 37
13	**3-Chloro-2-hydroxy-2-methylpropionitrile** (Chloroacetone cyanohydrin)	110^{22}		1.4520	1.2027[15]	230–5	110									
14	**1,11-Dicyanoundecane** (1,11-Dicyanohendecane)	189 90^{7}					111–2	*di* 175.6	*mono* 112.5–3.0, *di* 160.1							M.p. of amine, 58 HCl salt of amine, 254.5, al

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2					Miscellaneous
						Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzenesulfonamide	Phenylthiourea	Picrate	
						B P °C	M P °C				B P °C					
15	**2-Cyanobutyric acid**	153[15]					111 5	212 4								Hydrazide of acid, 95 6, Amide, 113
16	**2-Cyanobiphenyl**	172[15]					114	177								Acid + conc H_2SO_4 → fluorenone, 83
17	**1,12-Dicyanododecane** (α,ω-Dodecane dicyanide)	225 8[17]					129, w	*dl* 189	*dl* 191, 170 1							Di-*p*-toluidide of acid 165 M p of amine, 61 5 HCl salt of diamine, 309 10
18	**1-Cyano-4-isopropenylcyclohexene**	116 8[11]		1 4978	0 9439	164-5[10]	132 3	164 5								
19	**Sebaconitrile** (1,8-Dicyanooctane)	201 3[16]					134	*dl* 210	*dl* 198							M p of amine 60
20	**Suberonitrile** (1,6-Dicyanohexane)	180[12]		1 4448[22]			141	*dl* 216 7	*dl* 186 7		240 1 225 6	*dl* 121 2			*dl* 180	M p of amine, 52
21	**3-Cyanoindene** (Indene-3-carbonitrile)	140 2[13]					161, 156-7	180	158							Hydrazide of acid, 186
22	**Aminoacetonitrile** (Glycinonitrile)	58[15], part d					262 d	65-6	62 (+2 H_2O)		116 5	*dl* 244	*dl* 168		*dl* 233 5	HCl salt, 165 5 6 5, M p of amine, 8 5

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point C	Boiling point C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benz amide	Ben zene sulfon amide	Picrate	
				B P C	M P °C				B P C				
1	**2 Cyanodiphenyl-methane**	19	313 4		117	163							
2	**N Piperidinoacetonitrile**	19	210		215 7				182 3 58 61			*di* 225 220 1	Methiodide 192 3 HCl salt of acid 215 6 Phenylthiourea deriv of amine 92 3
3	**3-Chloro-2-tolunitrile**	19	107^{28}		159 154								
4	**Tetradecanonitrile**	19 20			54	103	82						M p of amine 37
5	**Cinnamonitrile**	20	255 6		133	153 109	147	175 179				181 yel aq al	HCl salt of amine 235
6	**Trichloroacrylonitrile**	20			76	97 8 87	98						n_D^4 1 5100
7	**DL-Mandelonitrile** (Benzaldehyde cyano hydrin)	22			118 9	133 4	151 2 146		116 7	148 9		153 4 al	M p of amine 56 5 8 0 O Benzoyl deriv 63 4 3 Nitrobenzoyl deriv 83 4 *p* Toluidide of acid 174 HCl salt of amine 208 19 acet
8	**Pentadecanonitrile**	23	322		52	102	78		299 301				M p of amine 34 0 6 5 HCl salt of amine 199 N Acetyl deriv of amine 72
9	**2-Methoxybenzonitrile**	24 5	255 6		00 1	129	131		226 8				H $PtCl_6$ salt of amine 187
10	**(2-Chlorophenyl) aceto-nitrile** (2 Chlorobenzyl cyanide)	25	251		95	175 w	138 9		105 8 [4]			187 bz	
11	**1,1-Dicyanoethane** (Methylmalononi trile)	26			135 138 d	*di* 217	*di* 182					*di* 252 d	Di *p* toluidide of acid 227 8 Di HCl salt of amine 201
12	**2-Cyanopyridine** (2 Pyridinecarbonitrile Picolinonitrile)	26	212 5		136 7	106 7	76		95 8[4]			159 60 d	HAuCl, salt 190 N Acetyl deriv of amine 59 60 bz pet eth Oxalate salt of amine 166 7 d
13	**4-Tolunitrile** (4 Methyl benzonitrile)	27 29	217		179 80	155 165	147 8		208	137		205 15 d	D^1 0 9805 M p of amine 13 N Acetyl deriv of amine 107 8
14	**D-Mandelonitrile**	28 9	170 d		133	123							$[\alpha]_{5461}^{25}$ +46 9 in bz
15	***d l*-(2-Bromophenyl) acetonitrile** (2 Bromo benzyl cyanide)	29	242 d		84	143 4 144 8						150 1	Et ester of acid b p 150 2 [3] M p of amine 163 4 HBr salt of amine 163 4
16	**(4-Chlorophenyl) aceto nitrile** (4 Chlorobenzyl cyanide)	30	265 7		105	175	164 5		114 6[19]			212	HCl salt of amine 218 0 8 5 *p* Toluene sulfonate deriv of amine 235
17	**Malononitrile** (Methyl ene cyanide)	30	218 9		135	170			136	140	96	250	n_D^{33} 1 4146 N Acetyl deriv of amine 126
18	**Hexadecanonitrile**	31			63	106 7	90						D_4^{31} 0 8224
19	**Maleonitrile** (*cis* 1 2 Dicyanoethylene)	31			130	181	187	163 173	163 70	*di* 178 5- 9 5	*di* 155 al	*di* 250 d	
20	**2,2-Dicyanopropane** (Dimethylmalono nitrile)	31 2	169 5 subl		192 3 subl part d >130	*di* 269	203 4	159 60	153	*di* 152			Di Me ester of acid b p 177^{755} HCl salt of amine 256 7

*Derivative data given in order m p crystal color solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B P , °C	M P °C				B P , °C				
21	*tert*-**Butylacetonitrile** (Neopentyl cyanide)	32-3	138	186 8		132	131						HCl salt of amine, 158 60, subl
22	**1-Naphthylacetonitrile**	33			131	154, 180							
23	**4,4-Dicyanoheptane** (Dipropylmalononitrile)	33 4 (*anh*) 49 50 (*hyd*)	223-4, 135-40$^{0\ 2}$		161	*di* 214	*di* 168 0 5, me al		132^{25}	*di* 154			
24	**Heptadecanonitrile**	34			61	106			335-40	91			M p of amine, 49, N-Acetyl deriv of amine, 62
25	**1-Naphthonitrile** (1-Cyanonaphthalene)	34, 37	299		162	202			155^{12}		148	223	N-Acetyl deriv of amine, 134, lgr Methiodide deriv of amine, 213, al
26	**2-Cyanopropionic acid**	35	142 5^{11}		135, 120	*di* 206	*di* 182, 214						Amide, 105 81 Mono-*p*-toluidide of acid, 145 d Di-*p*-toluidide of acid, 227 8 245
27	**4-Fluorobenzonitrile**	35	189-90		183	154-5			183			203	
28	**Coumarilonitrile** (Coumarin-2-carbonitrile)	36		310-5, sl d	192-3, w	159	159						Et ester of acid, 27 Ph ester of acid, 101
29	**Indole-3-acetonitrile**	36 0 5	157$^{0\ 2}$		164-5 199	150 1	149 5 50			137 8		247 d	Me ester of acid, 135 M p of amine, 116 7, 146 HCl salt of amine, 248 9 N-Acetyl deriv of amine, 77, pet eth
30	**3-Bromobenzonitrile**	38	225		155	155			244-5	135 6		205	
31	**2-(N-Anilino)-butyronitrile**	39			141	123, w	92, al						Et ester of acid, 26 b p 278
32	*trans-o*-**Chlorocinnamonitrile**	40			212, yel , al	168	176						Me ester of acid, b p 278 9
33	**Octadecanonitrile**	41 43			70	109	95 88						
34	**3-Chlorobenzonitrile**	41			158, 155	134	122-5		110-2^{17}	214		203	
35	**2-Chlorobenzonitrile**	43	232		141	142	118		103-4^{11}	116 7		217	N-Acetyl deriv of amine, 79-80
36	**4-Chloromandelonitrile**	43			119-22, 112-3	122-3							O-Benzoyl deriv , 57-8 Me ester of acid, 85 8, bz -pet eth
37	**Nonadecanonitrile**	43			69	109 5 8	95 5-6 5						Me ester of acid, 39 5 40
38	**2-Bromo-4-tolunitrile**	44			204								
39	**3,3-Dicyanopentane** (Diethylmalononitrile)	44-5	195, 92^{24}		125, w	*mono* 146, *di* 224							
40	**4-Cyanobutyric acid**	45			97 8	182-3	*di* 221 2			105			Amide, 69 70 Et ester of acid, b p 245 M p of amine, 157 8, HCl salt of amine, 92-4 $HAuCl_4$ salt of amine, 86 7, 106
41	**5-Chloro-2-tolunitrile**	45-6			169								Me ester of acid, 30-1
42	**(4-Aminophenyl)acetonitrile** (4-Aminobenzyl cyanide)	46	312		199	161 2							N-Benzoyl deriv , 176-7, Picrate, 185
43	*meso*-**2,3-Dimethylsuccinonitrile**	46			209, 198 d	*di* 310-3	*di* 235						Di-Me ester of acid, b p 198 9

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfon amide	Picrate	
				B P , °C	M P , °C				B P , °C				
44	**3-Bromo-4-tolunitrile**	47			140	137							
45	**(4-Bromophenyl)aceto-nitrile** (4-Bromobenzyl cyanide)	47			114, subl	192 4							Et ester of acid, 30, HCl salt of amine, 240–3
46	**N-Anilinoacetonitrile**	48 lgr			127 8	136	113						
47	**3-Cyanopropionic acid**	48 50			235	185	*mono* 157, *di* 269 d	*mono* 148 5, *di* 230		79 80			Amide, 97, Me ester of acid, b p 215, Di-*p*-toluidide of acid, 256, M p of amine, 193 203 d , HCl salt of amine, 135–6, 95–6
48	**3-Chloro-4-tolunitrile**	48 50			200 2								Me ester of acid, 28
49	**3,3-Diphenylacrylo-nitrile** (*β*-Phenyl cinnamonitrile)	49			162, 167		130 1						
50	**3-Bromo-2-hydroxy benzonitrile**	49–50			184	165							
51	**4,4-Dicyanoheptane** (Dipropylmalono-nitrile)	49-50 (*hyd*), 33 4 (*anh*)			161	*di* 214	*di* 168 0–5, me al		132^{25}	*di* 154			
52	***trans*-2,3-Diphenyl-acrylonitrile**	49–51	213 4^{23}		172	127, acet	141, al						
53	**Eicosanonitrile**	49 5			77, 75 2	108 9	92		196 $2^{4\ 0}$				M p of amine, 57 8, n_D^{70} of amine, 1 4341
54	**3-Cyanopyridine** (Nicotinonitrile)	50	240–5		232	122	85, w , 132, bz - lgr		88–90^{2}	132		*tri* 206 8	$HAuCl_4$ salt of amine, 196–8, Di-HCl salt of amine, 224
55	**(4-Iodophenyl)aceto-nitrile** (4-Iodobenzyl cyanide)	50–1			135								HCl salt of amine, 294 6 d
56	**4-Cyanodiphenyl-methane**	51			157 8								Acid $\xrightarrow{CrO_3}$ 4-Benzoyl-benzoic acid, 197–200, al
57	**2-(N-Anilino)-valero-nitrile**	51, pet eth			147–8, al	99, eth - pet eth							
58	**2-Aminobenzonitrile** (Anthranilonitrile)	51, yel , CS_2	267 8^{777}		147	109–11	130–1			167			Et ester of acid, b p , 266–8, *p*-Toluidide of acid, 151
59	**2-Bromobenzonitrile**	53	253		150	155–6			118^{9}				HCl salt of amine, 241, 208
60	**5-Cyanothiazole**	53			218	186							Me ester of acid, 68–9, N-Acetyl deriv of amine, 159–60
61	**3-Aminobenzonitrile**	53–4, aq al	288–90		174	78 9	114						N-Acetyl deriv , 248, Me ester of acid, 36–8, Et ester of acid, b p 294, Fe/AcOH → Benzonitrile, b p 190 + NH_3
62	**2-Quinolinoacetonitrile**	53 4	140^{1}		274–5				138–40^{7}			*di* 202	Picrate, 176–7d , Me ester of acid, 72, lgr
63	**2-Iodobenzonitrile**	55			162	184				154			HCl salt of amine, 248–50, N-Acetyl deriv of amine, 134–5

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S Benzyl thiu ronium chloride	Amine	Benz-amide	Ben-zene sulfon amide	Picrate	
				B P °C	M P °C				B P °C				
64	**2,4,6-Trimethylbenzo-nitrile**	55, bz	225 30		155, lgr	187 8			98 5 100[b]	153 4			Me ester of acid, b p 241 2[718]
65	**α-Aminobenzyl cyanide**	55			256	130 2, al			135[19]	*dl* 223 5			N-Acetyl deriv , 130-8, et ac pet eth N Benzoyl deriv , 151 Picrate, 160-1, yel
66	**Cyanoform** (Tricyano methane)	55 6 pet eth											NH_4 salt, 183
67	**Succinonitrile**	56 6	265 7		186 8	260	230	149	159	177		250 5	M p of amine, 27 N-Acetyl deriv of amine 137
68	**2-Iodo-4-tolunitrile** (2-Iodo-4-methylbenzo-nitrile)	57-8			205 6	167							
69	**2,6-Dinitrobenzonitrile**	58 (145)			202 3								Me ester of acid, 147 M p of amine, 88, HCl salt of amine, 185, H_2PtCl_6 salt of amine, 193
70	***d,l*-2,3-Dimethyl-succinonitrile**	58 9	.....		135	*mono* 148 9, *dl* 244	*dl* 222						Di-Me ester of acid, b p 200
71	**2-Chloro-4-tolunitrile**	61 2			155 6	182							
72	**4-Methoxybenzonitrile**	61 2	256 7		184 6	162 3	169	177 184 5	236 7				N-Acetyl deriv of amine, 96, H_2PtCl_6 salt of amine, 210
73	**2,4-Dichlorobenzonitrile**	61-2			164 160	194			140[122]				Me ester of acid, b p 132[15], n_D^{25} of amine 1 5738, HCl salt of amine, 281 2 4 3
74	**4-Methoxycinnamo-nitrile**	64			170	186							Me ester of acid, 90 Et ester of acid, 49 50
75	**3,5-Dichlorobenzo-nitrile**	65, subl			188				254[6]			241	Me ester of acid, 58, n_D^{26} of amine 1 5690, HCl salt of amine, 300
76	***cis*-1,4-Dicyanocyclo-hexane**	65			168 9								Acid + conc HCl at 180 → *trans* isomer, 300
77	**Bromomalononitrile**	65 6			113d	181							Di-*p*-toluidide of acid, 217
78	**2-Naphthonitrile** (2-Cyanonaphthalene)	66 62	305		184	192, 195						226	M p of amine, 60 N Acetyl deriv of amine, 126, Methiodide deriv of amine, 168, al
79	**Cyanoacetic acid**	66			135 6	170	226 7			120 w			Amide, 119 20, Anilide, 198 9, Warming with benzaldehyde → α-cyanocinnamic ac , 180, M p of amine, 200, HCl salt of amine, 123
80	**2-Cyano-2-ethylbutyric acid** (Diethylcyano-acetic acid)	66 57	240 5, 164[8]		125, w	*mono* 146, *dl* 224							NH_3 → Diethylcyano-acetamide, 121

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfon amide	Picrate	
				B P , °C	M P °C				B P , °C				
81	**2,4-Diphenylglutaronitrile**	66, 70 1	220-7[5]		2 forms (a) 164-5, w , (b) 185-6, chl - pet eth								Di-HCl salt of amine, 319 20, iso-PrOH
82	**α-Chloro-3-tolunitrile**	67, al	258 60		132, w	124						173	HCl salt of amine, 169, H_2PtCl_6 salt of amine, 219
83	**4-Chloro-2-tolunitrile**	67			172	183							
84	**1-Cyanoacenaphthene** (Acenaphthene 1-carbonitrile)	68			161								
85	**Phenylmalononitrile** (α-Cyanobenzyl cyanide)	69			152 3	233							
86	**6-Nitro-2-tolunitrile**	69 70			184	163							Me ester of acid, 66
87	**(4-Hydroxyphenyl) acetonitrile** (4-Hydroxybenzyl cyanide)	69 70, w	330		148-50	175						200	Acetate, 49 50 M p of amine, 160 1
88	**5-Bromo-2-tolunitrile**	70			187	180							
89	**α-Bromo-2-tolunitrile** (2-Cyanobenzyl bromide)	71 2	124[4]		147								Me ester of acid, 32 0- 5
90	**2,2-Diphenylglutaronitrile**	71 2 5			195-7, 183	1-*mono* 142-4							Anhydride of acid, 134, Imide of acid, 158 9
91	**(2-Aminophenyl)acetonitrile** (2-Aminobenzyl cyanide)	72			119	93							N-Acetyl deriv , 120, Benzamide, 175-9, N-Acetyl deriv of acid, 158
92	**3,4-Dichlorobenzonitrile**	72			208 9	133			139 40[17]			228	Me ester of acid, 46 5 7 5, HCl salt of amine 240 2
93	**1,2,2,3-Tetramethylcyclopentene-1-carbonitrile** (Camphoric nitrile)	73	217 9	255	106	80	91, al		210	98			
94	**Dicyanodimethyl amine** (Bis(cyanomethyl) amine)	75, 77			247 5, 225d	*di* 143	*di* 140 5		208	*tri* 166, chl		*tri* 212d	N-Nitroso deriv , 43, N-Benzoyl deriv , 131 2, Tri-HCl salt of amine, 233
95	**Diphenylacetonitrile** (α-Phenylbenzyl cyanide)	75			148	168	180	145	134[2]	144-5		211 2 d	M p of amine, 42 3 5, HBr salt of amine, 205 7
96	**4-Cyano-N,N-dimethylaniline**	75 6	318		242 5-3 5	206	182-3						Me ester of acid, 102, HCl salt of amine, 212
97	**1-Cyanoisoquinoline**	78, 93			161								
98	**4-Cyanopyridine**	78, 83			315	155-6			120 5[12]			179-80, al	HCl salt, 199, $HAuCl_4$ salt, 208 10
99	**α-Chloro-4-tolunitrile** (4-Cyanobenzyl chloride)	78-80, al	263		203	173						185	H_2PtCl_6 salt of amine, 226
100	**2,5-Diphenylvaleronitrile**	79			80-1, lgr								
101	**3-Cyanobenzaldehyde** (3-Formylbenzonitrile)	79-81			175, w	190d							Oxime, 99-101, w , Semicarbazone of acid, 265, Phenylhydrazone of acid, 164

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B P, °C	M P, °C				B P, °C				
102	**6-Nitro-3-tolunitrile**	80			219	151							Me ester of acid, 81-2, Et ester of acid, 55, al
103	**Benzoylacetonitrile**	81			103-4d	113	108					155d	Carbazone of acid, 125, HCl salt of amine, 128
104	**6-Chloro-2-tolunitrile**	82 3			102	167							Me ester of acid, 104
105	**8-Cyanoquinoline**	84, 50% al			187	171-3, w							Et ester of acid, 38 b p 175-7[7]
106	**2-Nitro-3-tolunitrile**	84			223	192							Me ester of acid, 74, me al
107	**2,3,4,5-Tetrachloro-benzonitrile**	84			194 5	207 8, acet - al	197, al						M p of amine 90 1
108	**4-Cyanobiphenyl**	85 6			228	223			195-200[15]				Me ester of acid, 117 8, M p of amine, 128 HCl salt of amine, 308 10 282
109	**2-Naphthylacetonitrile**	86, 81			142	200							
110	*cis*-**2,3-Diphenylacrylo-nitrile**	86	228 30[23]		137-8	167-8, chl - lgr	179, chl - pet eth						
111	**4-Aminobenzonitrile** (4-Cyanoaniline)	86			188	182 9			268 70				N-Acetyl deriv , 205, N-Benzoyl deriv , 170 Picrate, 150
112	**1-Cyano-2-phenylacrylo-nitrile** (Benzalmalono-nitrile)	87			195-6d	*di* 189-90							Di-Me ester of acid, 44 Di-Et ester of acid, 32
113	**5-Bromo-2,4-dimethyl-benzonitrile**	88 90			180-1	197 5-8 5							
114	**2-Cyanotriphenyl-methane**	89	270-85[20-30]		162								Me ester of acid, 98, me al
115	**5-Cyanoquinoline**	89 (*anh*), 70 (+1 5 H_2O)			342								Picrate, 241, Styphnate, 241d , yel HCl salt 248, yel , Me ester of acid, b p 128-32[0 2]
116	**2,6-Dimethylbenzo-nitrile**	90 1			116	138 5-9 0, 120-5			96-8				Me ester of acid, b p 94[9]
117	**Phenylcyanoacetic acid**	92											Amide, 147, Anilide, 136
118	**2-(N-Anilino)-propio-nitrile**	92, al			162, w	144	127, al						Et ester of acid, b p 272
119	**2,4-Dibromobenzonitrile**	92			174	198							Me ester of acid, 33
120	*β*-**(2-Nitrophenyl)-acrylonitrile**	92, w	194-6[7-8]		*cis* 146-7, yel , *trans* 240	185							Et ester of acid, 60
121	**5-Chloro-2-nitro-4-tolunitrile**	93			180-1								
122	*α*-**Bromo-3-tolunitrile** (3-Cyanobenzyl bromide)	93, al			155-6								
123	**4-Nitro-3-tolunitrile**	93-4			134	176-7							Me ester of acid, 78 9, me al
124	**2-(N-Anilino)-isobutyro-nitrile**	93-4, al			184-5, w	136	155, al						
125	**2-Cyanoquinoline**	94			157	133, 123							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B.P., °C	M.P., °C				B.P., °C				
126	**4-Cyanovaleric acid** (2-Methylglutaromononitrile)	95.6, w		205–8[12]	79	*di* 175.6							Di-*p*-toluidide of acid, 74.5, H_2PtCl_6 salt of amine 202.3
127	**Fumaronitrile**	96			295, 300	266	313–4	178, 182					
128	**4-Chlorobenzonitrile**	96, 94.6	223, 95[5]		240	179, 170	194		217	140		210	
129	**9-Phenanthrylacetonitrile**	96.5–7.0			224.5	250–2							
130	**3,5-Dibromobenzonitrile**	97, subl			219.20	187							Me ester of acid, 63
131	**2-Chloro-3-nitrobenzonitrile**	97–101, pa yel			185								Me ester of acid, 70 Et ester of acid, b.p. 314d
132	**2-Hydroxybenzonitrile** (2-Cyanophenol)	98		211[20]	159	133	135						$D_4^{99.6}$ 1.1052, $n_\alpha^{99.6}$ 1.53716 O-Benzoyl deriv., 106, pet. eth., M.p. of amine, 125, 129, H_2PtCl_6 salt of amine 197d HI salt of amine, 184
133	**4-Chloro-2-nitrobenzonitrile**	98			142	172							Me ester of acid, 42–3
134	**4-Cyanotriphenylmethane**	100, me al			165, ac a		196, ac a						
135	**4-Chloro-3-nitrobenzonitrile**	100.1			181–2	156	131					210d	Me ester of acid, 83 HCl salt of amine, 227.8
136	**3-Nitro-4-tolunitrile**	101			164.5	153							
137	**2-Cyano-3-phenylpropionic acid**	101.2, 75			120–1	225							Amide, 130, Di-Me ester of acid, 35.6
138	**3-Cyanophenanthrene**	102			269	233.4, 227–8	216.7						
139	**2,3,3-Triphenylpropionitrile**	102, me al			222–3, al	213							Me ester of acid, 162, HCl salt of amine, 269.72
140	**4-Cyanoquinoline**	102			253.4	181							Methiodide, 216, $HAuCl_4$ salt, 232 Di-HCl salt of amine, 255d
141	**4-Bromo-1-naphthonitrile** (1-Bromo-4-cyanonaphthalene)	102–3			212, 220								Me ester of acid, 42
142	**4-Bromo-2,5-dimethylbenzonitrile**	103–4			171.5–2.5	209–10							
143	**5-Nitro-3-tolunitrile**	104.5			174	164–5							Me ester of acid, 84–5
144	**2,4-Dinitrobenzonitrile**	104.5, al			182–3	203–4							Me ester of acid, 70, Hydrazide of acid, 231.3
145	**4-Nitro-2-tolunitrile**	105			179	173.4							Me ester of acid, 69
146	**6-Chloro-3-nitrobenzonitrile**	105–6			165	178							Me ester of acid, 73.
147	**5-Bromo-3-nitro-2-tolunitrile**	106–7			226	235							
148	**2-Nitro-4-tolunitrile**	107, pa yel			190	166							
149	**9-Cyanophenanthrene**	107, 111.0–3			256.5–7.0	232–3, 226	218			167		241	M.p. of amine, 108.5 HCl salt of amine, 294, N-Acetyl deriv. of amine, 182.3
150	**3-Cyanoquinoline**	108			275	198–9, 195							Picrate of acid, 217–8

* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B P , °C	M P °C				B P , °C				
151	**2-Cyanophenanthrene**	109			259 60	242 3	217 8						
152	**3-Nitro-2-tolunitrile**	109 10			151 2 pa yel	158							Me ester of acid, 50
153	**2-Nitrobenzonitrile**	110			146	174 6	155						HCl salt of amine, 248 50
154	**4-Chloro-1-naphthonitrile** (1-Chloro-4-cyanonaphthalene)	110			223-4, 210	235 6							
155	**5-Cyanoacenaphthene** (Acenaphthene-5-carbonitrile)	110 1			219, bz	198				182-4	148-9		
156	**4-Bromobenzonitrile**	112	235 7		251	189 90			250	143		221	M p of amine, 20 N-Acetyl deriv of amine 113
157	**2,4,5-Trimethoxybenzonitrile**	112 4, al		*ca* 300	144, bz - pet eth	184 5	154 5						Me ester of acid, 97 5 Et ester of acid, 72
158	**4-Hydroxybenzonitrile** (4-Cyanophenol)	113			213-4	162 (+1 H_2O)	196 7						M p of amine, 109 (anh), 95 (+1H_2O) HCl salt of amine 195 HI salt of amine 198 200
159	**2,3-Diphenylvaleronitrile** (2 forms)	(a) 115 al	(a) 235 40^{20} (b) 210 2^{20}		(a) 152-3 (b) 178 lgr								
160	**α-Bromo-4-tolunitrile** (4-Cyanobenzyl bromide)	115 6 al			229 30								Me ester of acid, 54 Et ester of acid, 35 6
161	**(4-Nitrophenyl)acetonitrile** (4-Nitrobenzyl cyanide)	116			153	197 8 191	198						
162	**6-Bromo-3-nitrobenzonitrile**	117			180	197 8	166						
163	**(2-Hydroxyphenyl) acetonitrile** (2-Hydroxybenzyl cyanide)	117 9		240 3	147 9	116 8, al		163					O-Benzoyl deriv 50, lgr HCl salt of amine, 155
164	**3-Nitrobenzonitrile**	118			140	141-3	153 4						HCl salt of amine 224
165	**4-Bromo-3-nitrobenzonitrile**	120			203 4	156							
166	**4-Cyanoazobenzene**	120 1, br , bz			241, red, al	224-5, red							Me ester of acid, 123 4, or , me al , Et ester of acid, 86-7, red, al
167	**Dipicolinonitrile** (2,6-Dicyanopyridine)	123 113			252d 228	*di* 302							Di-Me ester of acid, 124 5 Di-Et ester of acid, 41 2
168	**2-Cyanohexanoic acid**	123-6 5			101	*di* 200	*di* 193						
169	**Dibromomalononitrile** (Bromodicyanomethane)	124			147d 136-7d	*di* 200, 206d							Di-Me ester, 67
170	**1-Cyanoanthracene**	126			245, yel , al	260							Me ester of acid, 108, yel , ac a
171	**2,2,3-Triphenylpropionitrile**	126			162 132	111, al							Me ester of acid, 127
172	**1-Cyanophenanthrene**	128			232-3	284	245						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B P , °C	M P °C				B P , °C				
173	**2,3-Diphenylbutyronitrile** (2 forms)	(a) 129-30	210 2[16]		133-4	173 4							
			(b) 188 92[13]		186	193							Et ester of acid, 91 2
174	**5-Bromo-3-nitro-4-tolunitrile**	130			206	171							
175	**2,5-Dichlorobenzonitrile**	130		301	154	155			135[9]			230	HCl salt of amine, 151 2, n_D^{53} of amine 1 5885
176	**2,5-Dibromobenzonitrile**	132			157								Me ester of acid 40 1, *p*-Nitrophenyl ester of acid, 183 4
177	**5-Bromo-2-nitro-4-tolunitrile**	132			203 200	191							Et ester of acid, 61
178	**2-Hydroxy-3-nitrobenzonitrile** (2 Cyano-6-nitrophenol)	132 3			148	155 145 6							Me ester of acid, 132 (94) al
179	**4-Nitro-1-naphthonitrile** (1-Cyano-4-nitro naphthalene)	133			220 1	218							Me ester of acid 107 8
180	**4-Acetamidobenzonitrile**	133, w			185, ac a	177, al	167 8, al						N-Methylamide of acid, 172, al
181	**6-Cyanoquinoline**	135, bz - lgr			291 2	174, bz - al			158-9[2]				Me ester of acid, 90 HCl salt of amine, 239, n_D^{20} of amine 1 6390
182	**Apiolonitrile** (2,5-Dimethoxy-3,4-methylenedioxybenzonitrile)	135 5, al			175, w								Me ester of acid, 71 2, al
183	**1-Nitro-2-naphthonitrile** (2-Cyano-1-nitronaphthalene)	138			239								Hot aq $Ba(OH)_2$ → 1-hydroxy-2 naphthoic acid, 191 2 al
184	**3,5-Dichloro-2-hydroxybenzonitrile**	139			219 5 223	209							Me ester of acid 147
185	***trans*-1,4-Dicyanocyclohexane**	140			300								Di-Me ester of acid, 71
186	**3,3,3-Triphenylpropionitrile**	140, al			177	198							Me ester of acid, 120-1 5
187	**4-Cyano-2-phenylquinoline** (2-Phenyl-4-quinolinonitrile)	140, al	*ca* 365		218	196	198						M p of amine >287 HCl salt of amine 232 5
188	**Phthalonitrile** (*o*-Dicyanobenzene)	141			200 6	*di* 219	*di* 253	*di* 151, 157		*di* 184		170	N,N -Diacetyl deriv of diamine, 146
189	**8-Nitro-2-naphthonitrile** (2-Cyano-8-nitronaphthalene)	143			295, 288	218							Et ester of acid, 121 lgr
190	**5-Chloro-2-naphthonitrile** (5-Chloro-2-cyanonaphthalene)	144			270	186-7	202						Me ester of acid 81 Et ester of acid 45
191	**5-Chloro-1-naphthonitrile** (5-Chloro-1-cyanonaphthalene)	145			245, 241 2	239							Et ester of acid, 42
192	**3,5-Dichloro-4-hydroxybenzonitrile**	146			269, 265								Acetate, 93 Me ester of acid, 122
193	**4-Nitrobenzonitrile**	147, 149			241	200	211, 204					184 5	HCl salt of amine, 235-40
194	**5-Bromo-1-naphthonitrile** (1-Bromo-5-cyanonaphthalene)	147			261, 256	241							Et ester of acid, 48 9

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate	
				B P , °C	M P °C				B P °C				
195	**5-Iodo-2-naphthonitrile** (2-Cyano 5 iodonaphthalene)	148 5			264, al	196	203						M p of amine, 120 HCl salt of amine, 251 3 N-Acetyl deriv amine 135-6
196	**3-Cyano-3-phenylpropionic acid**	150	215 8^{10}		166-7								Di-Me ester of acid, 55, al , Imide of acid, 88-90, M p of amine, 209 HCl salt of amine, 203, N-Acetyl deriv of amine, 65
197	**2-Cyano-2-propylvaleramide** (Dipropylcyanoacetamide)	153			161	*dl* 214	*dl* 168 8 5, me al						
198	**2,6-Dibromobenzonitrile**	155, subl	308 9		157	208 5							Me ester of acid, 83 Hydrazide of acid, 204
199	**3-Chloro-4-hydroxybenzonitrile**	155			169-70, w , 164 5	180-2							Me ester of acid, 106 7, Et ester of acid, 77-8
200	**5-Chloro-2,4-dinitrobenzonitrile**	156			182 3	212	226						
201	**4-Benzamidobenzonitrile** (N-Benzoylanthranilonitrile)	156			181	218 9	279						Me ester of acid, 100 Et ester of acid 98
202	**5-Bromo-2-hydroxybenzonitrile**	158-9			165	232	222						O-Acetyl deriv of acid, 60
203	***d l*-2,3-Diphenylsuccinonitrile**	160			183 (+1 H_2O)		*mono* 173 5, al						
204	**Isophthalonitrile** (*m*-Dicyanobenzene)	161 5 2 0			345 7	*dl* 280							
205	**2-Hydroxy-4-nitrobenzonitrile** (2-Cyano-5-nitrophenol)	160 1, yel			235, 226, w	192 4							Benzoate, 122, yel , al , Et ester of acid, 84-5
206	***d l*-4-Cyano-3,4-diphenylbutyric acid** (*d l*-2,3-Diphenylglutaromononitrile)	162 3, bz			208-10 (cor), aq ac a	*mono* 200-5 d , al	*mono* 201-2, 50% al						Et ester, 99-100, al , Imide of acid, 225-9, aq al
207	***d*-3-Carboxy-2,2,3-trimethylcyclopentylacetonitrile**	164				233, $PhNO_2$							$[\alpha]_D$ +64 41, Me ester, 77, Et ester, 58
208	**5-Chloro-2-hydroxybenzonitrile** (4-Chloro-2-cyanophenol)	165-7			172, 167 5	226							Me ester of acid, 84
209	**2,3-Diphenylcinnamonitrile** (Cyanotriphenylethylene)	166 7, 162-3			213	223							
210	**1,7-Dicyanonaphthalene**	167, al			294-6								
211	**4,4'-Dicyanodiphenylmethane**	169			334, 290								Di-Me ester of acid, 81 2
212	**2,2'-Diphenic acid mononitrile** (2-Carboxy-2'-cyanobiphenyl)	170 2, bz			233 5	*mono* 193, *dl* 212	*mono* 181-3						Di-Me ester of acid, 74, Me ester, 110, Et ester, 91-2
213	**5-Nitro-2-naphthonitrile** (2-Cyano-5-nitronaphthalene)	172-3			295, yel	261-3, br -yel							Me ester of acid, 112, yel

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S-Benzylthiuronium chloride	Amine	Benzamide	Benzenesulfonamide	Picrate	
				B P °C	M P °C				B P °C				
214	**9-Cyanoanthracene** (9-Anthracenecarbonitrile)	175, 170-2			207, pa yel								Me ester of acid, 111, M p of amine, 90
215	**2,3-Dicyanopyridine**	175 6			228 9	*2-mono* 168 5d, *di* 165							
216	**1,3-Dicyanonaphthalene**	179, ac a			267 8								
217	**3-Cyanocoumarin**	182			187 d	236	250						Me ester of acid, 116 7 Et ester of acid, 64
218	**2-Cyanocinnamic acid**	183, al			195 6d	*di* 189-90							NH_3 → 2-Cyanocinnamamide, 123 Me ester of nitrile 89 Di-Me ester of acid, 44 5
219	**2-Cyanobenzoic acid**	187, 192			200 6	*di* 219	*di* 253	*di* 151, 157		*di* 184		170	NH_3 → 2-Cyanobenzamide, 173 Me ester 51 Et ester, 70 65
220	**1,2-Dicyanonaphthalene**	190, bz			175	*di* 265							
221	**2-Hydroxy-5-nitrobenzonitrile** (2-Cyano-4-nitrophenol)	194-6, yel , w			229-30, 227	225, al							*p*-Nitrobenzoyl ester of acid, 115
222	**Tetracyanoethylene**	198 200, subl	223										n_D^{25} 1 560 D^2 1 348 N,N Dimethylaniline → N,N-dimethyl 4-tricyanovinylaniline 173 5, ac a Anthracene → adduct, 268 70, acet
223	**5-Nitro-1-naphthonitrile** (1-Cyano-5-nitronaphthalene)	205			241 2, 239	235 6							Me ester of acid, 109-10, Et ester of acid, 93
224	**1,4-Dicyanonaphthalene**	208, ac a			309, 288								Di-Me ester of acid, 67 Di-Et ester of acid, 64
225	**1,6-Dicyanonaphthalene**	208-10			310								Di-Me ester of acid, 99
226	**1,5-Dicyanonaphthalene**	211, 266-7			310, ac a								Di-Me ester of acid, 114 5 Di-Et ester of acid, 123-4
227	**3-Cyanobenzoic acid**	217			345	280							NH_3 → 3-Cyanobenzamide, >300 Me ester, 65, Et ester, 56
228	**4-Cyanobenzoic acid**	219			*ca* 300, subl	*di* >250	*di* 334-7					232 d	NH_3 → 4-Cyanobenzamide, 223, Me ester, 62, Et ester, 54
229	**Terephthalonitrile** (*p*-Dicyanobenzene)	222			*ca* 300, subl	*di* >250	*di* 334-7					232d	N,N'-Diacetyl deriv of diamine, 225
230	**1,8-Dicyanonaphthalene**	232			260	*di* 250-82d							Di-Me ester of acid, 102 3, Di-Et ester of acid, 58 60
231	**4,4'-Dicyanobiphenyl**	233 4											Di-Me ester of acid, 214 224, Di-Et ester of acid, 112, Heating acid with lime → biphenyl, 71
232	***l*-2,3-Diphenylsuccinonitrile**	239 40			176-7, 190, w								Imide of acid, 196 8, ac a

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH_2NH_2				Miscellaneous
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfon amide	Picrate	
				B P °C	M P °C				B P °C				
233	**1-Cyano-9,10-anthraquinone**	247, yel, ac a			293 4, pa yel, ac a	280, pa yel, al	288–9, pa yel, $PhNO_2$						Me ester of acid, 189, yel, Et ester of acid, 169, yel
234	**2,3-Dicyanonaphthalene**	251, al			239–41								Imide of diacid, 275
235	**2,7-Dicyanonaphthalene**	267 8, ac a			>320	*dt* 297–8							Di-Me ester of acid 135–6
236	**2,6-Dicyanonaphthalene**	293, al			>300 d	*dt* >320							Di-Me ester of acid, 191

*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives

Sulfonyl chloride

$$RSO_3Na + PCl_5 \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} + POCl_3 + NaCl$$

From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent

For directions and examples see Cheronis, p 638, Linstead, p 89, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

Sulfonamide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow{NH_3} \underset{\text{Sulfon amide}}{RSO_2NH_2}$$

From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution

For directions and examples see Linstead, p 49, Shriner, pp 268, 270 Vogel, p 553, Wild, p 161

From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

See Cheronis, p 639

Sulfonanilide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow[NaOH]{C_6H_5NH_2} \underset{\text{Sulfonanilide}}{RSO_2NHC_6H_5} + NaCl$$

From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide

For directions and examples see Linstead, p 89, Wild, p 161

From the sulfonyl chloride and aniline

See Vogel, p 553

Sulfon-p-toluidide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow[NaOH]{p\text{-}CH_3C_6H_4NH_2} \underset{\text{Sulfon } p\text{-toluidide}}{RSO_2NHC_6H_4CH_3\text{-}p} + NaCl$$

From the sulfonyl chloride, *p*-toluidine and aqueous sodium hydroxide

For directions and examples see Vogel, p 553

Sulfon-1-naphthylamide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow{1\text{-}C_{10}H_7NH_2} \underset{\text{Sulfon-1-naphthylamide}}{RSO_2NHC_{10}H_7\text{-}1} + NaCl$$

From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene

For directions and examples see Cheronis, p 639

S-Benzylthiuronium salt *

$$RSO_3Na + \underset{\text{S-Benzylthiuronium chloride}}{[C_6H_5CH_2SC(NH_2)_2]^+Cl^-} \rightarrow \underset{\text{S-Benzylthiuronium sulfonate}}{[C_6H_5CH_2SC(NH_2)_2]^+RSO_3^-} + NaCl$$

From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

For directions and examples see Cheronis, pp 635, 636, Linstead, pp 15, 89 Shriner, p 269, Wild, pp 149, 159, E Chambers and G. W Watt, *J Org Chem*, **6**, 376 (1941), E Campaigne and C M Suter, *J Amer Chem Soc*, **64**, 3040 (1942), S Veibel, *J Amer Chem Soc*, **67**, 1867 (1945)

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol
See J J Donleavy, *J Amer Chem Soc*, **58**, 1004 (1936)

Anilinium salt *

$$RSO_3Na + C_6H_5NH_2 + HCl \rightarrow \underset{\text{Anilinium sulfonate}}{[C_6H_5NH_3]^+RSO_3^-} + NaCl$$

From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water
For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

p-Toluidinium salt *

$$RSO_3Na + p\text{-}CH_3C_6H_4NH_2 + HCl \rightarrow \underset{p\text{ Toluidinium sulfonate}}{[p\text{-}CH_3C_6H_4NH_3]^+RSO_3^-} + NaCl$$

From the sulfonic acid and *p*-toluidine
For directions and examples see Shriner, p 269
From the sodium, potassium or ammonium salt with *p*-toluidine or *p*-toluidine hydrochloride in water
See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942), A D Barton and L Young, *J Amer Chem Soc*, **65**, 294 (1943)
From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with *p*-toluidine and hydrochloric acid
See Cheronis, p 637, Fieser, *J Amer Chem Soc*, **51**, 2460 (1929)

o-Toluidinium salt *

$$RSO_3Na + o\text{-}CH_3C_6H_4NH_2 + HCl \rightarrow \underset{o\text{-Toluidinium sulfonate}}{[o\text{-}CH_3C_6H_4NH_3]^+RSO_3^-} + NaCl$$

From the sodium or the potassium salt of the sulfonic acid with *o*-toluidine and hydrochloric acid in water
For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

Phenylhydrazinium salt *

$$RSO_3H + C_6H_5NHNH_2 \rightarrow \underset{\substack{\text{Phenylhydrazinium}\\ \text{sulfonate}}}{[C_6H_5NHNH_3]^+RSO_3^-}$$

From the sulfonic acid with phenylhydrazine in water-alcohol
For directions and examples see Wild, p 159, P H Latimer and R W Bost, *J Amer Chem Soc*, **59**, 2500 (1937)

Phenols by KOH fusion

$$ArSO_3Na + NaOH \rightarrow \underset{\text{Phenol}}{ArOH} + Na_2SO_3$$

By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible
For directions and examples see Vogel, p 552
By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust
See Linstead, p 89

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide*

No	Name	Melting point °C	S-Benzyl thiuronium salt	*p*-Toluidinium salt	Anilinium salt	*o* Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
1	**Propane-1-sulfonic acid**			67-8			b p 180	52, eth		84	Phenylhydrazine salt, 204 5
2	**Ethane sulfonic acid**		115				b p 171	60, eth		66	Phenylhydrazine salt, 182 8
3	**Propane-2-sulfonic acid**	−37					b p 79[18]	60, eth - pet eth		134	B p 159[1 4], D_4^{25} = 1 1877, n_D^{20} = 1 4332, *m*-T uidide, 109
4	**Heptane-1-sulfonic acid**						16	75			Phenylhydrazine salt, 100 0 5
5	**2,4,5-Trimethoxybenzene sulfonic acid**						130	76	170		
6	**Methane sulfonic acid**	20					b p 60[21]	90	100	125-6	Phenylhydrazine salt, 193 5-4d
7	**Hexadecane-1-sulfonic acid** (Cetyl sulfonic acid)	54					54	97			
8	**10-Bromocamphor-3-sulfonic acid**						97	100 2			
9	**Benzyl sulfonic acid**			113, al	102	83	92 3, eth , bz	105, w , al	102, al	166 (146), yel , al	Diethylamide, 29, Ethylamide, 65-6, Hydrazide, 131-2, Methylamide, 109-10, Phenylhydrazine salt, 173
10	**3-Toluene sulfonic acid** (3-Methylbenzene sulfonic acid)	oil		106		108	12	108, al	96, al		
11	**3-Hydroxynaphthalene-2-sulfonic acid**				241 2		112	110			
12	**Pyridine-3-sulfonic acid**	357					Hydrochloride, 141-4 d	110 1	145		Diethylamide, 49-50, Hydrazide, 94, me al
13	**2,6-Dimethylbenzene sulfonic acid**	98					39	113 (96)			
14	**2-(N-Methylamino)benzene sulfonic acid**	182 d						114 5 5 5			N-4-Toluene sulfonyl, 193
15	**Indane-4-sulfonic acid**						53 3 5	118-9, w			
16	**2-Phenylethane-1-sulfonic acid**	91					33	122	77		
17	**4-Formylbenzene sulfonic acid** (Benzaldehyde-4-sulfonic acid)							122-4			Amide oxime, 185, Dimethylamide, 134-7, Di-O-acetate, 86-7 5, Chloride diacetate, 111-3
18	**2-Methylnaphthalene-1-sulfonic acid**						83-5	124			
19	**4-Fluorobenzene sulfonic acid**						36 (30)	125 (123), w			
20	**4-Chloro-3-methylbenzene sulfonic acid**						65	128	92		Sulfonyl bromide, 67 5
21	**3-Chloro-4-methoxybenzene sulfonic acid**						82	131			
22	**3-Ethoxybenzene sulfonic acid**						38	131			
23	**D-Camphor-10-sulfonic acid**	193					67	132	121		
24	**2-Fluoronaphthalene-6-sulfonic acid**	105					97, chl	133	129		
25	**DL-Camphor-8-sulfonic acid**	56 8					106	133-5, w			
26	**3-Methyl-4-nitrobenzene sulfonic acid**						50	133 5			. .
27	**3-Chloro-4-methylbenzene sulfonic acid**						38	134	96		.
28	**3,5-Dimethylbenzene sulfonic acid**			121-2, al			94 (90), bz	135, al	119, al		.

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point °C	S-Benzyl thiuronium salt	*p* Toluidinium salt	Anilinium salt	*o* Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
29	**Indane-5-sulfonic acid**	92					46–7, eth	135 5 6, al	129, al		
30	**D-Camphor-8-sulfonic acid**						138, $([\alpha]_D^{14}$ +128 7 in chl)	137, $([\alpha]_D^{13}$ +93 6 in al)			
31	**4-Toluene sulfonic acid** (4-Methylbenzene sulfonic acid)	104 5 (92)	181-2	198	238	190	71, eth	*anh* 138 5 9, *dihyd* 105	103, eth -al	157, al	Phenylhydrazide, 155, al , *o*-Toluidide, 110, aq ac a , Triethylammonium salt, 65
32	**2,4-Dimethylbenzene sulfonic acid**	62 (*hyd*)	146				34	139 (137)	110		
33	**4-Vinylbenzene sulfonic acid** (4-Styrene sulfonic acid)			182 3				139 40			Dimethylamide, 62 3
34	**3,4-Dichlorobenzene sulfonic acid**						22 4 (19)	140 (135)			
35	**2-Bromonaphthalene-1-sulfonic acid**						97	140			
36	**2,4,6-Trimethylbenzene sulfonic acid**	77					56	142	109		
37	**3-Aminobenzene sulfonic acid** (Metanilic acid)		148					142			
38	**D-Camphor-2-sulfonic acid**			196 7			88	143	124		Me ester 77, $([\alpha]_D$ +98 6 in chl)
39	**4-Methylnaphthalene-2-sulfonic acid**						124–5, eth	143 4, al			
40	**3,4-Dimethylbenzene sulfonic acid**	64	208				52	144			
41	**4-Chlorobenzene sulfonic acid**	93	175	208 10	222 3	163 4	53	144	104	190	
42	**4-Methyl-3-nitrobenzene sulfonic acid**	92 hyg		130	109	128	36	144 5		153	
43	**3-Bromocamphor-8-sulfonic acid**	195 6 (*anh*)					136 7	145			
44	**5-Chloro-2-methylbenzene sulfonic acid**						24 (21)	145, aq al			
45	**4-Bromo-3-methylbenzene sulfonic acid**						50	146			
46	**4-Methoxy-3-nitrobenzene sulfonic acid**						66	146 3			
47	**3-Chlorobenzene sulfonic acid**			199 200	206 7			148			
48	**2,5-Dimethylbenzene sulfonic acid**		184				24 6	148			
49	**Naphthalene-1-sulfonic acid**	90	137	181	183	237	68 (66)	150	112 (152)		
50	**4-Ethoxybenzene sulfonic acid**						39	150			
51	**4,6-Dichloro-2,5-dimethylbenzene sulfonic acid**						81	150	175		
52	**3-Bromo-4-methylbenzene sulfonic acid**						60	151			
53	**Benzene sulfonic acid**	66	148	205	240	176	14 5	153 (156)	112 (110)	170 1	N-Xanthylsulfonamide, 200
54	**2-Aminobenzene sulfonic acid** (Orthanilic acid)		132					153			N-Benzoyl deriv of amide, 198, Hydrochloride, 201
55	**2-Iodonaphthalene-1-sulfonic acid**						110	154			
56	**2,6-Dichloro-4-methylbenzene sulfonic acid**						56	154–5			
57	**2-Chloro-5-methylbenzene sulfonic acid**						56	156	229 30 5		
58	**2-Toluene sulfonic acid** (2-Methylbenzene sulfonic acid)	57	170	203 4	218		10	156 3	136, aq al		Sulfonyl bromide, b p 138^{10}, N-Xanthylsulfonamide, 182 3 5

*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point, °C	S Benzyl thiuronium salt	*p*-Toluidinium salt	Anilinium salt	*o*-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
59	**3-Bromocamphor-10-sulfonic acid**	47 5					65	156 5			
60	**2,4-Dinitrobenzene sulfonic acid**	106 8 (*hyd*)					102	157 (154)			Hydrazide, 110
61	**2-Methyl-4-nitrobenzene sulfonic acid**	130 (*anh*)				177	106	157			
62	**Benzophenone-3,3′-disulfonic acid**						*di* 137 8	*di* 157	*di* 177 8		Methylamide, 106 7, Dimethylamide, 118 9
63	**3-Nitrobenzyl sulfonic acid**	74					100, bz	159, w			
64	**4,6-Dimethyl-2-hydroxy-1,3-benzene disulfonic acid**						*di* 89 91	*di* 160 1			
65	**2-Nitrodiphenylamine-4-sulfonic acid**	220 d					157	162			
66	**2-Ethoxybenzene sulfonic acid**						65 6	163	158		Phenylhydrazide, 132 3
67	**3-Methyl-2-nitrobenzene sulfonic acid**						58 5	163 5			
68	**3-Amino-6-methylbenzene sulfonic acid**							164	146 7		Chloride of N-acetyl deriv, 124 Chloride of N-chloroacetyl deriv, 87, Amide of N-acetyl deriv, 242
69	**4-Chloro-2-nitrobenzene sulfonic acid**						75	164	138		Anhydride, 114 5, Phenylhydrazide, 151, Ph ester, 82
70	**4-Aminobenzene sulfonic acid** (Sulfanilic acid)		185	109		132		165	200	196	N-Acetyl, 214, Me ester, 92
71	**3,6-Dichloro-2,5-dimethylbenzene sulfonic acid**						71	165	171		
72	**6-Aminonaphthalene-1-sulfonic acid**		172 4					165			Benzoylguanidine salt, 210 11
73	**4-Bromobenzene sulfonic acid**	102 3 (88 9)	170	215 6	237 8	182 3	76, eth	166 (161)	119	183 4	
74	**5-Bromo-2-methylbenzene sulfonic acid**						33 5	167			
75	**2,3-Dimethylbenzene sulfonic acid**						47	167			
76	**5-Chloro-2-methyl-3-nitrobenzene sulfonic acid**						60	167			
77	**3-Nitrobenzene sulfonic acid**	48	146	222	222	193	64	167	126	166 7	
79	**4,6-Dichloro-2-methylbenzene sulfonic acid**						43	168			
80	**4-Chloronaphthalene-2-sulfonic acid**						106	168			Et ester, 76 9
81	**4-Bromo-2-methylbenzene sulfonic acid**						50	168			
82	**Propane-1,3-disulfonic acid**	92, d without melting					*di* 45	*di* 169, w	*di* 129		B p 157[14], Di-*m*-toluidide, 222, Dihydrazide, 105
83	**Propane-1,1-disulfonic acid**							*di* 169 70	151 2, al		Di-(N-ethyl)anilide, 128 9, al
84	**3-Carboxybenzene sulfonic acid** (3-Sulfobenzoic acid)	98 (*hyd*)	163		224 6		*di* 20	*di* 170			
85	**4-Methyl-2-nitrobenzene sulfonic acid**	141 (*anh*)					98 9	170			*o*-Anisidide, 135
86	**2,4-Dimethyl-3-nitrobenzene sulfonic acid**	144 (*anh*)					96	172			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point, °C	S-Benzyl thiuronium salt	*p* Toluidinium salt	Anilinium salt	*o*-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
87	**2,5-Dimethyl-3-nitrobenzene sulfonic acid**	128		135–6		126 5–7 5	60 1	172 3	143 4		
88	**4-Nitrodiphenylamine-2-sulfonic acid**						102–4	173	164		
90	**3,4-Dibromobenzene sulfonic acid**	66 5 7 5 (*anh*)					34	175			
91	**4-Chloro-3-nitrobenzene sulfonic acid**						40 1	175–6, yel, al			
92	**3-Amino-4-methylbenzene sulfonic acid**							176			N-Acetyl of chloride, 144, N-Benzoyl of Chloride, 196, N-Benzoyl, 203
93	**7-Chloronaphthalene-2-sulfonic acid**	118 (*anh*), 68 (*tetrahyd*)					86 5	176			Me ester, 89, Et ester, 65
94	**4-Bromo-3-nitrobenzene sulfonic acid**						55 7	176 7			
95	**4-Hydroxybenzene sulfonic acid**		169	202	170	192		176–7	141		
96	**5-Methylnaphthalene-1-sulfonic acid**	115						176–8			
97	**4-Methylnaphthalene-1-sulfonic acid**						81	177	158		
98	**4-Nitrobenzene sulfonic acid**	95 (109 11), hyg		179 80			80, lgr	180, 50% al	136 (171), al		
99	**3-Chloro-2-methylbenzene sulfonic acid**	60 72, 72 (*anh*)					72, pet eth	180, w			
100	**2,5-Dichlorobenzene sulfonic acid**	93 7 (> 100)	170	247–8	262 3	250–1	38	181 (186)	160	160	
101	**2,4,5-Trimethylbenzene sulfonic acid**	112					61 2	181			
102	**8-Aminonaphthalene-2-sulfonic acid**							181	146 7		N-Acetyl deriv of amide, 213, Benzoylguanidine salt, 214–6
103	**5-Chloro-4-methyl-2-nitrobenzene sulfonic acid**	128					99	181			
104	**2,4-Dichlorobenzene sulfonic acid**	86		204–6		170–2	55	182			
105	**4-Iodobenzene sulfonic acid**						85	183	143		
106	**Quinoline-8-sulfonic acid**	312					124	183 4			Picrate of Na salt, 226 7, Me ester, 96, Et ester, 73
107	**6-Chloronaphthalene-2-sulfonic acid**						110 5	183–4			Me ester, 89, Et ester, 79, Sulfonyl bromide, 124
108	**5-Nitronaphthalene-2-sulfonic acid**	118–9, yel			260		125	184, yel			
109	**4-Chloro-2-methylbenzene sulfonic acid**						54	185			
110	**4-Chloro-2,5-dimethylbenzene sulfonic acid**	100					50	185	155		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point, °C	S-Benzyl thiuronium salt	*p* Toluidinium salt	Anilinium salt	*o* Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
111	**2-Carboxy-5-methylbenzene sulfonic acid**	190 (158), (*anh*)					*di* 59	185			Nitrile of the sulfonyl chloride, 67, lgr, NH_4 salt of 2-amide, 186 (monohyd)
112	**8-Chloronaphthalene-2-sulfonic acid**						94	185-6			Et ester, 92
113	**2-Chloro-5-nitrobenzene sulfonic acid**	168-9 d (*hyd*)					89-90, w	185 6, w			
114	**2-Bromobenzene sulfonic acid**						51, eth	186, w			
115	**2,3-Dichloro-6-methylbenzene sulfonic acid**						49	186			
116	**2-Methyl-5-nitrobenzene sulfonic acid**	133 5 (*di-hyd*)		256 7		256-8	46 7	186	148		
117	**2-Chloro-4-methylbenzene sulfonic acid**						46 (52)	186			
118	**3,5-Dichloro-2-methylbenzene sulfonic acid**						54	186			
119	**6-Chloro-3-nitrobenzene sulfonic acid**	168 9					90, eth	186, w			
120	**2,4-Dimethyl-5-nitrobenzene sulfonic acid**	132 (122), dil HNO_3					98	187 (179)			Sulfonyl fluoride, 109-10
121	**2-Methyl-5-nitrobenzene sulfonic acid**	131					46 7 (44), eth -pet eth	187	148		
122	**4-Chloronaphthalene-1-sulfonic acid**	130 3 d			145-6	151	95	187	145-6	162	Me ester, 83, Et ester, 104
123	**8-Iodonaphthalene-1-sulfonic acid**						115	187	140		
124	**2,4-Diaminobenzene-1,5-disulfonic acid**						275	187	236		
125	**2,6-Dichloro-3-methylbenzene sulfonic acid**						19 5	188			
126	**4-Nitronaphthalene-1-sulfonic acid**						99	188			
127	**2-Chlorobenzene sulfonic acid**						28 5, eth	188			
128	**5-Methylnaphthalene-2-sulfonic acid**						120-2	188 9	248-50		
129	**Phenanthrene-3-sulfonic acid**	175 6 (*anh*), 120-1 (*mono-hyd*), 88-9 (*di-hyd*)		222			110-1 (108)	190			Me ester, 119-20, al, Et ester, 107 8
130	**2,4-Dibromobenzene sulfonic acid**	110 (*anh*)					79, eth	190			
131	**8-Nitronaphthalene-1-sulfonic acid**	115 (*tri-hyd*)					165 d	190 5-1 5	178-8 5		
132	**4-Methylbenzene-2,4-disulfonic acid**	oil		277 d	*di* 189	170-1	54 (56), eth	*di* 190 5-1	189		
133	**3,5-Dichloro-4-methylbenzene sulfonic acid**						69	191			
134	**2,5-Dimethyl-6-nitrobenzene sulfonic acid**	145 (*anh*)		158 5-9, al		143-5, 50% al	110, eth -pet -eth	192, 50% al	182, bl, al		

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point, °C	S-Benzyl thiuronium salt	*p*-Toluidinium salt	Anilinium salt	*o* Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1 naphthylamide	Miscellaneous
135	**Quinoline-6-sulfonic acid**	>260					91	192			
136	**3,4-Dicarboxybenzene sulfonic acid** (4-sulfophthalic acid)	138–40 (*monohyd*)					167–70 d, eth	192–200 d, w			
137	**2-Nitrobenzene sulfonic acid**	70 (85)					69	193	115		
138	**Phenanthrene-9-sulfonic acid**	174 (*anh*) 134 (*hyd*)		235			127	193 4, al			Me ester, 106, me al, Et ester, 108, al
139	**2-Carboxybenzene sulfonic acid** (2-Sulfobenzoic acid)	68 9 (*hyd*), 134 (*anh*)	206	197 (200)	165	127–8	79, pet eth, 40, eth	*C* 193–4 (*anh*), *S* 153 4, sl htng	194 5		
140	**4-Bromonaphthalene-1-sulfonic acid**						87	195			
141	**2,5-Dibromobenzene sulfonic acid**	128 (*anh*)					71, pet eth -eth	195, al			
142	**7-Methylnaphthalene-1-sulfonic acid**						96	195–6	162 4		
143	**5-Fluoronaphthalene-1-sulfonic acid**	105 6					122–3	196–7			Me ester, 118, eth
144	**Acenaphthene-3-sulfonic acid**				284 6		113–4	196–9			Me ester, 122–3, Et ester, 137–9, lgr
145	**2,5-Dimethyl-4-nitrobenzene sulfonic acid**	140		143 5 4 5		143 5 4 5	75	197–8	131		
146	**8-Chloronaphthalene-1-sulfonic acid**						101 (96 8)	197 6			Me ester, 70, Et ester, 67–8
147	**4-Chloro-3-methyl-5-nitrobenzene sulfonic acid**						52	201			
148	**5-Amino-2-hydroxybenzene sulfonic acid** (4-Aminophenol-2-sulfonic acid)	100 (*anh*)						202	159		Pyridine salt of O,N-diacetyl deriv, 143–4
149	**4-Nitrobenzyl sulfonic acid**	71					90	204	220		
150	**Anthracene-1-sulfonic acid**						90	205			
151	**6-Methylnaphthalene-2-sulfonic acid**						97 8	205 6			
152	**4-Iodonaphthalene-1-sulfonic acid**						124 (121)	206 (204)	136		
153	**4-Fluoronaphthalene-1-sulfonic acid**	100					86, chl	206	144		Et ester, 93
154	**4-Aminonaphthalene-1-sulfonic acid** (Naphthionic acid)		195					206			N-Acetyl deriv of amide, 241 N-Acetyl deriv of anilide, 231
155	**4-Amino-2-nitrobenzene sulfonic acid**						59–60	206 7			
156	**Retene-6-sulfonic acid**	121–3					146–7 5	206 7 5			Me ester, 117 9, Et ester, 114 5
157	**2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonic acid**						119	208	207		
158	**4-(N-methylamino)benzene sulfonic acid**	244 5 d						210–1			N-4-Toluenesulfonyl, benzidine salt, 255
159	**6-Chloronaphthalene-1-sulfonic acid**						70	214			Et ester, 114–5
160	**1-Nitronaphthalene-2-sulfonic acid**	105, grn			(202)		120–1, pink, bz - pet eth	214, 50% al	202		
161	**2,5-Dichlorobenzene-1,3-disulfonic acid**						114	215–7			

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point, °C	S-Benzyl thiuronium salt	*p*-Toluidinium salt	Anilinium salt	*o*-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon 1 naphthylamide	Miscellaneous
162	**5-Methylbenzene-1,3-disulfonic acid**						94, eth	216, w	153, al		
163	**Naphthalene-2-sulfonic acid**	91, hyg	190 1	221	269	213	76 (79)	217 (213)	132		
164	**4-Acetamidobenzene-1-sulfonic acid**							218		215	
165	**5-Aminonaphthalene-2-sulfonic acid**		191					218 9 d	127-8		N-Acetyl, 238-9
166	**8-Nitronaphthalene-2-sulfonic acid**	135-6 (*hyd*)					169	223, 228	172-3		
167	**5-Chlorobenzene-1,3-disulfonic acid**						106	224			
168	**2-Methylbenzene-1,4-disulfonic acid**						98, bz - pet eth	*di* 224	*di* 178		
169	**4-Carboxy-3-nitrobenzene sulfonic acid**	111 ($+2\frac{1}{2}$-H_2O)					*di* 160	*di* 226, *mono-S* 192			
170	**5-Chloronaphthalene-1-sulfonic acid**						95	226	138		Me ester, 89, Et ester, 46 Sulfonyl bromide, 110
171	**3,4-Di-iodobenzene sulfonic acid**	122 5, after drying at 100					82, bz - pet eth	227, aq al			Me ester, 93, al , Et ester, 82 5, al
172	**2,4,6-Tribromobenzene sulfonic acid**	64					64	228	220-2		
173	**4'-Nitrobiphenyl-4-sulfonic acid**						178	228			
174	**3,4-Dichloro-2-methylbenzene sulfonic acid**						52	228			
175	**Benzene-1,3-disulfonic acid**		214				63	229	148 50	245	Alkali fusion → resorcinol, 110
176	**Biphenyl-4-sulfonic acid**						115	230	125		
177	**2,4-Di-iodobenzene sulfonic acid**	162 (*anh*)					77 8	230			Me ester, 78, al , Et ester, 57, al
178	**1-Ethoxybenzene-2,5-disulfonic acid**						*di* 106-8	*di* 233			
179	**Methane disulfonic acid** (Methionic acid)						8, b p 133^{10}	*di* 233	*di* 192-3		B p $220\text{-}70^{10\text{-}15}$ d
180	**3,5-Dinitrobenzene sulfonic acid**						99, chl - lgr	235, w , al			
181	**4-Aminobenzene-1,3-disulfonic acid** (Aniline-2,4-disulfonic acid)	120 d						*di* 235			
182	**5-Iodonaphthalene-1-sulfonic acid**						114	236 (239)			
183	**5-Nitronaphthalene-1-sulfonic acid**				265		113	236	123		Me ester, 117 8, chl
184	**4-Carboxybenzene sulfonic acid** (4-Sulfobenzoic acid)	94 (*hyd*), 260 (*anh*)	213					*di* 57	*di* 236	*di* 252	
185	**2,3-Dichloro-4-methylbenzene sulfonic acid**						41	237			
186	**6-Hydroxynaphthalene-2-sulfonic acid**	167 (*anh*), 129 (*hyd*)	217 (207)	248	264	208		237	161		
188	**4-Methylbenzene-1,2-disulfonic acid**						109-11, bz -pet eth	237 9	190, al		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point °C	S-Benzyl thiuronium salt	*o* Toluidinium salt	Anilinium salt	*p*-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1 naphthylamide	Miscellaneous
189	**4,5-Dimethylbenzene-1,3-disulfonic acid**						79, yel , al	239	200, al		
190	**4-Hydroxybenzene-1,3-disulfonic acid** (Phenol-2,4-disulfonic acid)	>100 d					*di* 89	*di* 239	*di* 205		
191	**4-Methoxybenzene-1,3-disulfonic acid**						86	240	209		
192	**4-Acetamidonaphthalene-1-sulfonic acid** (Acetylnaphthionic acid)			232 3	231 2			241	231		
193	**Naphthalene-2,7-disulfonic acid**		212	299	251-2	238	158 (162), bz	242			
194	**5-Nitrobenzene-1,3-disulfonic acid**						*di* 97 8	*di* 242			
195	**2,4,6-Trimethylbenzene-1,3-disulfonic acid** (Mesitylene disulfonic acid)						*di* 125	*di* 244	*di* 150-1		
196	**2,3,4,6-Tetrabromobenzene sulfonic acid**						96 5	*ca* 245 d			
197	**4,6-Dimethylbenzene-1,3-disulfonic acid**						130, pet eth	249, w	196, 50% al		
198	**1-Chloronaphthalene-2-sulfonic acid**	130 3 d (*anh*)					84-5	250	171 2		Et ester, 104
199	**Azobenzene-4,4′-disulfonic acid**	169 d (*anh*)					*di* 222 (170)	*di* 250 d			
200	**Phenanthrene-2-sulfonic acid**	150		291			156, ac a	253-4, al	157 8		Me ester, 101-2 (96-8), Et ester, 89, yel br , al
201	**Benzene-1,2-disulfonic acid**		206				143	254	241		Imide, 186
202	**2-Amino-5-methylbenzene-1,4-disulfonic acid**	d at 290					*di* 156, chl	*di* 257, w	*di* 196-7, aq al		
203	**5-Aminonaphthalene-1-sulfonic acid** (Laurent's acid)		179					259-60	171		N-Acetyl deriv of aniline salt, 344
204	**2-Methylbenzene-1,3-disulfonic acid**						88, bz	>260	162, al		
205	**Anthracene-2-sulfonic acid**						122, yel , tol	261	201		Me ester, 157, yel , Et ester, 160, Phenylhydrazide, 210
206	**Anthraquinone-2-sulfonic acid**		211	308	309		197, pa yel , bz	261, yel , ac a	193, yel -br		Me ester, 123, Et ester, 125
207	**7-Nitronaphthalene-1-sulfonic acid**						169 70	261 2			
208	**Azoxybenzene-3,3 -disulfonic acid**	126					138	273			
209	**Naphthalene-1,4-disulfonic acid**						160 (166)	273, w , al	179		
210	**4,6-Dichlorobenzene-1,3-disulfonic acid**						123	276			
211	**Benzidine-2,2′-disulfonic acid**						Hydrochloride, 205	278			
212	**9,10-Dichloroanthracene-2-sulfonic acid**						221	279	248		
213	**4-Nitronaphthalene-2,7-disulfonic acid**						*di* 140 1	*di* 286-7			
214	**Benzene-1,4-disulfonic acid**						131 (139)	288	249		
215	**Azobenzene-3,4′-disulfonic acid**						*di* 123 5	*di* 288			
216	**Naphthalene-1,3-disulfonic acid**						*di* 137 5	*di* 292 3			
217	**2,5-Dimethylbenzene-1,3-disulfonic acid**						81, lgr	295, al	174, al		
218	**Naphthalene-1,6-disulfonic acid**	125 (*anh*)	81	314-5	298-9	323 4	129, bz	297-8			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

a) Listed in order of increasing m.p. of the corresponding sulfonamide* (Continued)

No	Name	Melting point °C	S-Benzyl thiuronium salt	*p* Toluidinium salt	Anilinium salt	*o* Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon 1 naphthylamide	Miscellaneous
219	**Naphthalene-1,7-disulfonic acid**						*di* 123	*di* 298 300			
220	**Biphenyl-4,4 -disulfonic acid**	72	171	330			203	300			
221	**Naphthalene-2,6-disulfonic acid**		256				225, bz	305			
222	**Azobenzene-3,3 -disulfonic acid**						166	305			
223	**Naphthalene-1,5-disulfonic acid**	240 5 (*anh*)	257 (251)				*di* 183	*di* 310 (>340)	*di* 249		Di-Me ester, 205, chl
224	**Benzene-1,3,5-trisulfonic acid**	>100					*tri* 187	*tri* 310 5	*tri* 237		Tri-Et ester, 147, bz
225	**Anthracene-1,5-disulfonic acid**						*di* 249, pa yel	*di* >330, yel	*di* 293		
226	**Anthracene-1,8-disulfonic acid**						225 yel, bz	333	224		
227	**Anthraquinone-1,8-disulfonic acid**	293 4					222 3, yel $PhNO_2$	>340	237 8, yel, $PhNO_2$		
228	**Anthraquinone-1,5-disulfonic acid**	310-1 (*hyd*), yel					265-70, yel, $PhNO_2$	>350	269 70, red-yel, $PhNO_2$		

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

b) M.p. of the amide deriv. not available; listed in order of increasing m.p. of the corresponding anilide deriv.*

No	Name	Melting point, °C	S-Benzyl thiuronium salt	*p*-Toluidinium salt	Anilinium salt	*o*-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfon anilide	Sulfon-1-naphthylamide	Miscellaneous
1	**Ethane-1,2-disulfonic acid**	104	201 2	270 d	270, w		*di* 95		69		*m*-Toluidide, 230, Di-Et ester, 77, eth
2	**Vinylsulfonic acid** (Ethylenesulfonic acid)		145 6, w				b p 118 20^{250}		71, b p 174[1]		B p 135[2], n_D^{25} 1 4505
3	**Phenol-O-sulfonic acid**	145 (hyd)		124-5	165				126 5-7 5		
4	**8-Aminonaphthalene-1-sulfonic acid** (Peri acid)		300						139 40		Anilinium salt of N-acetyl deriv , 273
5	**3,5-Dimethyl-2-hydroxybenzene sulfonic acid**	121 5 d							142 3		Chloride of O-acetyl deriv , 62, pet eth , Methylanilide, 111 2
6	**Benzophenone-2-sulfonic acid**						96-7		143 5		
7	**7-Hydroxynaphthalene-1,3,6-trisulfonic acid**						196		152-5		
8	**1-Hydroxynaphthalene-2-sulfonic acid**	>250	169						O-acetyl deriv , 157-8		O-acetyl deriv of *p*-toluidide, 135-6
9	**2-Hydroxynaphthalene-1,6-disulfonic acid**						*di* 111		*di* 191		
10	**Anthraquinone-2,7-disulfonic acid**						*di* 186, chl eth		*di* 192		
12	**7-Hydroxynaphthalene-1,3-disulfonic acid** (G-Acid)		228	294		271	161-2		195		
13	**7-Hydroxynaphthalene-1-sulfonic acid** (Bayer Acid)		218	232	240	242			195		
14	**4-Hydroxynaphthalene-1-sulfonic acid** (NW-Acid)	170, r h	103	196	186 7	203-4			199-200		2-Naphthylamide, 204
15	**5-Hydroxynaphthalene-1-sulfonic acid**	110-2 d							201		Chloride of O-acetyl deriv , 129
16	**2-Hydroxynaphthalene-3,6-disulfonic acid** (R-Acid)		233	250	254	257			202		
17	**Anthraquinone-1-sulfonic acid**	218	191		284		216 8, yel , $PhNO_2$		214, gold-yel		$NH_3 \rightarrow$ 1-Aminoanthraquinone, 252 (243)
18	**Anthraquinone-1,6-disulfonic acid**	215 7, gold, ac a					197 8, yel , $PhNO_2$		227 8, yel , cl -bz		
19	**2-Hydroxynaphthalene-1,5-disulfonic acid**						*di* 177		*di* 231		
20	**2-Hydroxynaphthalene-1,7-disulfonic acid**			219			169		233		
21	**Anthraquinone-1,7-disulfonic acid**	120 (*hyd*)					231-2, br-yel , $PhNO_2$		237 8, yel , cl -bz		
22	**Anthraquinone-2,6-disulfonic acid**						*di* 250, yel , cl -bz		*di* 321		

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives

Sulfonyl chloride

$$RSO_3Na + PCl_5 \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} + POCl_3 + NaCl$$

From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent

For directions and examples see Cheronis, p 638, Linstead, p 89, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

Sulfonamide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow{NH_3} \underset{\text{Sulfon amide}}{RSO_2NH_2}$$

From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution

For directions and examples see Linstead, p 49, Shriner, pp 268, 270 Vogel, p 553, Wild, p 161

From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

See Cheronis, p 639

Sulfonanilide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow[NaOH]{C_6H_5NH_2} \underset{\text{Sulfonanilide}}{RSO_2NHC_6H_5} + NaCl$$

From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide

For directions and examples see Linstead, p 89, Wild, p 161

From the sulfonyl chloride and aniline

See Vogel, p 553

Sulfon-p-toluidide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow[NaOH]{p\text{-}CH_3C_6H_4NH_2} \underset{\text{Sulfon } p\text{-toluidide}}{RSO_2NHC_6H_4CH_3\text{-}p} + NaCl$$

From the sulfonyl chloride, *p*-toluidine and aqueous sodium hydroxide

For directions and examples see Vogel, p 553

Sulfon-1-naphthylamide *

$$RSO_3Na \rightarrow \underset{\text{Sulfonyl chloride}}{RSO_2Cl} \xrightarrow{1\text{-}C_{10}H_7NH_2} \underset{\text{Sulfon-1-naphthylamide}}{RSO_2NHC_{10}H_7\text{-}1} + NaCl$$

From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene

For directions and examples see Cheronis, p 639

S-Benzylthiuronium salt *

$$RSO_3Na + \underset{\text{S-Benzylthiuronium chloride}}{[C_6H_5CH_2SC(NH_2)_2]^+Cl^-} \rightarrow \underset{\text{S-Benzylthiuronium sulfonate}}{[C_6H_5CH_2SC(NH_2)_2]^+RSO_3^-} + NaCl$$

From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

For directions and examples see Cheronis, pp 635, 636, Linstead, pp 15, 89 Shriner, p 269, Wild, pp 149, 159, E Chambers and G. W Watt, *J Org Chem*, **6**, 376 (1941), E Campaigne and C M Suter, *J Amer Chem Soc*, **64**, 3040 (1942), S Veibel, *J Amer Chem Soc*, **67**, 1867 (1945)

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol
See J J Donleavy, *J Amer Chem Soc*, **58**, 1004 (1936)

Anilinium salt *

$$RSO_3Na + C_6H_5NH_2 + HCl \rightarrow \underset{\text{Anilinium sulfonate}}{[C_6H_5NH_3]^+RSO_3^-} + NaCl$$

From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water
For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

p-Toluidinium salt *

$$RSO_3Na + p\text{-}CH_3C_6H_4NH_2 + HCl \rightarrow \underset{p\text{ Toluidinium sulfonate}}{[p\text{-}CH_3C_6H_4NH_3]^+RSO_3^-} + NaCl$$

From the sulfonic acid and *p*-toluidine
For directions and examples see Shriner, p 269
From the sodium, potassium or ammonium salt with *p*-toluidine or *p*-toluidine hydrochloride in water
See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942), A D Barton and L Young, *J Amer Chem Soc*, **65**, 294 (1943)
From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with *p*-toluidine and hydrochloric acid
See Cheronis, p 637, Fieser, *J Amer Chem Soc*, **51**, 2460 (1929)

o-Toluidinium salt *

$$RSO_3Na + o\text{-}CH_3C_6H_4NH_2 + HCl \rightarrow \underset{o\text{-Toluidinium sulfonate}}{[o\text{-}CH_3C_6H_4NH_3]^+RSO_3^-} + NaCl$$

From the sodium or the potassium salt of the sulfonic acid with *o*-toluidine and hydrochloric acid in water
For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, *J Org Chem*, **7**, 581 (1942)

Phenylhydrazinium salt *

$$RSO_3H + C_6H_5NHNH_2 \rightarrow \underset{\substack{\text{Phenylhydrazinium}\\ \text{sulfonate}}}{[C_6H_5NHNH_3]^+RSO_3^-}$$

From the sulfonic acid with phenylhydrazine in water-alcohol
For directions and examples see Wild, p 159, P H Latimer and R W Bost, *J Amer Chem Soc*, **59**, 2500 (1937)

Phenols by KOH fusion

$$ArSO_3Na + NaOH \rightarrow \underset{\text{Phenol}}{ArOH} + Na_2SO_3$$

By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible
For directions and examples see Vogel, p 552
By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust
See Linstead, p 89

*Derivatives recommended for first trial
WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)*

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	*p*-Toluidine	Aniline	*o* Toluidine	
1	**Methanedisulfonyl chloride**	8	b p 220 $70^{15\ 20}$d	233	192-3						B p 133[10]
2	**2-Ethylbenzenesulfonyl chloride**	11 7		100							
3	**3-Methylbenzenesulfonyl chloride** (Toluene-3-sulfonyl chloride)	12		108, al	96						
4	**4-Ethylbenzenesulfonyl chloride**	12		110							N-Xanthylsulfonamide 196
5	**Benzenesulfonyl chloride**	14 5	43 4 (monohyd) 66 (anh)	156, 153		170 1	148	205	240	176	N-Xanthylsulfonamide, 200
6	**Heptane-1-sulfonyl chloride**	16		75							
7	**2,6-Dichloro-3-methylbenzenesulfonyl chloride**	19 5		188							
8	**3-Carboxybenzenesulfonyl chloride**	20	98 (hyd), 148 (anh)	*di* 170			163	224 6			The m p is that of the 1,3-dichloride
9	**3,4-Dichlorobenzenesulfonyl chloride**	22 4 19		140 135							
10	**5-Chloro-2-methylbenzenesulfonyl chloride**	24		145, aq al							
11	**2,5-Dimethylbenzenesulfonyl chloride**	24 6	48 (anh) 86 (hyd)	148			184				N-Xanthylsulfonamide, 176
12	**2-Chlorobenzenesulfonyl chloride**	28 5		188							
13	**2-Phenylethane-1-sulfonyl chloride**	33	91	122	77						
14	**5-Bromo-2-methylbenzenesulfonyl chloride**	33 5		166 7							
15	**2,4-Dimethylbenzenesulfonyl chloride**	34	62 (hyd)	110							
16	**3,4-Dibromobenzenesulfonyl chloride**	34	66 5 7 5 (anh)	175							
17	**2,4,6-Trichlorobenzenesulfonyl chloride**	35 40		210 2d							
18	**4-Methyl-3-nitrobenzenesulfonyl chloride**	36	92, hyg	144 5	109	153		130-1		28	
19	**4-Fluorobenzenesulfonyl chloride**	36, 30		125							
20	**3-Ethoxybenzenesulfonyl chloride**	38		131							
21	**3-Chloro-4-methylbenzenesulfonyl chloride**	38		134	96						
22	**2,5-Dichlorobenzenesulfonyl chloride**	38	93-7	181	160	160	170	247-8	262 3	250 1	
23	**2,6-Dimethylbenzenesulfonyl chloride**	39	98	113 96							
24	**4-Ethoxybenzenesulfonyl chloride**	39		150							
25	**4-Chloro-3-nitrobenzenesulfonyl chloride**	40 1 60-2		175 6 yel al							
26	**2,3-Dichloro-4-methylbenzenesulfonyl chloride**	41		237							
27	**4,6-Dichloro-2-methylbenzenesulfonyl chloride**	43		168							
28	**3,3-Dimethylbutane-1-sulfonyl chloride**	43 4		96 7							
29	**Propane-1,3-disulfonyl chloride**	45	92d	169, w	*di* 125						Di-*m*-toluidide 222
30	**2-Chloro-4-methylbenzenesulfonyl chloride**	46, 52		186							
31	**Indane-5-sulfonyl chloride**	46-7, eth	92	135 5-6, al	129, al						
32	**2-Methyl-5-nitrobenzenesulfonyl chloride**	46-7	133 5 (+2H_2O)	186	148			256-7		256-8	B p 183 5[10]
33	**2,3-Dimethylbenzenesulfonyl chloride**	47		167							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasimg m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	*p*-Toluidine	Aniline	*o*-Toluidine	
34	**4-Bromo-3-methylbenzenesulfonyl chloride**	50		146							
35	**3-Methyl-4-nitrobenzenesulfonyl chloride**	50		133 5							
36	**4-Bromo-2-methylbenzenesulfonyl chloride**	50		168							
37	**4-Chloro-2,5-dimethylbenzenesulfonyl chloride**	50	100	185	155						
38	**2-Bromobenzenesulfonyl chloride**	51, eth		186 w							
39	**3,4-Dichloro-2-methylbenzenesulfonyl chloride**	51 2		228							
40	**3,4-Dimethylbenzenesulfonyl chloride**	52	64 55	144			208				
41	**4-Chloro-3-methyl-5-nitrobenzenesulfonyl chloride**	52		201							
42	**4-Chlorobenzenesulfonyl chloride**	53	69 93	144	104	190	175	208-10	222 3	163 4	
43	**Indane-4-sulfonyl chloride**	53 3 5		118 9, w							B p 140 1
44	**4-Methylbenzene-1,3-disulfonyl chloride** (Toluene-2,4-disulfonyl chloride)	54 46		*di* 186 7 191	189						
45	**4-Chloro-2-methylbenzenesulfonyl chloride**	54		185							
46	**3,5-Dichloro-2-methylbenzenesulfonyl chloride**	54		186							
47	**Hexadecane-1-sulfonyl chloride**	54	54	97							
48	**2,4-Dichlorobenzenesulfonyl chloride**	55	86	182				204 6		170-2	
49	**4-Bromo-3-nitrobenzenesulfonyl chloride**	55 7		176 7							
50	**2,4,6-Trimethylbenzenesulfonyl chloride**	56	78	142	109						
51	**2-Chloro-5-methylbenzenesulfonyl chloride**	56		156	229 30 5						
52	**2,6-Dichloro-4-methylbenzenesulfonyl chloride**	56		154 5							
53	**4-Carboxybenzenesulfonyl chloride**	57	94 (hyd), 260 (anh)	*di* 236	*di* 252						The m p is that of the 1,4-dichloride
54	**Tetralin-6-sulfonyl chloride**	58		135	155 6						
55	**3-Methyl-2-nitrobenzenesulfonyl chloride**	58 5		163 5							
56	**5-Carboxy-2-methylbenzenesulfonyl chloride** (4-Toluic acid-2-sulfonyl chloride)	59	190, 158 (anh)	185							The m p is that of the 1,5-dichloride
57	**4-Amino-3-nitrobenzenesulfonyl chloride** (2-Nitroaniline-4-sulfonyl chloride)	59-60		206-7							
58	**5-Chloro-2-methyl-3-nitrobenzenesulfonyl chloride**	60		167							
59	**3-Bromo-4-methylbenzenesulfonyl chloride**	60		151							
60	**2,5-Dimethyl-3-nitrobenzenesulfonyl chloride**	61	128, 200	173	143 4			136			
61	**2,4,5-Trimethylbenzenesulfonyl chloride**	61	112	181							
62	**Benzene-1,3-disulfonyl chloride**	63		229	148 50	245	214				N-Xanthylsulfonamide, 170 Alk fusion → resorcinol, 110
63	**4-Chloro-3-methylbenzenesulfonyl chloride**	63		128	92						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	*p*-Toluidine	Aniline	*o* Toluidine	
64	**7-Methylnaphthalene-2-sulfonyl chloride**	63 4		163-4							
65	**2,4,6-Tribromobenzenesulfonyl chloride**	64	64	228	220-2d						
66	**3-Nitrobenzenesulfonyl chloride**	64	48	167	126	166 5	146	222	126 5-7 5	193	
67	**2,3,4-Trichlorobenzenesulfonyl chloride**	64-5		227-30							
68	**3-Bromocamphor-10-sulfonyl chloride**	65	47 5	156							
70	**2-Ethoxybenzenesulfonyl chloride**	65 6		163	158						
71	**4-Methoxy-3-nitrobenzenesulfonyl chloride**	66		146 3							
72	**D-Camphor-10-sulfonyl chloride**	67	193	132	121 88						
73	**2-Methylbenzenesulfonyl chloride** (Toluene-2-sulfonyl chloride)	68	57	156 3	136		170	203-4	218		N-Xanthylsulfonamide, 182 3 5
74	**Naphthalene-1-sulfonyl chloride**	68, 66	90	150	112 152		137	181	183	237	
75	**4-Methylbenzenesulfonyl chloride** (Toluene-4-sulfonyl chloride)	69	104 5	138 5 9 (anh), 105 (+2H_2O)	103	157	181-2	198	238	190	
76	**2-Nitrobenzenesulfonyl chloride**	69	70 85	193	115						
77	**3,5-Dichloro-4-methylbenzenesulfonyl chloride**	69		191							
78	**2,4-Dimethoxybenzenesulfonyl chloride**	70		167							
79	**6-Chloronaphthalene-1-sulfonyl chloride**	70		214							
80	**3,4-Dimethyl-5-nitrobenzenesulfonyl chloride**	70		180							
81	**2,5-Dibromobenzenesulfonyl chloride**	71	128 (anh)	195							
82	**3,6-Dichloro-2,5-dimethylbenzenesulfonyl chloride**	71		165	171						
83	**3-Chloro-2-methylbenzenesulfonyl chloride**	72, pet eth	60-72	180, w							
84	**4-Methoxynaphthalene-2-sulfonyl chloride**	75		157	145						
85	**2-Chloronaphthalene-1-sulfonyl chloride**	75		153							
86	**4-Chloro-2-nitrobenzenesulfonyl chloride**	75	82	164, 237	138						Phenylhydrazide 151, Ph ester, 82
87	**2,5-Dimethyl-4-nitrobenzenesulfonyl chloride**	75	140	197-8	131			143 5 4 5		143 5 4 5	
88	**4-Bromobenzenesulfonyl chloride**	76, eth	88 90	166, 161	119	183 5	170	215 6	237-8	182-3	
89	**Naphthalene-2-sulfonyl chloride**	76, 79	91, hyg , 122	217, 213	132		190 1	221	269	213	
90	**6-Bromonaphthalene-1-sulfonyl chloride**	77		217							
91	**2,4-Di-iodobenzenesulfonyl chloride**	77-8	167 (anh)	230							Me ester, 78, al , Et ester, 57, al
92	**2-Carboxybenzenesulfonyl chloride**	79, pet eth	68 9 (hyd), 134 (anh)		194-5		206	196 200	165	127-8	The m p is that of the 1,2-dichloride
93	**2,4-Dibromobenzenesulfonyl chloride**	79, eth	110 (anh)	190							
94	**4,5-Dimethylbenzene-1,3-disulfonyl chloride**	79, yel		239	200, al						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	*p*-Toluidine	Aniline	*o*-Toluidine	
95	**4-Nitrobenzenesulfonyl chloride**	80 lgr	109 11 95 hyg	180, 50% al	171 136 d			179 80			
96	**6-Methoxynaphthalene-1-sulfonyl chloride**	80 5		149 5	177 5						
97	**2,5-Dimethylbenzene-1,3-disulfonyl chloride**	81, lgr		295 al	174 al						
98	**4,6-Dichloro-2,5-dimethylbenzenesulfonyl chloride**	81		150	175						
99	**4-Methylnaphthalene-1-sulfonyl chloride**	81, eth		174 177 al	158						
100	**3,4-Di-iodobenzenesulfonyl chloride**	82, bz pet eth	122 5	227, aq al							
101	**3-Chloro-4-methoxybenzenesulfonyl chloride**	82		131							
102	**7-Methoxynaphthalene-2-sulfonyl chloride**	83		220	121						
103	**2-Methylnaphthalene-1-sulfonyl chloride**	83 5		124							
104	**1-Chloronaphthalene-2-sulfonyl chloride**	84 5	130 3d (anh)	250	171 2						
105	**4-Iodobenzenesulfonyl chloride**	85		183	143						
106	**4-Ethoxynaphthalene-2-sulfonyl chloride**	85		183	143 5						
107	**4,5-Dichloro-3-methylbenzenesulfonyl chloride**	85 8		183 5							
108	**4-Methoxybenzene-1,3-disulfonyl chloride**	86		240	209						
109	**4-Fluoronaphthalene-1-sulfonyl chloride**	86	100 (hyd)	206	144						Et ester, 93
110	**7-Chloronaphthalene-2-sulfonyl chloride**	87	68 (tetrahyd) 118 (anh)	76							Me ester, 89, Et ester, 65
111	**4-Bromonaphthalene-1-sulfonyl chloride**	87		195							
112	**D-Camphor-3-sulfonyl chloride**	88	77	143	124			196 7			Me ester, 77
113	**2-Methylbenzene-1,3-disulfonyl chloride**	88		260	162						
114	**8-Methylnaphthalene-2-sulfonyl chloride**	88		116							
115	**4-Hydroxybenzene-1,3-disulfonyl chloride** (Phenol-2,4 disulfonyl chloride)	89	>100d	239							
116	**3,5-Dimethyl-2-hydroxybenzene-1,3-disulfonyl chloride**	89 91		160 1							
117	**Anthracene-1-sulfonyl chloride**	90		205							
118	**2-Chloro-5-nitrobenzenesulfonyl chloride**	90, w	168 9d (hyd)	185 6							
119	**Quinoline-6-sulfonyl chloride**	91	>260	192							
120	**Benzylsulfonyl chloride**	92 3, eth , lgr		105, w , al	102	166 146		113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
121	**6-Iodonaphthalene-1-sulfonyl chloride**	92 5		213							
122	**6-Methoxynaphthalene-2-sulfonyl chloride**	93		189	120						
123	**5-Chloro-2-nitrobenzenesulfonyl chloride**	93		159							
124	**1-Bromonaphthalene-2-sulfonyl chloride**	93		271							

*Derivative data given in order m p , crystal color solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thiuronium	*p*-Toluidine	Aniline	*o* Toluidine	
125	**5-Methylbenzene-1,3-disulfonyl chloride**	94, eth		216, w	153, al						
126	**3,5-Dimethylbenzenesulfonyl chloride**	94, 90, bz		135, al	129, al			121 2, al			
127	**8-Chloronaphthalene-2-sulfonyl chloride**	94		185							
128	**1-Iodonaphthalene-2-sulfonyl chloride**	94		247							
129	**4-Chloronaphthalene-1-sulfonyl chloride**	94 5	130 3d	187		162				151	*o* Toluidide 145 6 Me ester 83 Et ester, 104
130	**Ethane-1,2-disulfonyl chloride**	95		69			201 2	270d	270, w		Di-Et ester 77 eth *m*-Toluidide 230
131	**5-Bromonaphthalene-1-sulfonyl chloride**	95		232 3							
132	**5-Chloronaphthalene-1-sulfonyl chloride**	95		226	138						Sulfonyl bromide, 110, Me ester, 89, Et ester, 46
133	**7-Methylnaphthalene-1-sulfonyl chloride**	96		195 6	162 4						
134	**2,4-Dimethyl-3-nitrobenzene-sulfonyl chloride**	96	144 (anh)	172							
135	**5-Bromonaphthalene-2-sulfonyl chloride**	96		220							
136	**2-Benzoylbenzenesulfonyl chloride** (Benzophenone 2-sulfonyl chloride)	96 7			143 5						
137	**2,3,4,6-Tetrabromobenzenesulfonyl chloride**	96 5		245d							
138	**10-Bromocamphor-3-sulfonyl chloride**	97		100 2							
139	**6-Fluoronaphthalene-2-sulfonyl chloride**	97 chl	105 (hyd)	133	129		190 1	221	269	213	
140	**2-Bromonaphthalene-1-sulfonyl chloride**	97		140							
141	**6-Methylnaphthalene-2-sulfonyl chloride**	97 8		205 6							
142	**5-Nitrobenzene-1,3-disulfonyl chloride**	97 8		242							
143	**2,4-Dimethyl-5-nitrobenzene-sulfonyl chloride**	98	132 122 dil HNO_3	187 179							Sulfonyl fluoride, 109 10
144	**2-Methylbenzene-1,4-disulfonyl chloride**	98		224	*di* 178						
145	**4-Methyl-3-nitrobenzenesulfonyl chloride**	98 9		170							*o* Anisidide, 135
146	**4-Methoxynaphthalene-1-sulfonyl chloride**	98 5		226	147 5						
147	**5-Chloro-4-methyl-2-nitro-benzenesulfonyl chloride**	99	128	181							
148	**3,5-Dinitrobenzenesulfonyl chloride**	99, chl , lgr		235							
149	**4-Nitronaphthalene-1-sulfonyl chloride**	99		188							
150	**7-Iodonaphthalene-2-sulfonyl chloride**	100		210							
151	**7-Bromonaphthalene-2-sulfonyl chloride**	100		218							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	*p* Toluidine	Aniline	*o*-Toluidine	
152	**3-Nitrobenzylsulfonyl chloride**	100, bz	74 (hyd)	159 d , w							Me amide 106 7 Dimethylamide 118 9
153	**8-Chloronaphthalene-1-sulfonyl chloride**	101		197							
154	**2,4-Dinitrobenzenesulfonyl chloride**	102	106 8 (hyd) 130 (anh)	157 154							Hydrazide, 110
155	**4-Nitrodiphenylamine-2-sulfonyl chloride**	102 4		173	164						
156	**4-Ethoxynaphthalene-1-sulfonyl chloride**	103		170	180						
157	**7-Ethoxynaphthalene-2-sulfonyl chloride**	103		142	153						
158	**3,7-Diethylnaphthalene-1-sulfonyl chloride**	105 7		207							
159	**5,6-Dichloronaphthalene-1-sulfonyl chloride**	106		223							
160	**4-Chloronaphthalene-2-sulfonyl chloride**	106		168							Et ester 76 9
161	**2-Methyl-4-nitrobenzene-sulfonyl chloride**	106		157							
162	**DL-Camphor-8-sulfonyl chloride**	106	56 8	133 5, w							
163	**5-Chlorobenzene-1,3-disulfonyl chloride**	106		224							
164	**3-Ethoxybenzene-1,4-disulfonyl chloride**	106 8		*di* 233							
165	**6-Ethoxynaphthalene-2-sulfonyl chloride**	107 5		183	153						
166	**4-Methylbenzene-1,2-disulfonyl chloride**	109 11		237 9	190						
167	**2,5-Dimethyl-6-nitrobenzene-sulfonyl chloride**	110	145 (anh)	192	182			158 5 9		143 5 50% al	
168	**2-Iodonaphthalene-1-sulfonyl chloride**	110		154							
169	**Phenanthrene-3-sulfonyl chloride**	110-1	175 6 (anh) 120 1 (+1 H_2O) 88d (+2H_2O)	190			222				Me ester 119 20, al Et ester 107 8
170	**6-Chloronaphthalene-2-sulfonyl chloride**	110 5		184							
171	**2-Hydroxynaphthalene-1,6-disulfonyl chloride**	111			*di* 191						
172	**Acenaphthene-5-sulfonyl chloride**	111		223	178						
173	**3-Hydroxynaphthalene-2-sulfonyl chloride**	112		110					241 2		
174	**5-Nitronaphthalene-1-sulfonyl chloride**	113		236	123						
175	**Acenaphthene-3-sulfonyl chloride**	113 4	87 9	199	284 6						Me ester, 122 3, Et ester, 137 9, lgr
176	**2,5-Dichlorobenzene-1,3-disulfonyl chloride**	114		215 7							
177	**5-Chloronaphthalene-2-sulfonyl chloride**	115		216							
178	**Biphenyl-4-sulfonyl chloride** (4-Phenylbenzenesulfonyl chloride	115		230	125						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	*p*-Toluidine	Aniline	*o*-Toluidine	
179	**2-Ethoxynaphthalene-1-sulfonyl chloride**	116		158	187						
180	**4,5-Dichloronaphthalene-1-sulfonyl chloride**	117		229							
181	**2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonyl chloride**	117 8		206–8	205 7						
182	**6-Ethoxynaphthalene-1-sulfonyl chloride**	118		154	194 5						
183	**4,6-Dichloronaphthalene-1-sulfonyl chloride**	119		226							
184	**5-Methoxynaphthalene-1-sulfonyl chloride**	119 5		194 5	157						
185	**5-Methylnaphthalene-2-sulfonyl chloride**	120 2		188 9	248–50, 133–4						
186	**8-Bromonaphthalene-2-sulfonyl chloride**	121		187							
187	**5-Ethoxynaphthalene-1-sulfonyl chloride**	121		182 5	130						
188	**2-Methoxynaphthalene-1-sulfonyl chloride**	121		159	196 5						
189	**1-Nitronaphthalene-2-sulfonyl chloride**	121, pink, bz -pet eth	105, lgr	214	202						
190	**6,8-Dichloronaphthalene-2-sulfonyl chloride**	121		228							
191	**2-Chloro-5-methyl-6-nitrobenzene sulfonyl chloride**	122		177							
192	**Anthracene-2-sulfonyl chloride**	122		261	201						Me ester, 157, Et ester, 160
193	**5-Fluoronaphthalene-1-sulfonyl chloride**	122–3	105 (hyd)	196 7							Me ester, 118, eth
194	**4,6-Dichlorobenzene-1,3-disulfonyl chloride**	123		276							
195	**Azobenzene-3,4′-disulfonyl chloride**	123 5		*di* 288							
196	**7,8-Dichloronaphthalene-2-sulfonyl chloride**	124		227							
197	**4-Iodonaphthalene-1-sulfonyl chloride**	124, 121		206, 204	136						
198	**6-Bromonaphthalene-2-sulfonyl chloride**	124		127							
199	**Quinoline-8-sulfonyl chloride**	124	312	183–4							Me ester, 96, Et ester, 73
200	**4-Methylnaphthalene-2-sulfonyl chloride**	124 5		143–4							
201	**1,5-Dichloronaphthalene-1-sulfonyl chloride**	125		282							
202	**2,4,6-Trimethylbenzene-1,3-disulfonyl chloride**	125		*di* 244	*di* 150 1						
203	**5-Nitronaphthalene-2-sulfonyl chloride**	125	118–9, yel	184							
204	**6-Nitronaphthalene-1-sulfonyl chloride**	127		223–4							
205	**Phenanthrene-9-sulfonyl chloride**	127	174 (anh)	193–4				235			Me ester, 106, me al , Et ester, 108 al
206	**Naphthalene-1,6-disulfonyl chloride**	129	125 (anh)	298			81, 235	314–5	298–9	323–4	
207	**7-Chloronaphthalene-1-sulfonyl chloride**	129		235							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thiuronium	*p*-Toluidine	Aniline	*o*-Toluidine	
208	**4,6-Dichloronaphthalene-2-sulfonyl chloride**	130		218							
209	**2,4,5-Trimethoxybenzenesulfonyl chloride**	130		76	170						
210	**4,6-Dimethylbenzene-1,3-disulfonyl chloride**	130, pet eth		249, w	196, 50% al						
211	**5,6,7-Trichloronaphthalene-1-sulfonyl chloride**	131		249							
212	**Benzene-1,4-disulfonyl chloride**	131 139		288	249						
213	**5,8-Dichloronaphthalene-2-sulfonyl chloride**	134		244							
214	**3,7-Dichloronaphthalene-1-sulfonyl chloride**	136		269							
215	**3-Bromocamphor-8-sulfonyl chloride**	136 7									
216	**8-Chloro-7-methoxynaphthalene-1-sulfonyl chloride**	137		153	196						
217	**Benzophenone-3,3 -disulfonyl chloride**	137 8		*di* 157	*di* 177 8						N-Xanthylsulfonamide, 197
218	**Naphthalene-1,3-disulfonyl chloride**	137 5		*di* 292 3							
219	**7,8-Dichloronaphthalene-1-sulfonyl chloride**	138		221							
220	**Azoxybenzene-3,3'-disulfonyl chloride**	138	126	*di* 273							
221	**D-Camphor-8-sulfonyl chloride**	138		137							
222	**3-Methoxynaphthalene-2-sulfonyl chloride**	138		113	174						
223	**8-Cyanonaphthalene-1-sulfonyl chloride**	139		333 4							
224	**4-Nitronaphthalene-2-sulfonyl chloride**	139 5		225							
225	**6-Iodonaphthalene-2-sulfonyl chloride**	140		222							
226	**8-Iodonaphthalene-1-sulfonyl chloride**	140	115	187							
227	**4-Nitronaphthalene-2,7-disulfonyl chloride**	140 1		286–7							
228	**4-Hydroxybenzenesulfonyl chloride**	141		176–7			169	202	170	192	
229	**4,8-Dichloronaphthalene-2-sulfonyl chloride**	141		205							
230	**5-Iodonaphthalene-1-sulfonyl chloride**	141		239							
231	**Pyridine-3-sulfonyl chloride**	Hydrochloride, 141 4	357	110 1	145						Hydrazide, 94
232	**6,7-Dichloronaphthalene-1-sulfonyl chloride**	142		268							
233	**Benzene-1,2-disulfonyl chloride**	143		254	241						
234	**6-Ethoxy-1-nitronaphthalene-2-sulfonyl chloride**	146		218							
235	**Retene-6-sulfonyl chloride**	146 7 5, yel -br	121 3	206 7 5							
236	**7-Bromonaphthalene-1-sulfonyl chloride**	147		209							
237	**4-Acetamidobenzenesulfonyl chloride**	149		219	214	215					
238	**5,7-Dichloronaphthalene-1-sulfonyl chloride**	149		272							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzylthiuronium	*p*-Toluidine	Aniline	*o*-Toluidine	
239	**4,5-Dibenzylnaphthalene-1-sulfonyl chloride**	151		168							
240	**4,7-Dichloronaphthalene-1-sulfonyl chloride**	151		217							
241	**7-Ethoxy-8-nitronaphthalene-1-sulfonyl chloride**	155		173 4							
242	**2-Amino-5-methylbenzene-1,3-disulfonyl chloride**	156, chl		*dt* 257, w	*dt* 196-7, aq al						
243	**Phenanthrene-2-sulfonyl chloride**	156	150	253-4	157-8			291			Me ester, 101 2, Et ester, 89, yel -br
244	**4,7-Dichloronaphthalene-2-sulfonyl chloride**	156		196							
245	**6,7,8-Trichloronaphthalene-2-sulfonyl chloride**	157		245							
246	**4,5-Dichloronaphthalene-2-sulfonyl chloride**	158		197							
247	**5,6,8-Trichloronaphthalene-2-sulfonyl chloride**	158		235							
248	**Naphthalene-2,7-disulfonyl chloride**	158, 162		242			212	299	251-2	238	
249	**Naphthalene-1,4-disulfonyl chloride**	160 166		273, w , or al	179						
250	**4-Carboxy-3-nitrobenzene-sulfonyl chloride**	*dt* 160	111 (+2½ H_2O)	192							The m p is that of the 1,4-dichloride, Diamide, 226
251	**7-Hydroxynaphthalene-1,3-disulfonyl chloride**	161 2			195		228	294		271	
252	**Fluorene-2-sulfonyl chloride**	164	155 (hyd)	213d							
253	**2,5-Dimethylbenzene-1,4-disulfonyl chloride**	164		310	223						
254	**8-Nitronaphthalene-1-sulfonyl chloride**	165 d	115 d (+3H_2O)	191	178 8 5						
255	**7-Iodonaphthalene-1-sulfonyl chloride**	165		240							
256	**Azobenzene-3,3'-disulfonyl chloride**	166		*dt* 305							
257	**3,6-Dichloronaphthalene-2-sulfonyl chloride**	166		218							
258	**5,6-Dichloronaphthalene-2-sulfonyl chloride**	167		192							
259	**Phthalic acid-4-sulfonyl chloride** (3,4-Dicarboxybenzenesulfonyl chloride)	167-70, d eth	138 40 (+1H_2O)	192-200 d , w							
260	**8-Nitronaphthalene-2-sulfonyl chloride**	169	135-6 (+1½ H_2O)	223	172-3						
261	**4-Amino-2-hydroxybenzene-sulfonyl chloride**	169		155							
262	**2-Hydroxynaphthalene-1,7-disulfonyl chloride**	169		233							
263	**7-Nitronaphthalene-1-sulfonyl chloride**	169-70		261-2							
264	**4,6,7,8-Tetrachloronaphthalene-2-sulfonyl chloride**	176		235							
265	**4'-Nitrobiphenyl-4-sulfonyl chloride**	178		228							
266	**Naphthalene-1,5-disulfonyl chloride**	183	245 (anh)	310, 340	249		257, 251 d	332			Di-Me ester, 205, chl
267	**Anthraquinone-2,7-disulfonyl chloride**	186, chl			*dt* 192						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzylthiuronium	*p*-Toluidine	Aniline	*o*-Toluidine	
268	**Benzene-1,3,5-trisulfonyl chloride**	187		*tri* 310 5	*tri* 237						Tri-Et ester, 147, bz
269	**7-Hydroxynaphthalene-1,3,6-trisulfonyl chloride**	196			152 5						
270	**Anthraquinone-2-sulfonyl chloride**	197		261	193		211	308	309		Me ester, 123, Et ester, 125
271	**Anthraquinone-1,6-disulfonyl chloride**	197 8, yel, $PhNO_2$	215 7, gold		227 8, yel						
272	**Biphenyl-4,4'-disulfonyl chloride**	203		300			171	330 d			
273	**Benzidine-2,2'-disulfonyl chloride**	Hydrochloride, 205		*di* 278							
274	**Anthraquinone-1-sulfonyl chloride**	216 8, yel, $PhNO_2$	218		214		191		284		NH_3 → 1-Aminoanthraquinone, 252, 243
275	**9,10-Dichloroanthracene-2-sulfonyl chloride**	221		279	248						
276	**Azobenzene-4,4'-disulfonyl chloride**	222	169d (anh)	250 d							Et ester, 104
277	**Anthraquinone-1,8-disulfonyl chloride**	222 3, yel, $PhNO_2$	293-4	>340	237-8, yel, $PhNO_2$						
278	**Anthracene-1,8-disulfonyl chloride**	225		333	224						
279	**Naphthalene-2,6-disulfonyl chloride**	225		305			256		360		
280	**2-Hydroxynaphthalene-1,5-disulfonyl chloride**	231			231						
281	**Anthracene-1,5-disulfonyl chloride**	240		*di* 330	*di* 293						
282	**Anthraquinone-2,6-disulfonyl chloride**	250, yel cl bz			*di* 321						
283	**Anthraquinone-1,3-disulfonyl chloride**	265 70, yel	310 1 (hyd)	>350	269 70, yel-red						
284	**2,4-Diaminobenzene-1,5-disulfonyl chloride**	275		187	236						
285	**Anthraquinone-1,7-disulfonyl chloride**	301 2, br-yel, $PhNO_2$	120 (hyd)		237-8, yel cl bz						

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XXIV

Formation of sulfonic acid by hydrolysis *

$$RSO_2NH_2 + H_2O \xrightarrow{HCl} \underset{\text{Sulfonic acid}}{RSO_3H} + NH_4Cl$$

From hydrolysis of the sulfonamide by 25% hydrochloric acid.

For directions and examples see Cheronis, p 631, Shriner, pp. 104, 267, R. S. Schreiber and R L Shriner, *J Amer Chem. Soc*, **56**, 1618 (1934).

From hydrolysis of the sulfonamide in a mixture of concentrated sulfuric acid and 85% phosphoric acid

See Cheronis, p. 633.

Formation of the amine by hydrolysis

$$2\,ArSO_2NHR + 5\,HBr + 5\,C_6H_5OH \rightarrow ArSSAr + \underset{\text{Amine}}{2\,RNH_2} + 5\,p\text{-}BrC_6H_4OH + 4\,H_2O$$

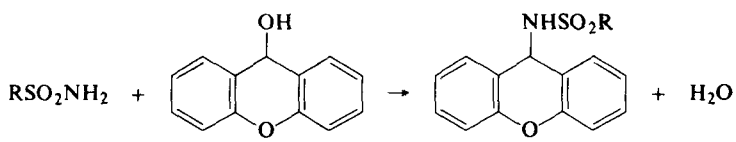
From hydrolysis of the sulfonamide in 48% hydrobromic acid and phenol.

For directions and examples see Shriner, pp 105, 267, H. R. Snyder and R E Heckert, *J Amer Chem Soc*, **74**, 2006 (1952); H R Snyder and H C Geller, *J Amer Chem Soc*, **74**, 4864 (1952).

NOTE For directions and explanations for the preparation of derivatives of the sulfonic acid formed by the hydrolysis of the sulfonamide see explanations and references to Table XXII, pp 369, 370.

For directions and explanations for the preparation of the amine formed by the hydrolysis of the sulfonamide see explanations and references to Table XVIII, pp. 291, 292, 293

N-Xanthylsulfonamide *



From the sulfonamide and xanthydrol in glacial acetic acid.

For directions and examples see. Cheronis, p. 634, Linstead, p. 95; Shriner, p. 267; R. F. Phillips and V. S. Frank, *J Org Chem*, **9**, 9 (1944).

N-Acetylsulfonamide.

$$RSO_2NH_2 + (CH_3CO)_2O \rightarrow RSO_2NHCOCH_3 + CH_3COOH$$

$$RSO_2NHR' + CH_3COCl \rightarrow \underset{\text{N-Acetyl-sulfonamide}}{RSO_2NR'COCH_3} + HCl$$

From the sulfonamide and acetic anhydride.

For directions and examples see. Cheronis, p. 634.

From the sulfonamide and acetyl chloride in acetic acid.

See. Linstead, p. 95; Vogel, p. 555.

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S Benzylthiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
1	**2-Methylpropane-1-sulfonamide**	14–6		b p 80[13]		38	107					
2	**N,N-Diethylbenzylsulfonamide**	29		92	105, w , al	102	166 (146)		113, al	102	83	
3	**2-Methylpropane-1-sulfonanilide**	38		b p 80[13]	14–6		107					
4	**3-Methylbutane-1-sulfonanilide**	42		b p 98[13]	3		90 1					
5	**Butane-1-sulfonamide**	45	–15	b p 75[10]		10 5	60 5					Phenylhydrazinium salt, 114 5
6	**Propane-1-sulfonamide**	52, eth	7 5	b p 78[15]		10	84		67–8			Phenylhydrazinium salt, 204 5d
7	**Ethane sulfonamide**	58, eth	–17	b p 178		58	66	115				Phenylhydrazinium salt, 182 8
8	**Ethane sulfonanilide**	58	–17	b p 178	58		66	115				Phenylhydrazinium salt, 182 8
9	**N,N-Diethyltoluene-4-sulfonamide**	60	104–5	69	105 (dihyd), 138 5 9 (anh)	103	157	181–2	198	238	190	*m*-Toluidide, 109
10	**Propane-2-sulfonamide**	60, eth - pet eth	–37	b p 61[9]		84	134					
11	**N-Ethyltoluene-4-sulfonamide**	64	104–5	69	105 (dihyd), 138 5–9 (anh)	103	157	181 2	198	238	190	
12	**N-Ethylbenzyl sulfonamide**	65–6, eth , lgr		92	105, w , al	102	166 (146)		113, al	102	83	
13	**N-(1-Naphthyl)ethane sulfonamide**	66	–17	b p 178	58	58		115				
14	**Ethane-1,2-disulfonanilide**	69		*di* 95, eth				201 2	d at 270	270, w		Di Et ester, 77, eth , *m*-Toluidide, 230
15	**N-Methyltoluene-2-sulfonamide**	74–5	57	68		136		170	203 4	218		
16	**Heptane-1-sulfonamide**	75		16								
17	**2,4,5-Trimethoxybenzene sulfonamide**	76		130		170						
18	**2-Phenylethane-1-sulfonanilide**	77	91	33	122							
19	**N-Methyltoluene-4-sulfonamide**	78 9	104–5	69	105 (dihyd), 138 5–9 (anh)	103	157	181 2	198	238	190	
20	**Propane-2-sulfonanilide**	84		b p 61[9]	60		134					
21	**N-(1-Naphthyl)propane-1-sulfonamide**	84	7 5	b p 78[15]	52	10			67 8			
22	**N,N-Dimethyltoluene-4-sulfonamide**	86–7	104–5	69	105 (dihyd), 138 5 9 (anh)	103	157	181 2	198	238	190	
23	**Methane sulfonamide**	90	20	b p 60[21]		100 5	125 5					Phenylhydrazinium salt, 193 5–4d
24	**N-(1-Naphthyl)-3-methylbutane-1-sulfonamide**	90–1		b p 98[13]	3	42						
25	**4-Chloro-3-methylbenzene sulfonanilide**	92		63	128							
26	**Toluene-3-sulfonanilide**	96		12	108				106			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
27	**3-Chloro-4-methylbenzene sulfonanilide**	96		38	134							
28	**3,3-Dimethylbutane sulfonamide**	96–7		43 4								
29	**Hexadecane-1-sulfonamide**	97	54	54								
30	**2-Ethylbenzene sulfonamide**	100		11 7								
31	**10-Bromocamphor-3-sulfonamide**	100–2		97								
32	**Methane sulfonanilide**	100 5	20	b p 60[21]	90		125 5					Phenylhydrazinium salt, 193 5–4d
33	**N,N-Dimethylbenzyl sulfonamide**	101		92–3, eth , lgr	105, w , al	102, al	166 (146)		113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
34	**Benzyl sulfonanilide** (Toluene-α-sulfonanilide)	102, al		92	105, w , al		166 (146)		113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
35	**Toluene-4-sulfonanilide**	103	92 (104 5)	69	137			181 2	198	238	190	N-Xanthylsulfonamide, 197
36	**4-Chlorobenzene sulfonanilide**	104	69 (93)	53	144		190	175	208 10	222 3	163 4	
37	**Benzyl sulfonamide** (Toluene-α-sulfonamide)	105, w , al		92–3, eth , lgr		102, al	166 (146)		113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
38	**N-(1-Naphthyl)-2-methylpropane sulfonamide**	107		b p 80[13]	14–6	38						
39	**Toluene-3-sulfonamide**	108, al		12		96			106		108	
40	**2,4-Dimethyl-6-nitrobenzene sulfonamide**	108	97									
41	**2,4,6-Trimethylbenzene sulfonanilide**	109	78	56	142							N-Xanthylsulfonamide, 203
42	**N-Methylbenzyl sulfonamide**	109–10		92–3, eth , bz	105, w , al	102, al	166 (146)		113, al	102	83	N-Xanthylsulfonamide, 188, Hydrazide, 131 2, Phenylhydrazide, 173
43	**2,4-Dimethylbenzene sulfonanilide**	110	62 (hyd)	34								
44	**4-Ethylbenzene sulfonamide**	110		12								N-Xanthylsulfonamide, 196
45	**3-Hydroxynaphthalene-2-sulfonamide**	110		112						241 2		
46	**Pyridine-3-sulfonamide**	110–1	357	Hydrochloride, 141–4 d		145						Hydrazide, 94
47	**Naphthalene-1-sulfonanilide**	112 (152)	90	68, 66	150			137	181	183	237	
48	**Benzene sulfonanilide**	112	66 (anh)	14 5	156		170 1	148	205	240	176	N-Xanthylsulfonamide, 200
49	**3-Methoxynaphthalene-2-sulfonamide**	113		138		174						
50	**2,6-Dimethylbenzene sulfonamide**	113 (96)	98	39								
51	**2-(N-Methylamino)benzene sulfonamide**	114 5 5 5	182 d									2-N-*p*-Toluenesulfonyl deriv of sulfonamide, 193

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
52	**2-Nitrobenzene sulfonanilide**	115	70 (85)	69	193							
53	**N-Benzyltoluene-4-sulfonamide**	115 6	92	69	137			181-2	198	238	190	N-Xanthylsulfonamide, 197
54	**8-Methylnaphthalene-2-sulfonamide**	116		88								
55	**Indane-4-sulfonamide**	118 9, w		53-3 5, b p 140-1[4]								
56	**4-Bromobenzene sulfonanilide**	119	88 90	76, eth	166, 161		183 5	170	215 6	237 8	182 3	
57	**3,5-Dimethylbenzene sulfonanilide**	119		94 90	135				121 2 d			
58	**6-Methoxynaphthalene-2-sulfonanilide**	120		93	189							
59	**D-Camphor-10-sulfonanilide**	121	193	67	132							
60	**7-Methoxynaphthalene-2-sulfonanilide**	121		83	220							
61	**2-Phenylethane-1-sulfonamide**	122	91	33		77						
62	**4-Formylbenzene sulfonamide**	122 4										Oxime, 158, O,O-Diacetate of sulfonamide, 86-7 5
63	**5-Nitronaphthalene-1-sulfonanilide**	123		113	236							Me ester, 117 8, chl
64	**2-Methylnaphthalene-1-sulfonamide**	124		83 5								
65	**D-Camphor-3-sulfonanilide**	124	77	88	143				196 7			Me ester, 77, $[\alpha]_D$ +98 6 in chl
66	**Biphenyl-4-sulfonanilide**	125		115	230							
67	**4-Fluorobenzene sulfonamide**	125		36 30								
68	**N-(1-Naphthyl)methane sulfonamide**	125 5	20	b p 60[21]	90	100 5						
69	**3-Nitrobenzene sulfonanilide**	126	48	64	167		166 5	146	222	222	193	
70	**Phenol-O-sulfonanilide**	126 5 7 5	145 (monohyd)						124 5	126 5 7 5		
71	**5-Aminonaphthalene-2-sulfonanilide**	127 8			219			191				5-N-Acetyl deriv of sulfonamide, 247
73	**4-Chloro-3-methylbenzene sulfonamide**	128		63		92						Sulfonyl bromide, 67 5
74	**6-Fluoronaphthalene-2-sulfonanilide**	129	105 (hyd)	97	133							
75	**5-Ethoxynaphthalene-1-sulfonanilide**	130		121	182 5							
76	**3-Chloro-4-methoxybenzene sulfonamide**	131		82								
77	**4-Aminonaphthalene-2-sulfonamide**	131 (hyd)										4-N-Acetyl deriv of sulfonamide, 220
78	**2,5-Dimethyl-4-nitrobenzene sulfonanilide**	131	140	75	197-8				143 5 4 5		143 5 4 5	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl-amide	S Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
79	**3-Ethoxybenzene sulfonamide**	131		38								
80	**D-Camphor-10-sulfonamide**	132	193	67		121 (88)						
81	**Naphthalene-2-sulfonanilide**	132	91 (hyg)	76 79	217 -13							
82	**6-Fluoronaphthalene-2-sulfonamide**	133	105 (hyd)	97, chl		129		190 1	221	269	213	
83	**DL-Camphor-8-sulfonamide**	133 5 w	56 8	106								
84	**3-Methyl-4-nitrobenzene sulfonamide**	133 5		50								
85	**3-Chloro-4-methylbenzene sulfonamide**	134		38		96						
86	**N-(1-Naphthyl)propane-2-sulfonamide**	134	-37	b p 61[a]	60	84						*m*-Toluidide, 109
87	**3,5-Dimethylbenzene sulfonamide**	135, al		94, 90, bz		129, al			121 2 al			
88	**Tetraline-6-sulfonamide**	135		58		155 6						
89	**Indane-5-sulfonamide**	135 5 6, al	92	46-7, eth b p 148 9[a]		129, al						
90	**Toluene-2-sulfonanilide**	136	57	68	156			170	203 4	218		N-Xanthylsulfonamide, 183
91	**4-Iodonaphthalene-1-sulfonanilide**	136		124 121	206 204							
92	**D-Camphor-8-sulfonamide**	137		138								$[\alpha]_D^{15}$ +93 6, in al
93	**4-Chloro-2-nitrobenzene sulfonanilide**	138	82	75	237							
94	**2,4-Dimethylbenzene sulfonamide**	138	62 (hyd)	34		110		146				N-Xanthylsulfonamide, 188
95	**Toluene-4-sulfonamide**	138 5 9 0 (anh) 105 (dihyd)	104 5	69		103	157	181 2	198	238	190	N-Xanthylsulfonamide, 197
96	**8-Aminonaphthalene-1-sulfonanilide**	139 40						300				
97	**4-Vinylbenzene sulfonamide**	139 40							182 3			Dimethylamide, 62 3
98	**2-Bromonaphthalene-1-sulfonamide**	140		97								
99	**3,4-Dichlorobenzene sulfonamide**	140, 135		22 4, 19								
100	**2,4,6-Trimethylbenzene sulfonamide**	142	78	56		109						N-Xanthylsulfonamide, 203
101	**7-Ethoxynaphthalene-2-sulfonamide**	142		103		153						
102	**3-Aminobenzene sulfonamide**	142						148				
103	**3,5-Dimethyl-2-hydroxybenzene sulfonanilide**	142 3	121 5									2-O-Acetyl deriv of sulfonyl chloride, 62, pet eth
104	**D-Camphor-3-sulfonamide**	143	77	88		124			196 7			N-Methylanilide, 111 2, Me ester, 77, $[\alpha]_D$ +98 6 in chl
105	**5-Chloro-2-methylbenzene sulfonamide**	143	21, 24									

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthylamide	S Benzylthiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
106	**4-Iodobenzene sulfonanilide**	143		85	183							
107	**2,5-Dimethyl-3-nitrobenzene sulfonanilide**	143 4	128 (200)	61	173				135-6		126 5-7 5	
108	**4-Methylnaphthalene-2-sulfonamide**	143 4		124 5								
109	**Benzophenone-2-sulfonanilide**	143 5		96 7								
110	**4-Ethoxynaphthalene-2-sulfonanilide**	143 5		85	183							
111	**3,4-Dimethylbenzene sulfonamide**	144	64 (55)	52				208				
112	**4-Fluoronaphthalene-1-sulfonanilide**	144	100 (hyd)	86	206							Et ester, 93
113	**4-Chlorobenzene sulfonamide**	144	69 (93)	53		104	190	175	208-10	222 3	163 4	
114	**4-Methyl-3-nitrobenzene sulfonamide**	144 5	92 (hyg)	36		109	153		130 1		28	
115	**3-Chloro-6-methylbenzene sulfonamide**	145, aq al		24								
116	**Pyridine-3-sulfonanilide**	145			110 1							
117	**3-Bromocamphor-8-sulfonamide**	145	195 6 (anh)	136 7								
118	**4-Chloronaphthalene-1-sulfonanilide**	145 6	130 3	94 5	187		162			145 6	151	Me ester, 83 Et ester, 104
119	**4-Bromo-3-methylbenzene sulfonamide**	146		50								
120	**4-Methoxy-3-nitrobenzene sulfonamide**	146 3		66								
121	**1-Aminonaphthalene-7-sulfonanilide**	147			181 (hyd)							Benzoylguanidine salt, 214 6
122	**4-Methoxynaphthalene-2-sulfonanilide**	147 5		98 5	226							
123	**3-Chlorobenzene sulfonamide**	148							199-200	206 7		
124	**2-Methyl-5-nitrobenzene sulfonanilide**	148	133 5	46-7	186				256 7		256 8	
125	**2,5-Dimethylbenzene sulfonamide**	148	48 (anhyd) 86 (hyd)	24 6				184				N-Xanthylsulfonamide, 176
126	**Benzene-1,3-disulfonanilide**	148 50		63	229		245	214				N-Xanthylsulfonamide, 170
127	**6-Methoxynaphthalene-1-sulfonamide**	149 5		80 5		177 5						
128	**Naphthalene-1-sulfonamide**	150	90	68, 66		112 (152)		137	181	183	237	
129	**4-Ethoxybenzene sulfonamide**	150		39								
130	**4,6-Dichloro-2,5-dimethylbenzene sulfonamide**	150		81		175						
131	**3-Bromo-4-methylbenzene sulfonamide**	151		60								
132	**2-Hydroxynaphthalene-3,6,8-trisulfonanilide**	152-5		*tri* 196								
133	**7-Ethoxynaphthalene-2-sulfonanilide**	153		103	142							
134	**2-Chloronaphthalene-1-sulfonamide**	153		75								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S Benzylthiuronium	*p* Toluidinium	Anilinium	*o* Toluidinium	
135	**8-Chloro-7-methoxynaphthalene-1-sulfonamide**	153		137		196						
136	**2-Aminobenzene sulfonamide**	153						132				2-N Benzoyl deriv of sulfonamide 198, Hydrochloride, 201
137	**5-Methylbenzene-1,3-disulfonanilide**	153, al		94, eth	216, w							
138	**6-Ethoxynaphthalene-2-sulfonanilide**	153		107 5	183							
139	**2-Iodonaphthalene-1-sulfonamide**	154		110								
140	**6-Ethoxynaphthalene-1-sulfonamide**	154		118		194 5						
141	**2,6-Dichloro-4-methylbenzene sulfonamide**	154–5		56								
142	**4-Chloro-2,5-dimethylbenzene sulfonanilide**	155	100	50	185							
143	**4-Amino-2-hydroxybenzene sulfonamide**	155		169								
144	**Tetraline-6-sulfonanilide**	155 6		58	135							
145	**Benzene sulfonamide**	156 (153)	43 4 (monohyd), 66 (anh)	14 5			170 1	148	205	240	176	N Xanthylsulfonamide, 200
146	**2-Chloro-5-methylbenzene sulfonamide**	156		56		229–30 5						
147	**D-3-Bromocamphor-10-sulfonamide**	156	47 5	65								
148	**Toluene-2-sulfonamide**	156 3	57	68		136		170	203 4	218		N Xanthylsulfonamide, 182–3,5
149	**4-Methoxynaphthalene-2-sulfonamide**	157		75 5	145							
150	**5-Methoxynaphthalene-1-sulfonanilide**	157		119 5	194 5							
151	**N-(1-Naphthyl)toluene-4-sulfonamide**	157	104–5	69	105 (dihyd), 138 5 9 (anh)	103		181 2	198	238	190	
152	**Benzophenone-3,3′-disulfonamide**	157		*di* 137–8		*di* 177 8						N-Xanthylsulfonamide, 197
153	**2,4-Dinitrobenzene sulfonamide**	157, 154	106 8 (hyd), 130 (anh)	102								Hydrazide 110
154	**2-Methyl-4-nitrobenzene sulfonamide**	157		106								
155	**2-Nitrodiphenylamine-4-sulfonanilide**	157	220d		162							
156	**Phenanthrene-2-sulfonanilide**	157 8	150	156	253–4				291			Me ester, 101 2, Et ester, 89, yel -br
157	**4-Methylnaphthalene-1-sulfonanilide**	158		81	174, 177							
158	**2-Ethoxynaphthalene-1-sulfonamide**	158		116		187						
159	**4-Methoxynaphthalene-1-sulfonanilide**	158		81	177							

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
160	**2-Ethoxybenzene sulfonanilide**	158		65 6	163							Phenylhydrazide, 132 3
161	**2-Methoxynaphthalene-1-sulfonamide**	159		121		196 5						
162	**3-Nitrobenzylsulfonamide** (3-Nitrotoluene-α-sulfonamide)	159d , w	74 (hyd)	100 bz								Me amide, 106 7 Dimethylamide, 118 9
163	**5-Amino-2-hydroxybenzene sulfonanilide**	159 (98)	100 (anh)		202 d							
164	**5-Chloro-2-nitrobenzene sulfonamide**	159		93								
165	**2,5-Dichlorobenzene sulfonanilide**	160	93 7	38	181			170				
166	**3,5-Dimethyl-2-hydroxybenzene-1,4-disulfonamide**	160 1		*di* 89 91								
167	**6-Hydroxynaphthalene-2-sulfonanilide**	161	129 (hyd) 167 (anhyd)		238			217 (207)	247	264	208	
168	**2-Methylbenzene-1,3-disulfonanilide**	162		88	260							
169	**N-(1-Naphthyl)-4-chloronaphthalene-1-sulfonamide**	162	130 3	94 5	187	145 6				145 6	151	Me ester, 83 Et ester, 104
170	**2-Nitrodiphenylamine-4-sulfonamide**	162	220 d			157						
171	**7-Methylnaphthalene-1-sulfonanilide**	162 4		96	197							
172	**2-Ethoxybenzene sulfonamide**	163		65 6		158						Phenylhydrazide, 132 3
173	**7-Methylnaphthalene-2-sulfonamide**	163 4		63 4								
174	**3-Methyl-2-nitrobenzene sulfonamide**	163 5		58 5								
175	**5-Amino-2-methylbenzene sulfonamide**	164				146 7						5-N-Acetyl deriv of sulfonamide, 242
176	**4-Chloro-2-nitrobenzene sulfonamide**	164		75		138						Phenylhydrazide, 151, Ph ester, 82
177	**4-Nitrodiphenylamine-2-sulfonanilide**	164		102 4	174							
178	**4-Aminobenzene sulfonamide**	165				200	196	185				
179	**3,6-Dichloro-2,5-dimethylbenzene sulfonamide**	165		71		171						
180	**6-Aminonaphthalene-1-sulfonamide**	165						172 4				Benzoylguanidine salt, 210 1
181	**N-(1-Naphthyl)benzyl sulfonamide**	166 (146)		92 3, eth , bz	105, w , al	102, al			113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
182	**4-Bromobenzene sulfonamide**	166, 161	88-90	76, eth		119	183 5	170	215-6	237-8	182-3	
183	**5-Bromo-2-methylbenzene sulfonamide**	166 7		33-5								
184	**N-(1-Naphthyl)-3-nitrobenzene sulfonamide**	166 5	48	64	167	126		146	222	126 5-7 5	193	
185	**3-Nitrobenzene sulfonamide**	167	48	64		126	166 5	146	222	126 5-7 5	193	

*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthylamide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o* Toluidinium	
186	**2,4-Dimethoxybenzene sulfonamide**	167		70								
187	**5-Chloro-2-methyl-3-nitrobenzene sulfonamide**	167		60								
188	**4-Hydroxynaphthalene-1-sulfonamide**	167				199-200						
189	**2,3-Dimethylbenzene sulfonamide**	167		47								
190	**4,6-Dichloro-2-methylbenzene sulfonamide**	168		43								
191	**4-Chloronaphthalene-2-sulfonamide**	168		106								Et ester, 76 9
192	**4,5-Dibenzylnaphthalene-1-sulfonamide**	168		151								
193	**4-Bromo-2-methylbenzene sulfonamide**	168		50								
194	**Propane-1,3-disulfonamide**	169, w	92 d	*di* 45		*di* 125						Di-*m*-toluidide, 222, Dihydrazide, 105
195	**Propane-1,1-disulfonamide**	169 70				151-2, al						
196	**2,4,5-Trimethoxybenzene sulfonanilide**	170		130	76							
197	**4-Acetamidonaphthalene-1-sulfonanilide**	170			241							
198	**4-Ethoxynaphthalene-1-sulfonamide**	170		103		180						
199	**3-Carboxybenzene sulfonamide**	*di* 170	98 (hyd), 148 (anh)	*di* 20				163	224-6			
200	**4-Methyl-2-nitrobenzene sulfonamide**	170		98 9								*o*-Anisidide, 135
201	**N-(1-Naphthyl)benzene sulfonamide**	170-1	43-4 (monohyd), 66 (anh)	14 5	156	112		148	205	240	176	Me ester, b p 150^{15}, N-Xanthylsulfonamide, 200
202	**3,6-Dichloro-2,5-dimethylbenzene sulfonanilide**	171		71	165							
203	**5-Aminonaphthalene-1-sulfonanilide**	171			260			179				
204	**4-Nitrobenzene sulfonanilide**	171 (136)	109 11 (95)	80, lgr	180				179-80			
205	**2,4-Dimethyl-3-nitrobenzene sulfonamide**	172	144 (anh)	96								
206	**8-Nitronaphthalene-2-sulfonanilide**	172-3	135 6 (hyd)	169	223							
207	**2,5-Dimethyl-3-nitrobenzene sulfonamide**	173	128 (200)	61		143 4			136			
208	**4-Nitrodiphenylamine-2-sulfonamide**	173		102 4		164						
209	**7-Ethoxy-8-nitronaphthalene-1-sulfonamide**	173 4		155								
210	**2,5-Dimethylbenzene-1,3-disulfonanilide**	174, al		81, lgr	295, al							
211	**3-Methoxynaphthalene-2-sulfonanilide**	174		138	113							
212	**3,4-Dibromobenzene sulfonamide**	175	66 5-7 5 (anhyd)	34								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
213	**4,6-Dichloro-2,5-dimethylbenzene sulfonanilide**	175		81	150							
214	**4-Chloro-3-nitrobenzene sulfonamide**	175 6, yel, al		40 1 (60 2)								
215	**7-Chloronaphthalene-2-sulfonamide**	176	68 (tetrahyd) 118 (anhyd)	87								Me ester, 89, Et ester, 65
216	**3-Amino-4-methylbenzene sulfonamide**	176										3-N-Benzoyl deriv of sulfonamide, 203, 3-N-Acetyl deriv of sulfonyl chloride, 144, 3-N-Benzoyl deriv of sulfonyl chloride, 196
217	**4-Bromo-3-nitrobenzene sulfonamide**	176-7		55 7								
218	**4-Hydroxybenzene sulfonamide**	176 7		141				169	202	170	192	
219	**5-Methylnaphthalene-1-sulfonamide**	176 8	115									
220	**4-Methylnaphthalene-1-sulfonamide**	177 d 174		81, lgr		158						
221	**2-Chloro-5-methyl-6-nitrobenzene sulfonamide**	177		122								
222	**Benzophenone-3,3 -disulfonanilide**	177 8		*di* 137 8	*di* 157							
223	**6-Methoxynaphthalene-1-sulfonanilide**	177 5		80 5	149 5							
224	**Acenaphthene-5-sulfonanilide**	178		111	223							
225	**2-Methylbenzene-1,4-disulfonanilide**	*di* 178		98	224							
226	**8-Nitronaphthalene-1-sulfonanilide**	178 8 5	115 (trihyd)	165 d	190 5 1 5							
227	**Naphthalene-1,4-disulfonanilide**	179		160 (166)	273, w , al							
228	**4-Nitrobenzene sulfonamide**	180, 50% al	109 11 (95) (hyg)	80, lgr		171 (136) d			179 80			
229	**4-Ethoxynaphthalene-1-sulfonanilide**	180		103	170							
230	**3,4-Dimethyl-5-nitrobenzene sulfonamide**	180		70								
231	**3-Chloro-2-methylbenzene sulfonamide**	180 w	60-72	72, pet eth								
232	**2-Aminonaphthalene-8-sulfonamide**	181 (hyd)				147						1-N-Acetyl deriv of sulfonamide, 213, Benzoylguanidine salt, 214-6
233	**2,5-Dichlorobenzene sulfonamide**	181	93 7 (>1 00)	38		160	160	170	247-8	262-3	250-1	
234	**2,4,5-Trimethylbenzene sulfonamide**	181	112	61								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	*p*-Toluidinium	Anilinium	*o* Toluidinium	
235	**5-Chloro-4-methyl-2-nitrobenzene sulfonamide**	181	128	99								
236	**2,4-Dichlorobenzene sulfonamide**	182	86	55					204 6		170 2	
237	**2,5-Dimethyl-6-nitrobenzene sulfonanilide**	182	145 (anh)	110	192				158 5 9, al		143 5, 50°, al	
238	**5-Ethoxynaphthalene-1-sulfonamide**	182 5		121		130						
239	**6-Ethoxynaphthalene-2-sulfonamide**	183		107 5		153						
240	**4-Iodobenzene sulfonamide**	183		85		143						
241	**4-Ethoxynaphthalene-2-sulfonamide**	183		85		143 5						
242	**Quinoline-8-sulfonamide**	183-4	312	124								Me ester, 96, Et ester, 73, Picrate of Na salt, 226-7
243	**4,5-Dichloro-3-methylbenzene sulfonamide**	183-5		85 8								
244	**N-(1-Naphthyl)-4-bromobenzene sulfonamide**	183 5	88 90	76, eth	166 161	119		170	215 6	237-8	182 3	
245	**6-Chloronaphthalene-2-sulfonamide**	184		110 5								
246	**5-Nitronaphthalene-2-sulfonamide**	184	118 9, yel	125						260 d		
247	**8-Chloronaphthalene-2-sulfonamide**	185		94								
248	**4-Chloro-2-methylbenzene sulfonamide**	185		54								
249	**4-Chloro-2,5-dimethylbenzene sulfonamide**	185	100	50		155						
250	**2-Carboxy-5-methylbenzene sulfonamide** (4-Toluic acid-2-sulfonamide)	185	190 (158) (anh)	*di* 59								
251	**2-Chloro-5-nitrobenzene sulfonamide**	185-6	168-9 d (hyd)	90, w								
252	**2-Bromobenzene sulfonamide**	186, w		51, eth								
253	**3,5-Dichloro-2-methylbenzene sulfonamide**	186		54								
254	**2-Methyl-5-nitrobenzene sulfonamide**	186	133 5 (dihyd)	46-7, b p 183-5[10]		148			256-7		256-8	
255	**2-Chloro-4-methylbenzene sulfonamide**	186		46, 52								
256	**4-Methylbenzene-1,3-disulfonamide** (Toluene-2,4-disulfonamide)	186-7 (191)		54, 46		189			277 d	*di* 189	*di* 170-1	Di-*m*-toluidide, 138
257	**2-Ethoxynaphthalene-1-sulfonanilide**	187		116	158							
258	**4-Chloronaphthalene-1-sulfonamide**	187	130 3 d	94-5		145-6	162			145-6	151	Me ester, 83, Et ester, 104
259	**8-Iodonaphthalene-1-sulfonamide**	187	115	140								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
260	**2,4-Dimethyl-5-nitrobenzene sulfonamide**	187 (179)	132 (122) dil HNO_3	98								Sulfonyl chloride, 109 10
261	**2,4-Diaminobenzene-1,5-disulfonamide**	187		275		236						
262	**8-Bromonaphthalene-2-sulfonamide**	187		121								
263	**2-Chlorobenzene sulfonamide**	188		28 5								
264	**4-Nitronaphthalene-1-sulfonamide**	188		99								
265	**2,6-Dichloro-3-methylbenzene sulfonamide**	188		19 5								
266	**5-Methylnaphthalene-2-sulfonamide**	188 9		120 2		248 50 (133 4)						
267	**4-Methylbenzene-1,3-disulfonanilide**	189		54, 46	186-7							
268	**6-Methoxynaphthalene-2-sulfonamide**	189		93		120						
269	**Sulfanilylguanidine** (Sulfaguanidine)	189 90 (anh), 143 (hyd)										4-N-Acetyl deriv of sulfonamide, 262 6 (248 51) Hydrochloride, 205 6
270	**N-(1-Naphthyl)-4-chlorobenzene sulfonamide**	190	69 (93)	53	144	104		175	208-10	222 3	163 4	
271	**2,4-Dibromobenzene sulfonamide**	190	110 (anh)	79, eth								
272	**4-Methylbenzene-1,2-disulfonanilide** (Toluene-3,4-disulfonanilide)	190		109 11	237 9							
273	**Phenanthrene-3-sulfonamide**	190	175-6 (anh), 120-1 (monohyd) 88 d (dihyd)	110 1				222				Me ester, 119 20, al Et ester, 107-8
274	**4-Aminonaphthalene-1-sulfonanilide**	190										4-N-Acetyl deriv of sulfonamide, 247
275	**8-Nitronaphthalene-1-sulfonamide**	191	115 d (trihyd)	165 d		178-8 5						
276	**2-Hydroxynaphthalene-1,6-disulfonanilide**	191		*di* 111								
277	**3,5-Dichloro-4-methylbenzene sulfonamide**	191		69								
278	**Sulfapyridine**	191-2										4-N-Acetyl deriv of sulfonamide, 226 7, acet
279	**Anthraquinone-2,7-disulfonanilide**	192		*di* 186 chl								
280	**4-Carboxy-3-nitrobenzene sulfonamide** (2-Nitrobenzoic acid-4-sulfonamide)	192	111 (+2½ H_2O)	*di* 160								Diamide, 226
281	**Quinoline-6-sulfonamide**	192	>260	91								
282	**5,6-Dichloronaphthalene-2-sulfonamide**	192		167								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
283	**Anthraquinone-2,7-disulfonamide**	192		186								
284	**2,5-Dimethyl-6-nitrobenzene sulfonamide**	192	145 (anh)	110		182			158 5 9		143 5, 50% al	
285	**2-Amino-5-methylbenzene-1,3-disulfonanilide**	192		156	257							
286	**Methane disulfonanilide**	192 3	220 7[15] d	8 b p 133[10]	*di* 233							
287	**3,4-Dicarboxybenzene sulfonamide** (Phthalic acid-4 sulfonamide)	192 200 d w	138 40 (monohyd)	167 70 d eth								
288	**2-Nitrobenzene sulfonamide**	193	70 (85)	69		115						
289	**Anthraquinone-2-sulfonanilide**	193		197	261			211	308	309		Me ester, 123 Et ester, 125
290	**Phenanthrene-9-sulfonamide**	193 4	174 (anh)	127					235			Me ester, 106, me al Et ester, 108, al
291	**2-Carboxybenzene sulfonanilide**	194 5	68 9 (hyd) 134 (anh)	79, pet eth				206	196 (200)	165	127 8	
292	**5-Methoxynaphthalene-1-sulfonamide**	194 5		119 5		157						
293	**6-Ethoxynaphthalene-1-sulfonanilide**	194 5		118	154							
294	**7-Hydroxynaphthalene-1,3-disulfonanilide**	195		161 2				228	294		271	
295	**4-Bromonaphthalene-1-sulfonamide**	195		87								
296	**7-Hydroxynaphthalene-1-sulfonanilide**	195						218	232	240	242	
297	**2,5-Dibromobenzene sulfonamide**	195	128 (anh)	71								
298	**7-Methylnaphthalene-1-sulfonamide**	195 6		96		162 4						
299	**4,6-Dimethylbenzene-1,3-disulfonanilide**	196, 50% al		130, pet eth	249, w							
300	**4,7-Dichloronaphthalene-2-sulfonamide**	196		156								
301	**N-(1-Naphthyl)-4-aminobenzene sulfonamide**	196			165	200		185				
302	**8-Chloro-7-methoxynaphthalene-1-sulfonanilide**	196		137	153							
303	**5-Fluoronaphthalene-1-sulfonamide**	196 7	105 (hyd)	122 3								Me ester, 118, eth
304	**2-Methoxynaphthalene-1-sulfonanilide**	196 5		121	159							
305	**8-Chloronaphthalene-1-sulfonamide**	197		101								
306	**4,5-Dichloronaphthalene-2-sulfonamide**	197		158								
307	**2,5-Dimethyl-4-nitrobenzene sulfonamide**	197 8	140	75		131			143 5 4 5		143 5 4 5	

*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
308	**Sulfamethazine** (Sulfadimethylpyrimidine)	198 9 (+½ H_2O), pa yel										4-N-Acetyl deriv of sulfonamide, 249 50
309	**Acenaphthene-3-sulfonamide**	199	87 9	113 4		284 6						Me ester, 122 3, Et ester, 137 9, lgr
310	**4-Hydroxynaphthalene-1-sulfonanilide**	199 200	170		167			103	196	186-7	203 4	2-Naphthyl sulfonamide, 204
311	**4-Aminobenzene sulfonanilide**	200			165		196	185	109		132	4-N-Acetyl deriv of sulfonanilide, 214, Me ester, 92
312	**4,5-Dimethylbenzene-1,3-disulfonanilide**	200, al		79, yel	239							
313	**4-Chloro-3-methyl-5-nitrobenzene sulfonamide**	201		52								
314	**Anthracene-2-sulfonanilide**	201		122	261							Phenylhydrazide, 210, Me ester, 157, Et ester, 160
315	**5-Hydroxynaphthalene-1-sulfonanilide**	201	110 2 d									O-Acetyl deriv of sulfonyl chloride, 129
316	**2-Hydroxynaphthalene-3,6-disulfonanilide**	202						233	250	254	257	
317	**5-Amino-2-hydroxybenzene sulfonamide**	202 d	100 (anh)			159 (98)						
318	**1-Nitronaphthalene-2-sulfonanilide**	202	105, grn	121, bz - pet eth	214							
319	**Sulfathiazole**	202 5										4-N-Acetyl deriv of sulfonamide, 256 7
320	**4-Nitrobenzyl sulfonamide** (4-Nitrotoluene-α-sulfonamide)	204	71	90	220 d							
321	**Anthracene-1-sulfonamide**	205		90								
322	**4,8-Dichloronaphthalene-2-sulfonamide**	205		141								
323	**3-Amino-4-hydroxybenzene sulfonamide**	205 (170)	155-6 d									
324	**4-Hydroxybenzene-1,3-disulfonanilide** (Phenol-2,4-disulfonanilide)	205	> 100 d	89	239							
325	**6-Methylnaphthalene-2-sulfonamide**	205-6		97 8								
326	**2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonanilide**	205-7		117-8	206-8							
327	**4-Iodonaphthalene-1-sulfonamide**	206, 204		124, 121		136						
328	**4-Fluoronaphthalene-1-sulfonamide**	206	100 (hyd)	86		144						Et ester, 93
330	**4-Amino-3-nitrobenzene sulfonamide**	206 7		59-60								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S Benzylthiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
331	**Retene-6-sulfonamide**	206 7 5	121 3	146 7 5, yel -br								Me ester, 117 9, Et ester, 114-5
332	**2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonamide**	206 8		117-8		205 7						
333	**3,7-Diethylnaphthalene-1-sulfonamide**	207		105 7								
334	**6-Bromonaphthalene-2-sulfonamide**	207		124								
335	**7-Bromonaphthalene-1-sulfonamide**	209		147								
336	**4-Methoxybenzene-1,3-disulfonanilide**	209		86	240							
337	**7-Iodonaphthalene-2-sulfonamide**	210		100								
338	**4-(N-Methylamino)benzene sulfonamide**	210 11	244 5 d									*p*-Toluenesulfonate, benzidine salt, 255
339	**2,4,6-Trichlorobenzene sulfonamide**	210-2 d		35 40								
340	**4-Aminonaphthalene-1-sulfonamide**	212				190						
341	**6-Iodonaphthalene-1-sulfonamide**	213		92 5								
342	**Fluorene-2-sulfonamide**	213 d	155 (hyd)	164								
343	**Anthraquinone-1-sulfonanilide**	214	218	216-8, yel , $PhNO_2$				191		284		$NH_3 \rightarrow$ 1-Aminoanthraquinone, 252 (243)
344	**1-Nitronaphthalene-2-sulfonamide**	214	105, grn	121, pink, bz -pet eth		202						
345	**4-Acetamidobenzene sulfonanilide**	214		149	219		215					
346	**6-Chloronaphthalene-1-sulfonamide**	214		70								Et ester, 114-5
347	**N-(1-Naphthyl)-4-acetamidobenzene sulfonamide**	215		149	219	214						
348	**2,5-Dichlorobenzene-1,3-disulfonamide**	215 7		114								
349	**5-Methylbenzene-1,3-disulfonamide**	216, w		94, eth		153, al						
350	**5-Chloronaphthalene-2-sulfonamide**	216		115								
351	**Naphthalene-2-sulfonamide**	217, 213	91 (hyg), (122)	76, 79		132		190 1	221	269	213	
352	**4,7-Dichloronaphthalene-1-sulfonamide**	217		151								
353	**6-Bromonaphthalene-1-sulfonamide**	217		77								
354	**4,6-Dichloronaphthalene-2-sulfonamide**	218		136								
355	**7-Bromonaphthalene-2-sulfonamide**	218		100								
356	**3,6-Dichloronaphthalene-2-sulfonamide**	218		166								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
357	**6-Ethoxy-1-nitronaphthalene-2-sulfonamide**	218		146								
358	**5-Aminonaphthalene-2-sulfonamide**	218 9 d				127 8						1-N-Acetyl deriv of sulfonamide, 238 9
359	**4-Acetamidobenzene sulfonamide**	219		149		214	215					
360	**5-Bromonaphthalene-2-sulfonamide**	220		96								
361	**4-Nitrobenzyl sulfonanilide** (4-Nitrotoluene-α-sulfonanilide)	220 d	71	90	204							
362	**7-Methoxynaphthalene-2-sulfonamide**	220		83		121						
363	**2,4,6-Tribromobenzene sulfonanilide**	220 2 d	64	64	228							
364	**7,8-Dichloronaphthalene-1-sulfonamide**	221		138								
365	**8-Hydroxynaphthalene-1-sulfonamide**	222 d	107 (hyg)									
366	**6-Iodonaphthalene-2-sulfonamide**	222		140								
367	**2,5-Dimethylbenzene-1,4-disulfonanilide**	223		164	310							
368	**5,6-Dichloronaphthalene-1-sulfonamide**	223		106								
369	**Acenaphthene-5-sulfonamide**	223		111		178						
370	**6-Nitronaphthalene-1-sulfonamide**	223-4		127								
371	**2-Methylbenzene-1,4-disulfonamide**	224		98		*di* 178						
372	**5-Chlorobenzene-1,3-disulfonamide**	224		106								
373	**Anthracene-1,8-disulfonanilide**	224		225	333							
374	**4-Nitronaphthalene-2-sulfonamide**	225		139 5								
375	**4,6-Dichloronaphthalene-1-sulfonamide**	226		119								
376	**4-Carboxamido-3-nitrobenzene sulfonamide** (2-Nitrobenzamide-4-sulfonamide)	226	111 (+2 5 H_2O)	*di* 160	192							
377	**5-Chloronaphthalene-1-sulfonamide**	226		95		138						Sulfonyl bromide, 110, Me ester, 89, Et ester, 46
378	**4-Methoxynaphthalene-1-sulfonamide**	226		98 5		147 5						
379	**3,4-Di-iodobenzene sulfonamide**	227, aq al	122 5	82, bz - pet eth								
380	**7,8-Dichloronaphthalene-2-sulfonamide**	227		124								
381	**Anthraquinone-1,6-disulfonanilide**	227 8, yel	215 7, gold	197-8, yel , $PhNO_2$								
382	**2,3,4-Trichlorobenzene sulfonamide**	227-30		64 5								

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
383	**3,4-Dichloro-2-methylbenzene sulfonamide**	228		51 2								
384	**4'-Nitrobiphenyl-4-sulfonamide**	228		178								
385	**2,4,6-Tribromobenzene sulfonamide**	228	64	64		220 2 d						
386	**8-Nitronaphthalene-2-sulfonamide**	228 223	135 6 (+1 5 H_2O)	169		172 3						
387	**6,8-Dichloronaphthalene-2-sulfonamide**	228		121								
388	**Benzene-1,3-disulfonamide**	229		63		148–50	245	214				N-Xanthylsulfonamide, 170, Alk fusion → resorcinol, 110
389	**4,5-Dichloronaphthalene-1-sulfonamide**	229		117								
390	**Biphenyl-4-sulfonamide**	230		115		125						
391	**2,4-Di-iodobenzene sulfonanilide**	230	167 (anh)	77 8								Me ester, 78, al, Et ester, 52, al
392	**2-Hydroxynaphthalene-1,5-disulfonanilide**	231		*di* 231								
393	**5-Bromonaphthalene-1-sulfonamide**	232–3		95								
394	**2-Hydroxynaphthalene-1,7-disulfonanilide**	233		169								
395	**Methane disulfonamide**	233	b p 220 70^{15-20} d	*di* 8, b p 133^{10}		*di* 192–3						
396	**2-Ethoxybenzene-1,4-disulfonamide**	233		*di* 106 8								
397	**3,5-Dinitrobenzene sulfonamide**	235		99, chl , lgr								
398	**4-Aminobenzene-1,3-disulfonamide** (Aniline-2,4-disulfonamide)	235, w	120 d									
399	**7-Chloronaphthalene-1-sulfonamide**	235		129								
400	**5,6,8-Trichloronaphthalene-2-sulfonamide**	235		158								
401	**4,6,7,8-Tetrachloronaphthalene-2-sulfonamide**	235		176								
402	**5-Nitronaphthalene-1-sulfonamide**	236		113		123						
403	**4-Carboxamidobenzene sulfonamide**	236	94 (hyd) 260 (anh)	*di* 57		*di* 252						
404	**2,4-Diaminobenzene-1,5-disulfonanilide**	236		275	187							
405	**2,3-Dichloro-4-methylbenzene sulfonamide**	237		41								
406	**Benzene-1,3,5-trisulfonanilide**	*tri* 237	>100	*tri* 187	*tri* 310 5							Tri-Et ester, 147, bz
408	**Anthraquinone-1,7-disulfonanilide**	237–8, yel , cl bz	120 (hyd)	321–2, br -yel , $PhNO_2$								
409	**Anthraquinone-1,8-disulfonanilide**	237–8, yel , $PhNO_2$	293–4	222 3	>340							
410	**4-Methylbenzene-1,2-disulfonamide**	237 9		109–11		190						

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
411	**6-Hydroxynaphthalene-2-sulfonamide**	238	129 (hyd) 167 (anh)			161		217 (207)	248	264	208	
412	**4-Hydroxybenzene-1,3-disulfonamide** (Phenol-2,4-disulfonamide)	239	>100 d	89		205						
413	**5-Iodonaphthalene-1-sulfonamide**	239		141								
414	**4,5-Dimethylbenzene-1,3-disulfonamide**	239		79, yel		200, al						
415	**7-Iodonaphthalene-1-sulfonamide**	240		165								
416	**4-Methoxybenzene-1,3-disulfonamide**	240		86		209						
417	**4-Acetamidonaphthalene-1-sulfonamide**	241				170						
418	**Benzene-1,2-disulfonanilide**	241		143	254			206				
419	**5-Nitrobenzene-1,3-disulfonamide**	242		*di* 97 8								
420	**Naphthalene-2,7-disulfonamide**	242		158 162				212	299	251-2	238	
421	**2,4,6-Trimethylbenzene-1,3-disulfonamide**	244		*di* 125		*di* 150 1						
422	**5,8-Dichloronaphthalene-2-sulfonamide**	244		134								
423	**2,3,4,6-Tetrabromobenzene sulfonamide**	245 d		96 5								
424	**6,7,8-Trichloronaphthalene-2-sulfonamide**	245		157								
425	**N,N'-Di(1-naphthyl)benzene-1,3-disulfonamide**	245		63	229	148 50		214				Alk fusion → resorcinol, 110, N-Xanthylsulfonamide, 170
426	**Anthraquinone-1,5-disulfonamide**	246 (350)	310 d	265-70		270 d						
427	**1-Iodonaphthalene-2-sulfonamide**	247		94								
428	**9,10-Dichloroanthracene-2-sulfonanilide**	248		221	279							
430	**5-Methylnaphthalene-2-sulfonanilide**	248-50		120-2	188 9							
431	**4,6-Dimethylbenzene-1,3-disulfonamide**	249, w		130, pet eth		196, 50% al						
432	**Benzene-1,4-disulfonanilide**	249		131 (139)	288							
433	**5,6,7-Trichloronaphthalene-1-sulfonamide**	249		131								
434	**Naphthalene-1,5-disulfonanilide**	249	245 (anh)	*di* 183	310 (340)			257 251d	332			Di-Me ester, 205, chl
435	**1-Chloronaphthalene-2-sulfonamide**	250	130 3d (anh)	84 5		171 2						
436	**Azobenzene-4,4'-disulfonamide**	250 d	169d (anh)	*di* 222								Et ester, 104
437	**4-Carboxanilidobenzene sulfonanilide**	252	94 (hyd), 260 (anh)	*di* 57	*di* 236							

* Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
438	**Phenanthrene-2-sulfonamide**	253 4	150	156		157 8			291			Me ester, 101-2, Et ester, 89, yel -br
439	**Benzene-1,2-disulfonamide**	254		143		241		206				
440	**2-Amino-5-methylbenzene-1,3-disulfonamide**	257		156		192						
441	**2-Amino-5-methylbenzene-1,4-disulfonamide**	257, w	290	*di* 156, chl		*di* 196-7, aq al						
442	**5-Aminonaphthalene-1-sulfonamide**	260				171		179				5-N-Acetyl deriv of sulfonamide, 231-2
443	**2-Methylbenzene-1,3-disulfonamide**	260		88		162						
444	**Anthracene-2-sulfonamide**	261		122		201						Me ester, 157, Et ester, 160
445	**Anthraquinone-2-sulfonamide**	261		197		193		211	308	309		Me ester, 123, Et ester, 125
446	**7-Nitronaphthalene-1-sulfonamide**	261-2		169 70								
447	**6,7-Dichloronaphthalene-1-sulfonamide**	268		142								
448	**3,7-Dichloronaphthalene-1-sulfonamide**	269		136								
449	**Anthraquinone-2,6-disulfonanilide**	269-70	310 11 (hyd)	265 70, yel	>350							
450	**Anthraquinone-1,5-disulfonanilide**	270 d	310 d	265-70	246 (350)							
451	**1-Bromonaphthalene-2-sulfonamide**	271		93								
452	**5,7-Dichloronaphthalene-1-sulfonamide**	272		149								
453	**Naphthalene-1,4-disulfonamide**	273, w , al		160 (166)		179						
454	**Azoxybenzene-3,3′-disulfonamide**	273	126	*di* 138								
455	**4,6-Dichlorobenzene-1,3-disulfonamide**	276		123								
456	**Benzidine-2,2′-disulfonamide**	278		Hydrochloride, 205								
457	**9,10-Dichloroanthracene-2-sulfonamide**	279		221		248						
458	**1,5-Dichloronaphthalene-2-sulfonamide**	282		125								
459	**4-Nitronaphthalene-2,7-disulfonamide**	286-7		140 1								
460	**Azobenzene-3,4′-disulfonamide**	288		123 5								
461	**Benzene-1,4-disulfonamide**	288		131 (139)		249						
462	**Naphthalene-1,3-disulfonamide**	292 3		*di* 137 5								
463	**Anthracene-1,5-disulfonanilide**	293		*di* 240	*di* >330							
464	**2,5-Dimethylbenzene-1,3-disulfonamide**	295, al		81, lgr		174, al						

*Derivative data given in order m p , crystal color, solvent from which crystallized

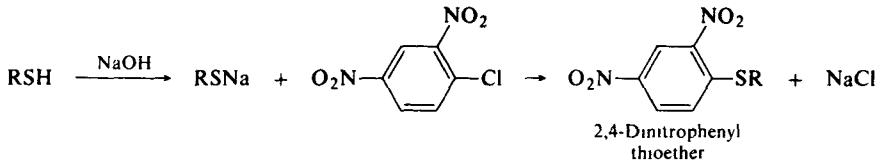
TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES
(Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	*p*-Toluidinium	Anilinium	*o*-Toluidinium	
465	**Naphthalene-1,6-disulfonamide**	298	125 (anh)	129				81 (235)	314–5	298–9	323–4	
466	**Naphthalene-1,7-disulfonamide**	298 300	123									
467	**Biphenyl-4,4'-disulfonamide**	300	72	203				171	330 d			
468	**Naphthalene-2,6-disulfonamide**	305		225				256		360		
469	**Azobenzene-3,3'-disulfonamide**	305		*di* 166								
470	**2,5-Dimethylbenzene-1,4-disulfonamide**	310		164		223						
471	**Naphthalene-1,5-disulfonamide**	310 (340)	245 (anh)	183		249		257, 251 d	332			Di-Me ester, 205, chl
472	**Benzene-1,3,5-trisulfonamide**	310 5	>100	*tri* 187		*tri* 237						Tri-Et ester, 147, bz
473	**Anthraquinone-2,6-disulfonanilide**	321		*di* 250, yel , cl bz								
474	**Anthracene-1,5-disulfonamide**	330		*di* 240		*di* 293						
475	**Anthracene-1,8-disulfonamide**	333		225		224						
476	**8-Cyanonaphthalene-1-sulfonamide**	333-4		139								
477	**Anthraquinone-1,8-disulfonamide**	>340	293 4	222 3, yel , $PhNO_2$		237–8, yel , $PhNO_2$						
478	**Anthraquinone-1,3-disulfonamide**	>350	310 11 (hyd)	265 70, yel		269–70, red-yel						

*Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XXV

*2,4-Dinitrophenyl thioether (2,4-Dinitrophenyl sulfide).**



2,4-Dinitrophenyl thioether

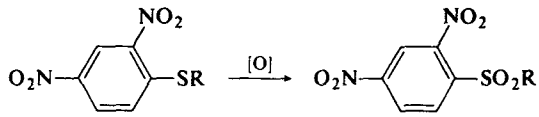
From the sodium thiolate (prepared from the thiol and sodium hydroxide) and 2,4-dinitrochlorobenzene in methanol.

For directions and examples see: Cheronis, p. 642.

From the sodium thiolate and 2,4-dinitrochlorobenzene in aqueous or absolute alcohol.

See: Linstead, p. 86; Shriner, p. 255; Vogel, p. 500; Wild, p. 91; R. W. Bost, J. O. Turner and R. D. Norton, *J. Amer. Chem. Soc.*, **54**, 1985 (1932); R. W. Bost, J. O. Turner and M. W. Conn, *J. Amer. Chem. Soc.*, **55**, 4956 (1933).

*2,4-Dinitrophenyl sulfone.**



2,4-Dinitrophenyl sulfone

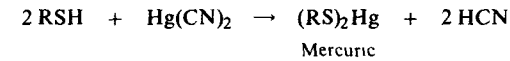
From the thioether (prepared from the thiol and 2,4-dinitrochlorobenzene) and potassium permanganate in aqueous or glacial acetic acid.

For directions and examples see: Cheronis, p. 641; Linstead, p. 87; Vogel, p. 501; Wild, pp. 91–2.

From the thioether with hydrogen peroxide, ammonium molybdate and perchloric acid in water.

See: Cheronis, p. 642.

Hg salt.

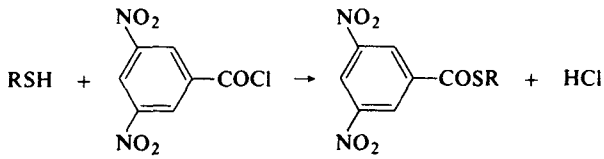


Mercuric thiolate

From the thiol and aqueous mercuric cyanide in ethanol.

For directions and examples see: Linstead, p. 86; Wild, pp. 90–91; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*3,5-Dinitrothiobenzoate.**

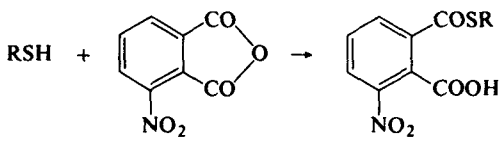


3,5-Dinitrothiobenzoate

From the thiol, 3,5-dinitrobenzoyl chloride and pyridine.

For directions and examples see: Cheronis, p. 643; Shriner, p. 255; Vogel, p. 501; Wild, p. 92; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*3-Nitrothiophthalate.**



3-Nitrothiophthalate

From 3-Nitrophthalic anhydride and the thiol.

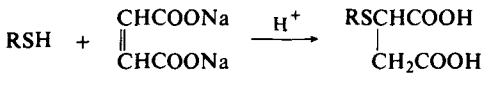
For directions and examples see: Wild, p. 93; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

EXPLANATIONS AND REFERENCES TO TABLE XXV (Continued)

S-Alkylmercaptosuccinic acid (Alkylthiosuccinic acid) *

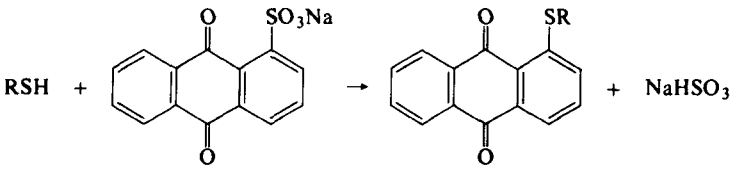


S-Alkylmercap tosuccinic acid

From the thiol and disodium maleate in ethanol

For directions and examples see J G Hendrickson and L F Hatch, *J Org Chem*, **25**, 1747 (1960)

1-Anthraquinonyl thioether



1 Anthraquinonyl thioether

From the thioether with sodium anthraquinone-1-sulfonate and sodium hydroxide in water

For directions and examples see E E Reid, C M MacKall and G E Miller, *J Amer Chem Soc*, **43**, 2104 (1921) W S Hoffman and E E Reid, *J Amer Chem Soc*, **45**, 1831 (1923) L M Ellis and E E Reid, *J Amer Chem Soc*, **54**, 1674 (1932)

Acetate

$$RSH + CH_3COCl \rightarrow CH_3COSR + HCl$$

$$RSH + (CH_3CO)_2O \rightarrow CH_3COSR + CH_3COOH$$

$$RSH + CH_2{=}C{=}O \rightarrow CH_3COSR$$

Acetate

From the thiol with acetyl chloride, or from the thiol with acetic anhydride and aqueous sodium hydroxide, or from the thiol with ketene

For directions and examples see A Schoberl and A Wagner in *Methoden der Organischen Chemie (Houben-Weyl)*, Vol 9 (Ed E Muller), Georg Thieme Verlag, Stuttgart, 1955, pp 753–756

Methyl thioether

$$RSNa + CH_3I \rightarrow RSCH_3 + NaI$$

Methyl thioether

From the sodium thiolate with alkyl halide

For directions and examples see E E Reid, *The Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960, p 25

Disulfide

$$2\,RSH \xrightarrow{[O]} RSSR + H_2O$$

Disulfide

From the thiol (or thiophenol) with ferric chloride in aqueous acetic acid

For directions and examples see Linstead, p 87, Wild, p 95, T Zincke and W Frohneberg, *Chem Ber*, **43**, 840 (1910)

From the thiol with chlorine, bromine or iodine in hydrocarbon solvent

See E E Reid, *The Chemistry of Bivalent Sulfur*, Vol 1, Chemical Publishing Co, New York, 1958, p 124

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

a) Liquids (Listed in order of increasing atmospheric b.p.)*

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	3,5-Dinitrothiobenzoate	3-Nitrothiophthalate	1-Anthraquinonyl thio ether	Mercury salt	S-Alkylmercaptosuccinic acid	Disulfide	Miscellaneous
1	**Methanethiol** (Methyl mercaptan)	5.96	−123		0.8599[25]	127.8	189.5			221	176	133	−84.72, b.p. 116.8	
2	**Ethanethiol** (Ethyl mercaptan)	36	−144.4	1.4318	0.83147[25]	114–5	160	62	149	184	85	119.5	−101.4, b.p. 153.5	Acetyl, b.p. 114
3	**2-Propanethiol** (*sec*-Propyl mercaptan)	56	−130.7	1.4256	0.8142	93.5–5.0	140.5	84	145	134	63		−69 b.p. 176	
4	**2-Methyl-2-propanethiol** (*tert*-Butyl mercaptan)	64.2	1.26	1.4230	0.7999	109–11						164	b.p. 200.1	Benzoyl, b.p. 110[28]
5	**1-Propanethiol** (*n*-Propyl mercaptan)	67.5	−113.8	1.4348	0.8047	85–6.5	127.5	52	137	151	72	118.9	−85.59 b.p. 195–6	
6	**2-Butanethiol** (*sec*-Butyl mercaptan)	84.5	−165.0	1.4367	0.8294	65.6–6.0	120				189	135	b.p. 95.7[14]	Benzoyl, b.p. 150[20]
7	**2-Methyl-1-propanethiol** (Isobutyl mercaptan)	88.72		1.4386	0.8357	74.5–5.0	105.5	63.4	136	144	95	120.9–1.4	b.p. 220	
8	**2-Propene-1-thiol** (Allyl mercaptan)	90.67.9		1.4680	0.93044	72	105	52					b.p. 174d	
9	**1-Butanethiol** (*n*-Butyl mercaptan)	98.100	−119 to −115	1.44402	0.8337	66	92	49	144	112.5	86	103.7–4 144.5	b.p. 226	Benzoyl, b.p. 160[23]
10	**2-Pentanethiol** (*sec*-Amyl mercaptan)	112.9	−169	1.4386[25]	0.82815[25]								b.p. 122.3[10]	
11	**2-Methoxyethanethiol**	113		1.4488[23]		90								Acetyl, b.p. 110[110]
12	**D,L-3-Methylbutanethiol** (Isoamyl mercaptan)	117 118 20		1.44118	0.83475							115.6–6.0	b.p. 250	
13	**1-Phenylethane-1-thiol**	119 20		1.557	1.022		161						58	Acetyl, b.p. 123–5[13]
14	**D-2-Methyl-1-butanethiol**	119 21			0.8403[25]	78.9					60	122.3–6	b.p. 122.3	$[\alpha]_D^{23}$ +3.21
15	**2-Chloropropanethiol**	125		1.4844	1.1062	76.7							b.p. 113–20[20]	Acetyl, b.p. 70–1[9]
16	**2-Chloroethanethiol**	125–6		1.5289	1.203	95.7							b.p. 170.80	Acetyl, b.p. 51[4]
17	**2-Ethoxyethanethiol**	125.6		1.5795	0.9462	66							b.p. 150–2[15]	
18	**1-Pentanethiol** (*n*-Amyl mercaptan)	126.64	−75.83	1.44366	0.8390	79.5 80.5	83	40	132	114	75	107.8	b.p. 140–5[17]	$PdCl_2$ deriv., 41
19	**2-Hexanethiol** (*sec*-Hexyl mercaptan)	142 138.9	−147.0	1.4426[25]	0.83050[25]									
20	**1,2-Ethanedithiol** (Ethylene dithioglycol)	147, 46 7[16]	−41.0	1.5550	1.1185[25]	248								Di-Me eth., b.p. 183
21	**1-Hexanethiol** (*n*-Hexyl mercaptan)	151.2	−81.03	1.4490	0.8526	73.5–5.0	97			129	58	96.0–5		
22	**2-Hydroxyethanethiol**	158, 54[12]		1.4443	1.1143	100.2					123		28	Diacetyl, b.p. 98–9, Dibenzoyl, 39, S-Phenylurethane, 59–60, bz

*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

a) Liquids (Listed in order of increasing m.p.)* (Continued)

No	Name	Boiling point °C	Melting point, °C	n_D^{20}	D_4^{20}	2,4-Dinitrophenyl thio ether	2,4-Dinitrophenyl sulfone	3 5 Dinitrothiobenzoate	3 Nitro thio phthalate	1-Anthraquinonyl thioether	Mercury salt	S-Alkyl mercapto succinic acid	Disulfide	Miscellaneous
23	**Cyclohexanethiol** (Cyclohexyl mercaptan)	158–60		1 4933	0 9782	148	172				78	150 5–1 5	b p 288	
24	*cis*-**3-Methyl-1-cyclohexanethiol**	165		$1\ 4647^{25}$	$0\ 916^{25}$									$[\alpha]_{546}$ −2 24
25	**Thiophenol** (Mercaptobenzene)	169 5, 172 5	−14 9	1 5888	1 0780	121	161	149	131				66 5 61	4-Nitrothiobenzoyl, 115 7–8, Phenylurethane, 128
26	*trans*-**3-Methyl-1-cyclohexanethiol**	171		$1\ 4663^{25}$	$0\ 914^{25}$									$[\alpha]_{546}$ +5 50
27	**2-Thiophenethiol**	171 1, 166		1 6021	$1\ 168^{19\ 5}$	119	143						56	Acetyl, b p 230 2
28	**1,3-Propanedithiol**	172 9	−79 0	$1\ 5371^{25}$	$1\ 0775^{25}$	194							b p 198^{20}	Dibenzoyl, 56 3
29	**1-Heptanethiol** (*n*-Heptyl mercaptan)	176 7	−43 4	$1\ 4498^{25}$	$0\ 83891^{25}$	81–2	101	53	96	132	77	105 8–6 2	b p 164^{6}	
30	**2-Octanethiol** (*sec*-Octyl mercaptan)	186 4	−79 0	$1\ 4481^{25}$	$0\ 83293^{25}$								b p $161–71^{6}$	
31	**2-Thiocresol** (2-Toluenethiol)	194 3	15			101, 98 9 5	155				170 3			S-4-Nitrobenzoyl, 90–1
32	**Phenylmethanethiol** (Benzyl mercaptan)	194–5			1 058	130, 128 5–9 5	182 5	120	137			189–90, 192	74, 70	Ph eth, 42
33	**3-Thiocresol** (3-Toluenethiol)	195 4				100–1 5, 91	145							S-4-Nitrobenzoyl, 95–6, Ag deriv, 126–7
34	**1,4-Butanedithiol**	195 6	−53 9	$1\ 5265^{25}$	$1\ 0395^{25}$									Dibenzoyl, 49 5
35	**2-Phenylethanethiol**	199		$1\ 5643^{19}$	$1\ 0318^{18}$	93–4 5	133						b p $168–80^{15}$	Acetyl, b p 134 5^{14}
36	**1-Octanethiol** (*n*-Octyl mercaptan)	199 1	−49 2	$1\ 4519^{25}$	$0\ 83956^{25}$	78, 76–7 5	98			95	71	96 1–6	b p $178–83^{5}$	
37	**2-Chlorothiophenol**	205			$1\ 2752^{19\ 5}$	138							90	
38	**2,5-Dimethylthiophenol** (*p*-Xylene-2-thiol)	211–2												S-Ph eth, b p 172 5[11], S-4-Tolyl eth, b p 188[11]
39	**2,4-Dimethylthiophenol** (*m*-Xylene-4-thiol)	214												S-Ph eth, b p 171[11], S-Benzyl eth, 35

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

a) Liquids (Listed in order of increasing m.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	2,4-Dinitrophenyl thio ether	2,4-Dinitrophenyl sulfone	3 5 Dinitro thiobenzoate	3 Nitrothiophthalate	1-Anthraquinonyl thio ether	Mercury salt	S-Alkyl mercaptosuccinic acid	Disulfide	Miscellaneous
40	**2-Hydroxythiophenol** (Thiocatechol)	216 7^{751}, 88 90^{8}	5-6		1 2373^{0}									O-Me eth , b p 218-9, Di-Me eth , b p 237
41	**Bis(2-mercaptoethyl) ether**	217	−80	1 5339	1 1648^{25}									4-Nitrobenzoyl, 106 5
42	**1,5-Pentanedithiol**	217 3, 110^{16}	−72 5											Dibenzoyl, 45
43	**1-Nonanethiol** (*n*-Nonyl mercaptan)	220 2	−20 1	1 45197	0 83714	86, 84 5	92			117 5		105-6	b p 211-2^{6}	
44	**2-Isopropyl-5-methylbenzenethiol** (Thiothymol)	230-1										78, al		
45	**5-Isopropyl-2-methylbenzenethiol** (Thiocarvacrol)	235-6			0 9975$^{17.5}$						109			S-Me eth , b p 244
46	**1,6-Hexanedithiol**	237 1	−21 0	1 5077^{25}	0 9886^{25}									Dibenzoyl, 57
47	**1-Naphthalenethiol** (α-Mercapto naphthalene)	285, 114 8^{10}		1 6802	1 1607									Benzyl eth , 78-80, 4-Nitrobenzoyl, 121-30, Acetyl, b p , 200-3^{25}

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)
b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point, °C	Boiling point °C	2,4-Dinitrophenyl thioether	2,4 Dinitrophenyl sulfone	Acetate	Benzoate	S-Alkylmercaptosuccinic acid	Disulfide	Methyl thioether	Miscellaneous
1	**3-Hydroxythiophenol** (Thioresorcinol)	17	168[15]				*di* 78		95	15 b p 224 sl d	Di-Me eth, b p 224-5
2	**Hexadecanethiol** (Cetyl mercaptan)	19	123-8[0.5]	91, 96	105			105 6 5	55 5		
3	**1,10-Decanedithiol**	20 17 8	297 1				*di* 57 55				D_4^{45} 0 9432 n_D^{45} 1 4940
4	**Benzoylmethanethiol** (2-Mercaptoacetophenone)	23 4	116 22[4]						81		D_4^{20} 1 1753, Oxime, 70, Phenylhydrazone, 90 1
5	**2-Aminothiophenol**	26	234, 125-7[6]	152		*di* 135			93	b p 234 sl d	
6	**3-Phenylenedithiol** (Dithioresorcinol)	27 1	245 123[14]								Trinitrobenzene add comp, 76 7
7	**4-Dimethylaminothiophenol**	28 5	259 60	176					118		
8	**2-Phenylenedithiol** (Dithiocatechol)	29	238 9			*di* 88 5	*di* 74 5 94-5				
9	**4-Hydroxybenzenethiol** (Thiohydroquinone)	30	144 6[20]			*S*- 85 6, bz-lgr, *di* 66	75, *di* 161			84 5	S-Et eth, 39-41
10	***threo*-Dithiothreitol** (*threo*-2,3-Dihydroxy-1,4 dithiobutane)	42 3	123-5[2]			*tetra* 73, me al					Oxid → *trans*-4,5-dihydroxy-*o*-dithiane, 132, Diisopropylidene deriv 78, me al
11	**4-Thiocresol** (4-Toluenethiol)	43-4	195	102 5 4	189 5	*di* 66	*di* 161				S-4-Tolyl deriv, 57 S-4-Nitrobenzoyl 114 5 S-Chloroacetyl, 40
12	**4-Chloro-1-naphthalenethiol**	43 4, al							122		
13	**4-Aminothiophenol**	46	140 5[16]			N-*mono* 154 163, yel			82	b p 272 3	
14	**1,4-(Dimethylthio)-benzene** (*p*-Xylylene dimercaptan)	46-7	156[12]				*di* 135				
15	**5-Amino-2-methylthiophenol**	47, bz-pet eth				*di* 125, yel, bz-pet eth				147 lgr	Tri-Me eth, b p 159
16	**4-Chlorothiophenol**	54	123					163 4	73		
17	**2-Hydroxy-1-naphthalenethiol**	55, pet eth				O- 120, CCl_4, *di* 57					
18	**1,3,5-Benzenetrithiol**	57 60				*tri* 73-4, al				*tri* 66 8, al	
19	**2-Nitrothiophenol**	58 61		131 3					199	64 5	
20	**1-Amino-2-propanethiol**	63 5							Dihydrochloride, 214		Hydrochloride, 87-8, al Picrate, 143-4 d
21	**4-Bromothiophenol**	75	231	142	190	51 2, me al			94 5	38, al	Benzenesulfonate, 75
22	**3-Nitrothiophenol**	77							84		
23	**4-Nitrothiophenol**	77		160			123 7, 50% ac a		184	72	
24	**4-Nitro-1-naphthalenethiol**	77 9		193					189		
25	**2-Naphthalenethiol** (2-Mercaptonaphthalene)	81	286	145	228	53 5			139		4-Nitrobenzoyl, 183-4, 2-Tolyl eth, b p 229 5[11]

*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point °C	2,4-Dinitro phenyl thio-ether	2,4-Dinitro-phenyl sulfone	Acetate	Benzoate	S-Alkyl mercapto succinic acid	Disulfide	Methyl thio-ether	Miscellaneous
26	**DL-*erythro*-Dithiothreitol** (*erythro*-2,3-Dihydroxy-1,4-dithiobutane)	82 3, lt pet eth				*tetra* 126, bz					Oxid → *cis*-4,5-dihydroxy-*o*-dithiane, 132 Di-isopropylidene deriv, 145, pet eth
27	**4-Iodothiophenol**	85 6, al		140 5					124	45 38	CrO_3/AcOH → sulfone, 83
28	**4-Amino-1-naphthalenethiol**	91 3				N-*mono* 173			168		
29	**2-(3-Aminopropionamido)ethanethiol** (Aletheine)	93 6, subl $140^{10\ s}$				*di* 139 40, et ac					Hydrochloride, 214 7, 95% al, Oxalate, 121 2, al
30	**Bis(4-mercaptophenyl)ether**	98				*di* 68					
31	**4-Phenylenedithiol** (1,4-Dimercaptobenzene)	98, aq al				*di* 126, pet eth				*di* 85, me al	Di-Et eth, 81 5, al
32	**2-Aminoethanethiol**	98 100	130	94 5		*di* 30			Dihydrochloride, 216		Hydrochloride, 70 2, al, Picrate, 126 S-Acetyl hydrochloride, 137
33	**Triphenylmethanethiol**	107		190		139-41	185		*ca* 155		
34	**4-Bromo-2-nitrothiophenol**	110		142							
35	**4-Biphenylthiol**	111 2, al		146	170				150	107 8, al	
36	**3-Amino-1-propanethiol**	112 3							Dihydrochloride, 219		Hydrochloride, 69, dil al
37	**1,8-Naphthalenedithiol**	113 4, al								*di* 84	
38	**4-Hydroxy-1-naphthalenethiol**	114				*di* 77					
39	**Bis(4-thiophenyl)sulfide**	114				*di* 65			190		
40	**2,4,6-Trinitrothiophenol**	114		217							
41	**1,5-Naphthalenedithiol**	118 21, yel				*di* 187-9	*di* 232			*di* 250	
42	**4-Chloro-2-nitrothiophenol**	120 2		141							
43	**2,4-Dinitrothiophenol**	131 2		193 7	240 1	107	113		280		
44	**6-Hydroxy-2-naphthalenethiol**	137, al				*di* 110, 107, al			221		
45	**2-Benzothiazolthiol**	177 9, aq me al								52, aq al	Et eth, 26 al
46	**2,7-Naphthalenedithiol**	181, 174, al				*di* 110	*di* 152-3				
47	**1-Anthraquinonethiol**	187, yel, ac a							>350,	218, yel, al	Et eth, 183, yel, al, Benzyl eth, 241, yel, ac a
48	**2-Anthraquinonethiol**	206, yel, ac a							257	162, yel, ac a	Et eth, 138, yel, al, Benzyl eth, 138, yel, al
49	**2-Benzimidazolthiol**	298, 296 7, dil al									Benzyl eth, 186 7, 1-N-Me eth, 190-2

*Derivative data given in order m p, crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLE XXVI

Sulfone *

$$RSR' \xrightarrow{[O]} \underset{\text{Sulfone}}{RSO_2R'}$$

From the thioether in glacial acetic acid with dilute aqueous potassium permanganate

For directions and examples see Cheronis, p 641, Linstead, p 87, G W Fenton and C K Ingold, *J Chem Soc*, 2338 (1929), H Rheinboldt and E Giesbrecht, *J Amer Chem Soc*, **68,** 973 (1946)

From the thioether with aqueous hydrogen peroxide in acetone or in acetic acid

See O Hinsberg, *J prakt Chem*, **90,** 350 (1914), H Rheinboldt and E Giesbrecht, *J Amer Chem Soc*, **68,** 973 (1946), C G Overberger, S P Lighthelm and E A Swire, *J Amer Chem Soc*, **72,** 2856 (1950)

From the thioether with hydrogen peroxide and ammonium molybdate in aqueous perchloric acid

See Cheronis, p 641

From the thioether with potassium bichromate and sulfuric acid in water

See G Raiziss, L W Clemence, M Severac and J C Moetsch, *J Amer Chem Soc*, **61,** 2763 (1939)

From the thioether with chromic anhydride in glacial acetic acid

See C G Overberger, S P Lightelm and E A Swire, *J Amer Chem Soc*, **72,** 2856 (1950)

For extensive lists of references for the oxidation of thioethers to the corresponding sulfones *see* A Schoberl and A Wagner in *Methoden der Organischen Chemie (Houben-Weyl)*, Vol 9, (Ed E Miller), Georg Thieme Verlag, Stuttgart, 1955, pp 227–231, E E Reid, *Organic Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960, pp 64–65

Sulfoxide

$$RSR' \xrightarrow{[O]} \underset{\text{Sulfoxide}}{RSOR'}$$

From the thioether with hydrogen peroxide in acetic acid, in acetone or in alcohol-acetic acid mixture

For directions and examples see O Hinsberg, *Chem Ber*, **43,** 289 (1910), R L Shriner, H C Struck and W V Jorison, *J Amer Chem Soc*, **52,** 2060 (1930), P Karrer, N J Antia and R Schwyzer, *Helv chim Acta*, **34,** 1392 (1951)

From the thioether with perphthalic acid in ether

See H Bohme, *Chem Ber*, **70,** 378 (1937)

From the thioether with chromic anhydride in aqueous acetic acid

See R Knoll, *J prakt Chem*, **113,** 40 (1926)

For additional references for the oxidation of thioethers to the corresponding sulfoxides *see* A Schoberl and A Wagner in *Modern Methoden der Organischen Chemie (Houben-Weyl)*, Georg Thieme Verlag, Stuttgart, 1955, pp 211–215

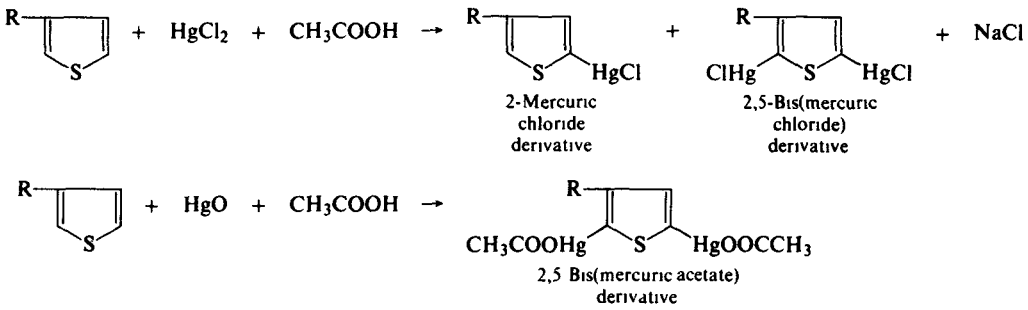
Mercuric halide addition compound

$$R_2S + HgX_2 \rightarrow \underset{\substack{\text{Mercuric halide}\\ \text{addition compound}}}{R_2S \cdot HgX_2}$$

From the thioether with mercuric chloride, bromide or iodide in ethanol, acetone or aqueous solution

For directions and examples see W F Faragher, J C Morrell and S Comay, *J Amer Chem Soc*, **51,** 2774 (1929), E E Reid, *Organic Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960.

Mercuric halide or mercuric acetate derivative



*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

EXPLANATIONS AND REFERENCES TO TABLE XXVI (Continued)

These derivatives are for substituted thiophenes only.

From the substituted thiophene with the mercuric salt (with or without sodium acetate) in ethanol or in acetic acid.

For directions and examples see: H. D. Hartough, *Thiophene and its Derivatives*, (*The Chemistry of Heterocyclic Compounds*, Vol. 3), Interscience, London, 1952, pp. 444–453.

For various additional compounds of thioethers with metal salts *see*: E. E. Reid, *Organic Chemistry of Bivalent Sulfur*, Vol. 2, Chemical Publishing Co., New York, 1960, pp. 52–60.

*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)

a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	**Dimethyl sulfide** (Methyl sulfide)	37 3	−98 27	1 4356	0 8458[21]	109 b p 238	18 45 b p 189	109 7	Tri-$HgCl_2$ add comp , 158 150 1, rapid htng HgI_2 add comp , 75, $SnBr_4$ add comp , 85-7, $PtCl_2$ add comp 159 $PtBr_2$ add comp 159 $PdCl_2$ add comp , 130 $PdBr_2$ add comp , 125 $AgNO_3$ add comp , 126
2	**Ethyl methyl sulfide**	66 9	−104 8	1 4353	0 8483	36, eth		130	$HgCl_2$ add comp , 128 HgI_2 add comp 59 $PdCl_2$ add comp 67
3	**Methyl vinyl sulfide**	67 3		1 4845	0 9026				
4	**Divinyl sulfide** (Vinyl sulfide)	84			0 9174				
5	**Allyl methyl sulfide**	91 3		1 4712	0 8767				
6	**Diethyl sulfide** (Ethyl sulfide)	92	−102 05	1 44233	0 8368	73 4 b p 248	4 6, 15 b p 88 9[15]	152 6 154	Disulfoxide 123 4[11] Mono-$HgCl_2$ add comp , 90 Di-$HgCl_2$ add comp , 119 5 HgI_2 add comp 110 $AgNO_3$ add comp , 122 $SnCl_4$ add comp , 102 $SnBr_4$ add comp 84, $PtCl_2$ add comp , 106 $PtBr_2$ add comp , 118 PtI_2 add comp 136, $PdCl_2$ add comp , 83 $PdBr_2$ add comp , 100
7	**Ethyl vinyl sulfide**	92		1 4756	0 8756				
8	**Isopropyl methyl sulfide**	93 5, 85	−101 48	1 4392	0 8291				
9	**Methyl *n*-propyl sulfide**	95 5	−112 98	1 4442	0 8438				
10	***tert*-Butyl methyl sulfide**	99		1 4402	0 8257				
11	**Chloromethyl methyl sulfide**	107 1		1 4967					
12	**Ethyl isopropyl sulfide**	107 3	−122 19	1 4407	0 8246				
13	**Isobutyl methyl sulfide**	112 5		1 4433	0 8335				
14	**Methyl 2-methylallyl sulfide**	113 0 2		1 4712					
15	**Allyl ethyl sulfide**	115 6			0 8676				
16	**Ethyl *n*-propyl sulfide**	118 5, 110 2	−117 04	1 4461	0 84448	25, b p 142[23]		173 7	
17	**Di-isopropyl sulfide** (Isopropyl sulfide)	120 7	−78 08	1 4381	0 8135	36	68 5	176	$PtCl_2$ add comp , 163 $PtBr_2$ add comp , 174, PtI_2 add comp , 176, PtI_4 add comp , 139
18	***n*-Butyl methyl sulfide**	122 5		1 4477	0 8427				$HgCl_2$ add comp , 116 5
19	**Chloromethyl ethyl sulfide**	128				33		b p 78 80[16]	
20	**Isopropyl propyl sulfide**	132		1 4440	0 8269				
21	***sec*-Butyl ethyl sulfide**	133 6		1 4477	0 8353				
22	**Ethyl isobutyl sulfide**	134 2		1 4452	0 8306				$HgCl_2$ add comp , 108
23	**Diallyl sulfide** (Allyl sulfide)	139[758], 35[5-7]	−83	1 4877[27]	0 88765[27]	b p 109[3]	b p 107-9[7 8]	b p 78 80[16]	
24	**Methyl 2-methylbutyl sulfide**	139-40			0 8410[19]				
25	**2-Chloroethyl methyl sulfide**	140, 44[20]		1 4908	1 1155				
26	**Di-*n*-propyl sulfide** (*n*-Propyl sulfide)	141 2	−101 9	1 4481	0 8358	30	14 5 5 0, b p 82[15]	194	Mono-$HgCl_2$ add comp , 88 9 Di-$HgCl_2$ add comp 122 127 5 Chloroamine-T → sulfilimide, 110 1 5
27	***n*-Butyl ethyl sulfide**	144 2	−95 13	1 4491	0 8376	50		193	
28	**Methyl pentyl sulfide** (Amyl methyl sulfide)	144 5-5 5		1 448	0 843				$HgCl_2$ add comp , 127
29	**Di-*tert*-butyl sulfide** (*tert*-Butyl sulfide)	150		1 4505				201, b p 88[21]	
30	**Diacetyl sulfide** (Thioacetic anhydride)	155 8d , 63[20]		1 4810[21]	1 124				Reduction → acetaldehyde, b p 20 2, 2,4-dinitrophenylhydrazone, 168
31	**Dichloromethyl sulfide** (Chloromethyl sulfide)	156 5	−54, −37	1 5313	1 4065	70 5-2 0			
32	**2-Chloroethyl ethyl sulfide**	157, 63-5[47]		1 06644	1 4878				

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)
a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Sulfone	Sulfoxide	Disulfide	Miscellaneous
33	**2-Aminoisopropyl methyl sulfide**	158				b p 140[4]			
34	**Ethyl 3-methylbutyl sulfide**	160		1 4495	0 8349	13 5			$HgCl_2$ add comp , 87
35	**4-Chlorophenyl methyl sulfide**	170		1 6023[25]	1 1224[25]	57 8			
36	**3-Aminopropyl methyl sulfide**	170				44, b p 165 8[6]	197		Hydrochloride, 136, Picrate, 127, Oxalate, 207d
37	**Di-isobutyl sulfide** (Isobutyl sulfide)	172 3		1 4463	0 8262	17, b p 265	68 5	215	Mono-$HgCl_2$ add comp , 116, Di-$HgCl_2$ add comp , 131, $PtCl_2$ add comp , (i) 83 (ii) 139, $PtBr_2$ add comp , 143 4 PtI_2 add comp , 187 $PtCl_4$ add comp , 162, $AuCl_3$ add comp , 87 $PdCl_2$ add comp , 95, $PdBr_2$ add comp , 140, PdI_2 add comp , 145
38	**Di-2-methylallyl sulfide** (2-Methylallyl sulfide)	173							
39	**Chloromethyl dichloromethyl sulfide**	177 2[753]		1 5395	1 5258				
40	**Dicrotyl sulfide** (Crotyl sulfide)	186 5, 88 9[20]		1 495[25]	0 9032[0]				
41	**Di-*n*-butyl sulfide** (*n*-Butyl sulfide)	188 0 182, 109 15[15]	−79 7	1 45405	0 8386	44, resolidifies at 32 5	33	231	Di-$HgCl_2$ add comp 113 110 5 $PtBr_2$ add comp 65 PtI_2 add comp 67 $PdCl_2$ add comp , 32 $Pd(NO_3)_2$ add comp , 166, $AgNO_3$ add comp 98
42	**4-Aminobutyl methyl sulfide**	188 90				42 b p 165[3]			Hydrochloride, 153 4, acet Picrate, 116 8
43	**Di-dichloromethyl sulfide** (Di-chloromethyl sulfide)	189 62 4[10]		1 5464	1 6273				
44	**Methyl phenyl sulfide**	194-6 78-9[13]		1 5870	1 0533[25]	88, w			
45	**2-Chloroethyl chloromethyl sulfide**	194 5 77[10]		1 5311	1 338				
46	**Benzyl methyl sulfide**	195 8		1 5550[25]		127, w			
47	**Ethyl phenyl sulfide**	205, 200-2		1 5701[15]	1 024[15]	42, b p 160[12]			$PdCl_2$ add comp , 140
48	**Isopropyl phenyl sulfide**	208		1 5468	0 9855				$PdCl_2$ add comp , 162
49	**Methyl 4-tolyl sulfide**	211 2, 104-5[20]		1 57537[16]	1 0302[16]	89, bz - pet eth	50-4		
50	**Di-(3-methylbutyl)sulfide** (Isoamyl sulfide)	215 3		1 4471	0 8285	31, b p 295		250	$PdCl_2$ add comp , 95 $PdBr_2$ add comp , 133 PdI_2 add comp , 143, $SnCl_4$ add comp , 64, $SnBr_4$ add comp , 45 6
51	**Allyl phenyl sulfide**	215-8, 104-6[25]		1 5760	1 0275				
52	**Di-2-chloroethyl sulfide** (2-Chloroethyl sulfide, Mustard gas, Yperite)	217	14 4	1 53125	1 2741	56, b p 183[20]	109-11		
53	**Phenyl propyl sulfide**	219-20		1 5571	0 9995	44			$PdCl_2$ add comp , 91
54	**Ethyl 4-tolyl sulfide**	220 1		1 5568	1 0016[17 5]	55 6			
55	**Benzyl ethyl sulfide**	222 3, 98-9[13]				84			Mono-$HgCl_2$ add comp , 84, Di-$HgCl_2$ add comp , 142
56	**3-Methylbutyl phenyl sulfide**	240-2		1 5380	0 9681	36			$PdCl_2$ add comp , 97
57	**2-Chloroethyl phenyl sulfide**	245, 121[15]		1 5838	1 1799	45			
58	**2-Chloroethyl 4-tolyl sulfide**	255-7, 150-2[20]				78			
59	**2-Hydroxyethyl 4-tolyl sulfide**	282-3, 119 20[1]				55			
60	**Di-(3-tolyl)sulfide** (*m*-Tolyl sulfide)	290, 174[12]				94	b p 215[15]	b p 150 d	

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)
a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Sulfone	Sulfoxide	Disulfide	Miscellaneous
61	**Diphenyl sulfide** (Phenyl sulfide)	296, 157–8[18.5]	−21 5	1 6312	1 1160	128–9, b p 379	70 5	61	Disulfone of the disulfide, 193–4
62	**Di-*n*-heptyl sulfide** (*n*-Heptyl sulfide)	298				80			
63	**4-Chlorophenyl phenyl sulfide**	305–15d , 167–8[10]				34, 90			
64	**Phenyl 3-tolyl sulfide**	309 5, 164 5[11]	−6 5		1 0937[16]				
65	**Phenyl 2-tolyl sulfide**	309 9 300 5, 160 5[11]			1 1012[15]	81, al			
66	**Phenyl 4-tolyl sulfide**	311 5, 167 5[11]	15 7		1 0900[15.7]	127–8 al			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)

a) Liquids 2) Cyclic (Listed in order of increasing b.p.)*

No	Name	Boiling point, °C	Melting point, °C	n_D^{20}	D_4^{20}	Sulfone	$HgCl_2$ addition compound	Miscellaneous
1	**Ethylene sulfide** (Thiirane Thiacyclopropane)	55–6		1 4914	1 0046			Polymerizes rapidly
2	**2-Methylethylene sulfide** (2-Methylthiirane)	76		$1\ 473^{19}$	$0\ 946^{18}$			
3	**Thiophene**	84 12	−38 30	1 5287	1 0644			2-HgCl deriv , 182–3; 2-HgBr deriv , 169–70, 2-HgI deriv , 116–7
4	**2,2-Dimethylethylene sulfide** (2,2-Dimethylthiirane)	87, 84 6		1 4641				
5	**Trimethylene sulfide** (Thietane Thiacyclobutane)	95	−73 25	$1\ 506^{23}$	1 0200	76, w	93 5 d	Methiodide, 98 5–9 0
6	**2-Ethylethylene sulfide** (2-Ethylthiirane)	104		$1\ 475^{19}$	$0\ 930^{18}$			
7	**2-Methyltrimethylene sulfide** (2-Methylthietane)	106		1 4831	0 9571	b p 251 5–3 5		
8	**2-Methylthiophene**	112 4		1 52042	1 02183			5-HgCl deriv , 204, 5-HgBr deriv , 179–80, 5-HgI deriv , 111–2
9	**2,4-Dimethyltrimethylene sulfide** (2,4-Dimethylthietane)	113 4		$1\ 4502^{18}$	$0\ 8710^{18}$	b p 255 0 5 5		
10	**3-Methylthiophene**	115 4		1 52042	1 02183			2-HgCl deriv , 128–9, 2,5-Di-HgOOCCH$_3$ deriv , >240d
11	**2,2-Dimethyltrimethylenesulfide** (2,2-Dimethylthietane)	120		$1\ 4739^{18}$		55	118	
12	**Tetramethylene sulfide** (Thiolane Thiophane Thiacyclopentane)	121 2, 120 2 5	−96 17	1 5047	0 99869	28 36	128	Sulfoxide, 105–7[12]
13	**2-Methyltetramethylene sulfide** (2-Methylthiolane)	$132\ 5^{750}$	−100 71	1 4922	0 9555	b p 279–80^{758}	*di* 162	
14	**2-Ethylthiophene**	132 5–4 0		1 5127	$0\ 990^{24}$			5-HgCl deriv , 147–8, 5-HgI deriv , 96-7
15	**3-Ethylthiophene**	135 6		1 5146	0 9980			2-HgCl deriv , 67–8, 2,5-Di-HgCl deriv , 295–7d
16	**2,5-Dimethylthiophene**	135 5 6 0	−62 57	1 5126	0 98587			3-HgCl deriv , 156–7, 3-HgI deriv , 175
17	**2,4-Dimethylthiophene**	137 8, 140		1 5130	0 9956			5-HgCl deriv , 138–9, 5-HgI deriv , 137–9
18	**3-Methyltetramethylene sulfide** (3-Methylthiolane)	138 2	−81 10	1 4924	0 9634	1, 0 5	83	
19	**2,3-Dimethylthiophene**	140 2–1 2	−49 1 to −48 9	1 5188	1 0021			5-HgCl deriv , 218 5–9 5, 5-HgI deriv , 184 0–4 5, 4,5-Di-HgOOCCH$_3$, 237–40
20	***trans*-2,5-Dimethyltetramethylene sulfide** (*trans*-2,5-Dimethylthiolane)	142	−76 35	1 4766	0 9188	3, b p 278	111	
21	***cis*-2,5-Dimethyltetramethylene sulfide** (*cis*-2,5-Dimethylthiolane)	142 3		1 4799	0 9222	4, b p 278	*di* 180	
22	**3,4-Dimethylthiophene**	144 6		1 5212	$1\ 008_{21}^{23}$			2-HgCl deriv , 139–40 5, 2-HgBr deriv , 152, 2-HgI deriv , 142
23	**1,4-Thioxane**	148 9	−17	1 5070	1 1177	130, 105 5	171	Sulfoxide, 25, 45
24	**2-Methylpentamethylene sulfide** (2-Methylthiane)	151	−58 14	1 4905	0 9428	68 5	102	
25	**2-Isopropylthiophene**	152		1 5037	0 9673			
26	**3-Isopropylthiophene**	155 7, 157		1 5052	0 9733			5-HgCl deriv , 137
27	**3-Methylpentamethylene sulfide** (3-Methylthiane)	157–8	−60 17	1 4922	0 9473	83	136	
28	**2-Ethyltetramethylene sulfide** (2-Ethylthiolane)	157 8		1 4896	0 9451		*mono* 100, *di* 146–8	
29	**2-Propylthiophene**	157 5 9 5		1 5048	0 9683			5-HgCl deriv , 155, 5-HgSCN deriv , 169 0–9 5
30	**4-Methylpentamethylene sulfide** (4-Methylthiane)	158 6	−28 11	1 5049	0 9687	121 5	136	
31	**2-Ethyl-5-methylthiophene**	159 8 60 4	−68 6	1 5073	0 9663			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)
a) Liquids 2) Cyclic (Listed in order of increasing b.p.)* (Continued)

No	Name	Boiling point °C	Melting point °C	n_D^{20}	D_4^{20}	Sulfone	$HgCl_2$ addition compound	Miscellaneous
32	**2-Ethyl-3-methylthiophene**	160 0 1 5		1 5092[22 5]	0 9792[22 5]			5 HgCl deriv , 172-3, 5-HgI deriv , 156-7
33	**2,6-Dimethyl-1,4-thioxane**	160 1		1 4733		105 5		
34	**3-Propylthiophene**	160 2		1 5057	0 9716			
35	**2-Allylthiophene**	161, 158 5 9 0		1 5281[20 5]	1 0175[20 5]			
36	**3,5-Dimethyl-1,4-thioxane**	162				102		
37	**3-Ethyl-5-methylthiophene**	162 4	−60 to −59	1 5098	0 9742			
38	**2,3,5-Trimethylthiophene**	163 5, 164 5[46]		1 5131	0 9753			x-HgCl deriv , 160-1
39	**2-*tert*-Butylthiophene**	163 9	−59 2	1 49788	0 9514			
40	**3-*tert*-Butylthiophene**	168 9	−54 8	1 50149	0 9574			
41	**Hexamethylene sulfide** (Thiepane Thiacyclo heptane)	170 173 4		1 5125	0 9883	71	149	Methiodide, 141 5-2 0
42	**2,3,4-Trimethylthiophene**	172 7 160 3		1 5208	0 995			
43	**1,3-Dithiolane**(1,3-Dithiacyclopentane)	175		1 5975[15]	1 259[1]	*d*[1] 205	117, 126	Methiodide, 96, Disulfoxide, 134
44	**2-Methyl-5-propylthiophene**	179 5 80 5		1 5026				
45	**Cyclohexene sulfide** (7-Thiabicycloheptane)	180 71 5-3 5[21]		1 5309	0 9274			
46	**2-*n*-Butylthiophene**	181-2[740]		1 50896	0 9537			
47	**2,5-Diethylthiophene**	181-2, 63-6[14]		1 5036	0 962[14]			
48	**3-*n*-Butylthiophene**	181 3		1 51005	0 9570			
49	**2,3,4,5-Tetramethylthiophene**	182 4 187 9		1 5196	$0\ 9442^{21}_{21}$			
50	**3,4-Diethylthiophene**	185-7		1 5157[17]				2-HgCl deriv , 118
51	**2-Ethyl-1,3-dithiolane**	191 2				124		
52	**2,4-Dimethyltetramethylene sulfide** (2,4-Dimethylthiolane)	197 8[742]		1 4818	0 9265	b p 123 3[5]	89	
53	**3-Ethyl-2,4,5-trimethylthiophene**	204 6[748]		1 5132	0 9609			
54	**2-*n*-Octylthiophene**	257 9, 106 8[1]		1 4824	0 920			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)
b) Solids (Listed in order of increasing m.p.)*

No	Name	Melting point °C	Boiling point °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	**Ethyl 2-naphthyl sulfide**	16	170 5[15]	43 5			
2	**Ethyl hexadecyl sulfide**	19		88			
3	**Thiane** (Pentamethylene sulfide Thiacyclohexane)	19 07, 13	142	98 5 9 0			D_4^{20} 0 9849, n_D^{20} 1 5067, $HgCl_2$ add comp , 137 5, al , Methiodide, 192 subl
4	**2-Methyl-1,4-dithiane**	20		*di* 304			
5	**Didecyl sulfide** (Decyl sulfide)	27	217 8*	206 7			
6	**3-Tolyl 4-tolyl sulfide**	27 8 al	179[11]	116 ac a	72		
7	**Diundecyl sulfide** (Undecyl sulfide *n*-Hendecyl sulfide)	34 8					
8	**Di-(2-bromoethyl)sulfide** (Bromoethyl sulfide)	35		111 2			
9	**4-Iodophenyl phenyl sulfide** (4 Iododiphenyl sulfide)	35		141			
10	**2-Aminophenyl phenyl sulfide** (2-Aminodiphenyl sulfide)	35 6, al	212[25]	122, dil al			N-Benzenesulfonyl, 225 6
11	**4-Bromophenyl methyl sulfide**	37 5		56 7			
12	**Didodecyl sulfide** (*n*-Dodecyl sulfide)	40 5				34 5	
13	**Benzyl phenyl sulfide**	41 44 5, al	197[2]	146 6 5 148, al	123		
14	**Di-(4-chlorobenzyl)sulfide** (4-Chlorobenzyl sulfide)	41				59	
15	**1-Naphthyl phenyl sulfide**	41 8, aq al	220 5[11]	99 5 100 5 al			
16	**3-Nitrophenyl phenyl sulfide** (3-Nitrodiphenyl sulfide)	42 5		80 5 81			
17	**Ethyl 4-nitrophenyl sulfide**	44		138 5			
18	**Isopropyl 4-nitrophenyl sulfide**	44 5		115 3			
19	**Di-(4-methoxyphenyl)sulfide** (4-Methoxyphenyl sulfide)	46		130	96	45	Disulfone, 221, r h 210 2, s h
20	**Dibenzoyl sulfide** (Thiobenzoic anhydride, Benzoyl sulfide)	48, al				133, 128	
21	**Dibenzyl sulfide** (Benzyl sulfide)	50, chl		151 7, al bz	134 8	73	D_{50}^{20} 1 0712 $HgCl_2$ add comp , 131, HgI_2 add comp , 37 8, $FeCl_3$ add comp , 94 $PtCl_2$ add comp 159 $PtCl_4$ add comp 172d , $PtBr_2$ add comp 139 PtI_2 add comp 129
22	**2,5-Dichlorophenyl methyl sulfide**	51		88			
23	**Methyl 2-naphthyl sulfide**	51 8 64	226[11]	115 6, al	67 5		Disulfone, 166
24	**Bis(phenylthio)methane**	52		*di* 120-1			
25	**Ditetradecyl sulfide** (*n*-Tetradecyl sulfide)	53 8				46	
26	**Di-(2-diphenoxyethyl)sulfide**	54 al		108, pink, al		97	
27	**1,3-Dithiane**	54		*di* 330 308			
28	**Bis(benzylthio)methane**	55		*di* 216			
29	**4-Nitrophenyl phenyl sulfide** (4-Nitrodiphenyl sulfide)	55, yel lgr	240[25]	142, aq al			
30	**Di-*n*-octyl sulfide** (*n*-Octyl sulfide)	57		76		b p 178-83[5]	
31	**Di-(4-tolyl)sulfide** (4-Tolyl sulfide)	57 3	179[11]	158, bz	95, pet eth	48, al	
32	**2-Aminophenyl 4-aminophenyl sulfide** (2,4'-Diaminodiphenyl sulfide)	61, 62 5, aq al		124-6			Diacetyl, 208
33	**Dihexadecyl sulfide** (*n*-Hexadecyl sulfide)	61 3		103 4	99 8		
34	**2-Chloroethyl 4-nitrophenyl sulfide**	62		128			
35	**Di-(2-tolyl)sulfide** (2-Tolyl sulfide)	64, al	285, 174[15]	134 5, al	121, pet eth	38-9, al	
36	**Methyl 2-nitrophenyl sulfide**	64 5, yel , al		106			$D_4^{78.2}$ 1 2626, $n_D^{78.2}$ 1 62458, $AgNO_3$ add comp , 122, yel , al
37	**Benzyl 4-bromophenyl sulfide**	65		159			

*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
38	**1,2-Bis(phenylthio)ethane**	69 70		*dl* 180			
39	**Dioctadecyl sulfide** (Octadecyl sulfide)	71, 64 5				62 5	
40	**2-Phenyl-1,3-dithiane**	71-2		*dl* 265			
41	**Methyl 4-nitrophenyl sulfide**	72		141			$D_4^{80.1}$ 1 2391, $n_D^{80.1}$ 1 64008
42	**Di-(3-phenylpropyl)sulfide** (3-Phenylpropyl sulfide)	73		117		b p 165-$6^{0.03}$	
43	**Di-(2-methoxyphenyl)sulfide** (2-Anisyl sulfide)	73, al	252-3^{10}	157-8, bz		120	
44	**Di-(4-methylbenzyl)sulfide** (4-Methylbenzyl sulfide)	76		197			
45	**Cinnamyl phenyl sulfide**	78		111 2	90 1		
46	**4-(Methylthio)benzaldehyde**	78, yel , lgr	273, 153^{17}				Phenylhydrazone, 138, Thiosemicarbazone, 177-9, yel
47	**4-Nitrobenzyl phenyl sulfide**	79		209 5			
48	**1,2-Bis(tolylthio)ethane**	80 1		*dl* 200 1			
49	**2-Nitrophenyl phenyl sulfide** (2-Nitrodiphenyl sulfide)	80 2, 77, yel	210^{15}	147 5, al			
50	**Di-(2-aminobenzyl) sulfide**	81				90 1 lgr et ac	N,N'-Diformyl, 163 N,N'-Diacetyl, 209 Picrate, 203 4d
51	**4-Nitrophenyl 4-tolyl sulfide**	81 5, yel		170 1, yel			
52	**Di-(2-aminophenyl) sulfide**	87		146 7		93, al	N,N'-Diacetyl, 164 5 N,N'-Dibenzoyl, 162 3
53	**Di-(2-phenylethyl) sulfide** (2-Phenylethyl sulfide)	92 5 90		100 6	69	b p 172 $5^{0.8}$	
54	**4-Aminophenyl phenyl sulfide** (4 Aminodiphenyl sulfide)	96, lgr	243^{29}	176, al	152, w		Hydrochloride, 197 8d *N*-4-Toluenesulfonyl, 73
55	**Di-(4-amino-3-methylphenyl) sulfide**	96 25°, al					Dihydrochloride, 248-9 dil HCl N,N'-Diacetyl, 22, al , N,N'-Dibenzoyl, 233, me al , Dipicrate, 186, w
56	**Di-(4-chlorophenyl)sulfide** (4-Chlorophenyl sulfide)	98 88 90	212^{18}	148 9, subl	143	73	
57	**3-Aminophenyl 4-nitrophenyl sulfide** (3-Amino-4'-nitrodiphenyl sulfide)	99 100					*N*-Acetyl, 115-6, *N N*-Dimethyl, 83 4
58	**Di-(2-amino-5-methylphenyl) sulfide**	103 4, al				98	Dihydrochloride, 100d , al , N,N' Diacetyl, 165, al N,N'-Dibenzoyl, 185 6, al , Diurethane, 113, bz -pet eth Dipicrate, 179, bz
59	**Di-(4-aminobenzyl)sulfide**	104 5				96 8, al	N,N'-Diacetyl, 188, N,N'-Dibenzoyl, 224
60	**Di-(4-aminophenyl)sulfide**	108 9, w		178, me al	175d , al	85 106, al	N,N'-Diacetyl, 220 1 N,N' Dibenzoyl, 234
61	**Di-(1-naphthyl)sulfide**	110, al	290^{15}	187, al	166, al	91	
62	**1,4-Dithiane**	111 2	199-200	*mono* 200, *dl* >330			Methiodide, 73 4, Sulfoxide-sulfone, 279
63	**Di-(4-bromophenyl)sulfide** (4-Bromophenyl sulfide)	112, al	243^{20}	172	153, al	94 5	
64	**2,4-Dinitrophenyl phenyl sulfide** (2,4-Dinitrodiphenyl sulfide)	121, 117, bz		161			
65	**Di-(2-nitrophenyl)sulfide** (2-Nitrophenyl sulfide)	122 3, yel , al -ac a		164		198-9, ac a or bz	
66	**Benzyl 4-nitrophenyl sulfide**	123		172			
67	**Di-(3-hydroxyphenyl)sulfide** (3-Hydroxyphenyl sulfide)	130		190 1, 186-7	94 5, pet eth	95	Acetyl, 87
68	**1,3-Bis(2-nitrophenylthio)propane**	140		*dl* 156-7			
69	**Di-(2-hydroxyphenyl)sulfide** (2-Hydroxyphenyl sulfide)	142, bz		179, 164-5, bz		b p >200d	Diacetyl, 95-6, al Di-Me eth , 73
70	**1-Naphthyl 2-naphthyl sulfide** (1,2'-Dinaphthyl sulfide)	151	291 2^{15}	123			
71	**Di-(2-naphthyl)sulfide** (2-Naphthyl sulfide)	151	296^{15}	177, al	137 5 8 5	139	

*Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)
b) Solids (Listed in order of increasing m.p.)* (Continued)

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
72	**Di-(4-hydroxyphenyl)sulfide** (4-Hydroxyphenyl sulfide)	151, al		240 1, w	195, acet	150 1	Diacetyl, 94 55, Di-Me eth , 46, Di-Et eth 55
73	**Di-(4-nitrobenzyl)sulfide** (4-Nitrobenzyl sulfide)	158-9		260 5	212	126 5	
74	**Di-(4-nitrophenyl)sulfide** (4-Nitrophenyl sulfide)	174-5, 156 7, or , or pa yel		282, 245 225		182, ac a	
75	**Di-(3-nitrophenyl)sulfide** (3-Nitrophenyl sulfide)	193		201		84, al	
76	**Di-(2,4-dinitrophenyl)sulfide** (2,4-Dinitro phenyl sulfide)	193 7 193 4, yel , ac a		240 1		280	
77	**Di-(2,4,6-trinitrophenyl)sulfide** (Dipicryl sulfide)	230 1 226, yel		307			

* Derivative data given in order m p , crystal color, solvent from which crystallized

EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation

$$HA_{aq}^{\pm n} + H_2O \rightleftharpoons A_{aq}^{\pm n-1} + H_3O_{aq}^{+}$$

and the corresponding equilibrium constant K_e is given by

$$K_e = \frac{(a_{A\ aq}^{\pm n-1})(a_{H_3O^+})}{(a_{HA_{aq}^{\pm n}})(a_{H_2O})}$$

where the a's are the activities of the species At low electrolyte concentrations a_{H_2O} is virtually constant, and a second constant, K_a, the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{H_2O}) = \frac{(a_{A_{aq}^{\pm n-1}})(a_{H_3O^+})}{(a_{HA_{aq}^{\pm n}})} = \frac{(c_{A_{aq}^{\pm n-1}})(c_{H_3O^+})}{(c_{HA_{aq}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{HA_{aq}^{\pm n}}}$$

where the c's are the concentrations and the f's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient pK_a notation, where

$$pKa = -\log K_a$$

For Table XXVII, $HA^{\pm n}$ = RCOOH, and $A^{\pm n-1}$ = $RCOO^-$

For Table XXVIII, $HA^{\pm n}$ = ArOH, and $A^{\pm n-1}$ = ArO^-

For Table XXIX, $HA^{\pm n}$ = $RR'R''NH^+$ and $A^{\pm n-1}$ = RR'R''N(R, R' and R'' may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids $pK_a = pK_1$

For dicarboxylic acids both pK_1 and pK_2 are given, pK_1 is defined above, and pK_2 is the analogous dissociation constant of the monoanion, $A^{\pm n-1}$, obtained on the first dissociation For other dibasic acids such as the conjugate acids of amino acids, or diamines, pK_1 is as defined above, and pK_2 is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for pK determinations, *see* G Kortum, W Vogel and K Andrussow, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190–536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution *see* D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of pK, and data for both acids and bases *see* J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bently) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318–401, H C Brown, D H McDaniel and O Hafliger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION

(Listed in order of increasing pKa)

No	Name	T,°C	pK_1	pK_2	No	Name	T °C	pK_1	pK_2
1	**Heptafluoro-*n*-butyric acid**	25	0 17		51	**1,3,5-Benzenetricarboxylic acid**	25	2 12	3 89
2	**Trifluoroacetic acid**	25	0 23						pK_3 = 4 70
3	**Trichloroacetic acid**	25	0 63		52	**D,L-3,5-Di-iodotyrosine**	25	2 12	6 48
4	**2,4,6-Trinitrobenzoic acid**	25	0 65		53	**3-(2-Fluorophenyl)alanine**	24	2 12	9 01
5	**Tribromoacetic acid**	25	0 66		54	**3-(4-Fluorophenyl)alanine**	24	2 13	9 05
6	**3-Chlorophenylglycine**	25	1 05	3 93	55	**D,L-β-Phenylalanine**	25	2 16	9 15
7	**2,6-Dinitrobenzoic acid**	25	1 14		56	***l*-Lysine**	25	2 16	9 18
8	**Trichloroacrylic acid**	25	1 15						pK_3 = 10 79
9	**Difluoroacetic acid**	25	1 24		57	***d*-Lysine**	25	2 16	9 16
10	**Oxalic acid**	25	1 27	4 28					pK_3 = 10 81
11	**Dichloroacetic acid**	25	1 29		58	**Glutamic acid**	20	2 16	4 324
12	**2-Chloro-6-nitrobenzoic acid**	25	1 34						pK_3 = 9 96
13	**2-Bromo-6-nitrobenzoic acid**	25	1 37		59	**6,6,6-Trifluoronorleucine**	25	2 164	9 463
14	**Benzenehexacarboxylic acid**	25	1 40	2 19	60	**3-(3-Chlorophenyl)alanine**	25	2 17	8 91
				pK_3 = 3 31	61	**2-Chloro-5-nitrobenzoic acid**	25	2 17	
				pK_4 = 4 78	62	**D,L-Serine**	25	2 21	4 15
				pK_5 = 5 89	63	**Diethylmalonic acid**	25	2 21	7 29
				pK_6 = 6 96	64	**N-Propylalanine**	25	2 21	10 19
15	***d,l*-2,3-Dibromosuccinic acid**	20	1 42	3 24	65	**N-Ethylalanine**	25	2 22	10 22
16	**2,4-Dinitrobenzoic acid**	25	1 42		66	**D,L-N-Methylalanine**	25	2 22	10 19
17	***erythro*-2-Bromo-3-chlorosuccinic acid**	19	1 43	2 60	67	**2-Nitrobenzoic acid**	25	2 22	
18	***d,l*-2,3-Dichlorosuccinic acid**	20	1 46	2 86	68	**3-(2-Chlorophenyl)alanine**	25	2 23	8 94
19	***threo*-2-Bromo-3-chlorosuccinic acid**	20	1 46	2 77	69	**6-Bromo-2-methylolbenzoic acid**	20	2 25	
20	***meso*-2,3-Dibromosuccinic acid**	20	1 51	2 71	70	**6-Chloro-2-methylolbenzoic acid**	20	2 26	
21	***meso*-2,3-Dichlorosuccinic acid**	20	1 52	2 94	71	***d,l*-Valine**	25	2 286	9 744
22	**4,4,4-Trifluorovaline**	25	1 537	8 098	72	***d,l*-2-Aminobutyric acid**	25	2 29	9 83
23	**4,4,4-Trifluorothreonine**	25	1 554	7 822	73	**2-Benzyl-2-cyanopropionic acid**	25	2 29	
24	**2-Amino-4,4,4-trifluoro-*n*-butyric acid**	25	1 600	8 169	74	**2-Amino-*n*-pentanoic acid**	25	2 318	9 808
25	**2,5-Dinitrobenzoic acid**	25	1 62		75	**(3,4-Dihydroxyphenyl)alanine**	25	2 32	8 68
26	**Nitroacetic acid**	25	1 68						pK_3 = 9 88
27	**Trifluoroacrylic acid**	25	1 79		76	**2-Chloro-3-hydroxysuccinic acid**	25	2 32	
28	**Benzenepentacarboxylic acid**	25	1 80	2 73	77	**3-Hydroxyglutaric acid**	25	2 32	4 24
				pK_3 = 3 97					pK_3 = 9 56
				pK_4 = 5 25	78	***d,l*-Leucine**	25	2 32	9 74
				pK_5 = 6 46	79	***d,l*-Norleucine**	25	2 335	9 83
29	**Cyclopropane-1,1-dicarboxylic acid**	25	1 82	5 43	80	***d,l*-Alanine**	25	2 34	9 87
30	**Hydroxyproline**	25	1 82	9 66	81	***cis*-Caronic acid** (*cis*-1,1-Dimethyl-2,3-cyclopropanedicarboxylic acid)	25	2 34	8 31
31	**DL-Histidine**	25	1 82	6 04					
				pK_3 = 9 12	82	**N-Ethylglycine**	25	2 34	10 23
32	**2,3-Dinitrobenzoic acid**	25	1 85		83	**Glycine**	25	2 35	9 78
33	**2-Methyl-4-nitrobenzoic acid**	25	1 86		84	**N-Methylglycine**	25	2 35	10 18
34	**1,2,4,5-Benzenetetracarboxylic acid**	25	1 92	2 87	85	**N-Propylglycine**	25	2 35	10 19
				pK_3 = 4 49	86	**N-*n*-Butylglycine**	25	2 35	10 25
				pK_4 = 5 63	87	**N-Isobutylglycine**	25	2 35	10 12
35	***trans*-Ethylene oxide-1,2-dicarboxylic acid**	19	1 93	3 25	88	**2-Aminoisobutyric acid**	25	2 36	10 25
36	***cis*-Ethylene oxide-1,2-dicarboxylic acid**	18	1 94	3 92	89	**(Methylsulfonyl)acetic acid**	25	2 36	
37	**Maleic acid**	25	1 94	6 23	90	**2-Cyano-2-cyclohexylacetic acid**	25	2 37	
38	**Ornithine**	25	1 94	8 65	91	**2-Cyanopropionic acid**	25	2 37	
39	**2-Chloro-4-nitrobenzoic acid**	25	1 96		92	**D,L-Tryptophane**	25	2 38	9 39
40	**4-Aminosalicylic acid** (4-Amino-2-hydroxybenzoic acid)	25	1 99	3 92	93	**1,2,3,5-Benzenetetracarboxylic acid**	25	2 38	3 51
									pK_2 = 4 44
41	**2-Chloro-3-nitrobenzoic acid**	25	2 02						pK_3 = 5 81
42	**Asparagine**	25	2 05	3 87	94	**4-Aminobenzoic acid**	25	2 38	
43	**Anthranilic acid**	25	2 05	4 95	95	**2-Cyanoisobutyric acid**	25	2 42	
44	**5,5,5-Trifluoroleucine**	25	2 05	8 92	96	**Cyanoacetic acid**	25	2 46	
45	**S-Ethylcysteine**	25	2 05	8 60	97	**Pyruvic acid**	25	2'49	
46	**1,2,3,4-Benzenetetracarboxylic acid**	25	2 06	3 25	98	**O-Acetylcitric acid**	25	2 49	.
				pK_3 = 4 73	99	**3-Pentenoic acid**	25	2 51	
				pK_4 = 6 21	100	**1,2,4-Benzenetricarboxylic acid**	25	2 52	3 84
47	**Di-*n*-propylmalonic acid**	25	2 07	7 51					pK_3 = 5 20
48	**3-(4-Chlorophenyl)alanine**	25	2 08	8 96	101	**(2-Chlorovinyl)acetic acid**	25	2 54	
49	**3-(3-Fluorophenyl)alanine**	24	2 10	8 98	102	**Oxaloacetic acid**	25	2 55	4 37
50	**Arginine**	25	2 10	9 07	103	**Fluoroacetic acid**	25	2 58	

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION

(Listed in order of increasing pKa) (Continued)

No	Name	T,°C	pK_1	pK_2	No	Name	T,°C	pK_1	pK_2
104	**Phenylmalonic acid**	25	2 58	5 03	162	**(2,4-Dichloro-6-methylphenoxy)acetic acid**	20	3 13	
105	**2-Chloro-3-hydroxybutyric acid**	25	2 58		163	**2-Cyanobenzoic acid**	25	3 14	
106	**2-Fluoroacrylic acid**	25	2 58		164	**(3-Methoxyphenoxy)acetic acid**	25	3 14	
107	**2,4-Dioxo-*n*-pentanoic acid**	25	2 58		165	**Ethyl-*n*-propylmalonic acid**	25	3 15	7 43
108	**2-Chloro-3-hydroxy-3-phenyl propionic acid**	25	2 61		166	**4,4,4-Trifluorocrotonic acid**	25	3 15	
109	**2-Chloro-6-hydroxybenzoic acid**	25	2 63		167	**(4-Iodophenoxy)acetic acid**	25	3 16	
110	**2-Butynoic acid** (Tetrolic acid)	25	2 65		168	**(2-Iodophenoxy)acetic acid**	25	3 17	
111	**1-Aminocyclohexanecarboxylic acid**	25	2 66		169	**3,3-Difluoroacrylic acid**	25	3 17	
112	**Bromosuccinic acid**	50	2 69	4 69	170	**Dimethylmalonic acid**	25	3 17	6 06
113	**3-Hydroxy-2-naphthoic acid**	25	2 71		171	**Phenoxyacetic acid**	25	3 17	
114	**5-Aminosalicylic acid** (5-Amino-2-hydroxybenzoic acid	25	2 74	5 84	172	**Iodoacetic acid**	25	3 18	
					173	**3-Iodo-2-methylolbenzoic acid**	20	3 18	
115	**Triethylsuccinic acid**	25	2 74		174	**2-Hydroxy-3-chloroisobutyric acid**	25	3 20	
116	**Salicylic acid** (2-Hydroxybenzoic acid)	30	2 75, (3 00)	12 38	175	**(4-Methoxyphenoxy)acetic acid**	25	3 21	
					176	**(4-Methylphenoxy)acetic acid**	25	3 22	
117	**2,4-Dichlorobenzoic acid**	25	2 76		177	***meso*-Tartaric acid**	25	3 22	4 82
118	**1,2,3-Benzenetricarboxylic acid**	25	2 80	4 20	178	**2-Chlorocrotonic acid**	25	3 22	
				pK_3 = 5 87	179	**2,4-Dihydroxybenzoic acid**	30	3 22	
119	**3,4-Dinitrobenzoic acid**	25	2 82		180	**(2-Methoxyphenoxy)acetic acid**	25	3 23	
120	**3,5-Dinitrobenzoic acid**	25	2 82		181	**(2-Methylphenoxy)acetic acid**	25	3 23	
121	**Guanidinoacetic acid**	25	2 82		182	**Cyclopentane-1,1-dicarboxylic acid**	25	3 23	4 08
122	**2-Bromobenzoic acid**	25	2 85		183	**3-Bromomandelic acid**	25	3 23	
123	**Malonic acid**	25	2 86	5 65	184	**3-Chloromandelic acid**	25	3 24	
124	**Chloroacetic acid**	25	2 86		185	**2,6-Dimethylbenzoic acid**	25	3 25	
125	**Ethylmethylmalonic acid**	25	2 86	6 43	186	**3-Iodomandelic acid**	25	3 26	
126	**2-Iodobenzoic acid**	25	2 86		187	**2-Fluorobenzoic acid**	25	3 27	
127	**2-Chloropropionic acid**	18	2 88		188	**3-Chloro-2-methylbenzoic acid**	25	3 27	
128	**(4-Nitrophenoxy)acetic acid**	25	2 89		189	**(4-Chloro-2-methylphenoxy)acetic acid**	25	3 28	
129	**Bromoacetic acid**	25	2 90		190	**3-Bromo-2-methylbenzoic acid**	20	3 28	
130	**2-Chlorobenzoic acid**	25	2 92		191	***cis*-3-Chloroacrylic acid**	18	3 32	
131	**(4-Cyanophenoxy)acetic acid**	25	2 93		192	***cis*-Cyclopropane-1,2-dicarboxylic acid**	24	3 33	6 47
132	**Isopropylmalonic acid**	25	2 94	5 38	193	**(2,6-Dimethylphenoxy)acetic acid**	25	3 36	
133	**(3-Nitrophenoxy)acetic acid**	25	2 95		194	**Anthraquinone-1-carboxylic acid**	20	3 37	
134	**Phthalic acid**	25	2 95	5 41	195	**3-Hydroxy-3-phenylpropionic acid**	18	3 40	
135	**2-Chloroisobutyric acid**	18	2 97		196	***d,l*-Mandelic acid**	25	3 41	
136	**3,5-Dinitro-4-methylbenzoic acid**	25	2 97		197	**Anthraquinone-2-carboxylic acid**	20	3 42	
137	**(2-Cyanophenoxy)acetic acid**	25	2 97		198	**N-Formylglycine**	19	3 43	
138	**2-Bromopropionic acid**	18	2 97		199	**2,4,6-Trimethylbenzoic acid**	25	3 44	
139	**Ethylmalonic acid**	25	2 99	5 83	200	**3-Nitrobenzoic acid**	25	3 44	
140	***n*-Propylmalonic acid**	25	2 996	5 84	201	**Cyclohexane-1,1-diacetic acid**	25	3 45	7 08
141	***d*-Tartaric acid**	25	3 00	4 34	202	**2-Phenylbenzoic acid** (Biphenyl-2-carboxylic acid)	25	3 46	
142	**Fumaric acid**	25	3 02	4 38					
143	**(3-Cyanophenoxy)acetic acid**	25	3 03		203	***meso*-2,3-Diphenylsuccinic acid**	25	3 48	
144	**Benzilic acid**	18	3 05		204	**(2,4-Dinitrophenyl)acetic acid**	25	3 50	
					205	**Tetramethylsuccinic acid**	25	3 50	7 28
146	**Methylmalonic acid**	25	3 05	5 76	206	***d,l*-2,3-Diethylsuccinic acid**	25	3 51	6 60
147	**(2-Chlorophenoxy)acetic acid**	25	3 05		207	**2-Phenoxybenzoic acid**	20	3 53	
148	**3,3,3-Trifluoropropionic acid**	25	3 06		208	**2-Hydroxy-2-phenylpropionic acid**	18	3 53	
149	**3-Aminobenzoic acid**	25	3 07	4 73					
150	**(3-Chlorophenoxy)acetic acid**	25	3 07		210	**Terephthalic acid**	25	3 54	4 46
151	**2-Hydroxy-3-chlorobutyric acid**	25	3 08		211	**2-*tert*-Butylbenzoic acid**	25	3 54	
152	**(3-Fluorophenoxy)acetic acid**	25	3 09		212	**3-Aminopropionic acid**	25	3 55	
153	**(2-Fluorophenoxy)acetic acid**	25	3 09		213	**4-Cyanobenzoic acid**	25	3 55	
154	**(4-Chlorophenoxy)acetic acid**	25	3 10		214	**3-(Methylamino)benzoic acid**	25	3 55	
155	**(3-Bromophenoxy)acetic acid**	25	3 10		215	**3-Methoxy-2-methylolbenzoic acid**	20	3 58	
156	**α-Iodopropionic acid**	18	3 11		216	***d,l*-2,3-Diphenylsuccinic acid**	25	3 58	
157	**(2-Bromophenoxy)acetic acid**	25	3 12		217	**2-Aminocyclohexanecarboxylic acid**	25	3 59	10 21
158	**3-Chlorolactic acid**	25	3 12		218	**3-Cyanobenzoic acid**	25	3 60	
159	**(4-Bromophenoxy)acetic acid**	25	3 13		219	**3-Ethoxy-2-methylolbenzoic acid**	20	3 62	
160	**(3-Iodophenoxy)acetic acid**	25	3 13		220	**Isophthalic acid**	25	3 62	4 60
161	**(4-Fluorophenoxy)acetic acid**	25	3 13		221	**3-Ethyl-3-methylglutaric acid**	25	3 62	6 70

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION
(Listed in order of increasing pKa) (Continued)

No	Name	T °C	pK_1	pK_2
222	**3,3-Diethylglutaric acid**	25	3 62	7 12
223	***meso*-2,3-Diethylsuccinic acid**	25	3 63	6 46
224	**(2,4-Dichlorophenoxy)acetic acid**	20	3 64	
225	**Malonamic acid** (Malonic acid mono-amide)	25	3 64	
226	**2-Isopropylbenzoic acid**	25	3 64	
227	**Decahydronaphthyloxyacetic acid**	25	3 64	
228	**2-Cyclohexyloxypropionic acid**	25	3 64	
229	***trans*-3-Chloroacrylic acid**	18	3 65	
230	**9-Anthracenecarboxylic acid**	20	3 65	
231	**Ethoxyacetic acid**	18	3 65	
232	***trans*-Cyclopropane-1,2-dicarboxylic acid**	24	3 65	5 13
233	**N-Acetylglycine**	25	3 67	
234	**1-Anthracenecarboxylic acid**	20	3 68	
235	**2-Benzyl-2-phenylsuccinic acid**	20	3 69	6 49
236	**3,3-Di-*n*-propylglutaric acid**	25	3 69	7 31
237	**Cyclopentyloxyacetic acid**	25	3 70	
238	**3,3-Dimethylglutaric acid**	25	3 70	6 29
239	***cis*-3-Aminocyclohexanecarboxylic acid**	15	3 70	
240	***d,l*-N-Acetylalanine**	25	3 72	
241	**N-Propionylglycine**	25	3 72	
242	**2,3-Dimethylbenzoic acid**	25	3 74	
243	**Formic acid**	25	3 74	
244	**Phthalamic acid** (Phthalic acid mono-amide)	25	3 75	
245	**Glutaconic acid**	25	3 77	5 08
246	***meso*-2,3-Dimethylsuccinic acid**	25	3 77	5 94
247	**2-Ethylbenzoic acid**	25	3 79	
248	**3-Methylcyclopentyl-1,1-diacetic acid**	25	3 79	6 74
249	***trans*-Cyclobutane-1,2-dicarboxylic acid**	20	3 79	5 61
250	**Cyclohexyloxyacetic acid**	25	3 80	
251	**2-Hydroxybutyric acid**	18	3 80	
252	**Cyclopentyl-1,1-diacetic acid**	25	3 80	6 77
253	**3-Bromobenzoic acid**	25	3 81	
254	**3-Chlorobenzoic acid**	25	3 82	
255	***trans*-Caronic acid** (*trans*-1,1 Dimethyl-2,3-cyclopropanedicarboxylic acid)	25	3 82	5 32
256	**2,2-Diethylsuccinic acid**	25	3 84	
257	***trans*-3-Aminocyclohexanecarboxylic acid**	15	3 85	
258	**3-Iodobenzoic acid**	25	3 85	
259	**(4-Nitrophenyl)acetic acid**	25	3 85	
260	***cis*-3-Methylcyclohexyloxyacetic acid**	25	3 85	
261	**Lactic acid**	25	3 86	
262	***cis*-Cinnamic acid**	25	3 88	
263	**Hydroxyacetic acid**	25	3 89	
264	**1,2,3-Cyclohexanetricarboxylic acid**	23	3 89	4 85 pK_3 = 8 83
265	***cis*-Cyclobutane-1,2-dicarboxylic acid**	19	3 90	5 89
266	**2-Methylcyclohexyloxyacetic acid**	25	3 90	
267	**3-Fluorobenzoic acid**	25	3 90	
268	**3-Hydroxybenzoic acid**	30	3 90	9 78
269	**2-Methylbenzoic acid**	25	3 91	
270	**2,2-Diphenylglutaric acid**	20	3 91	5 38
271	**3-Phenoxybenzoic acid**	20	3 91	
272	**2-(Bromomethyl)butyric acid**	18	3 92	
273	**Diphenylacetic acid**	25	3 94	
274	**2,2-Dibenzylsuccinic acid**	20	3 96	6 66
275	**Triphenylacetic acid**	25	3 96	
276	***trans*-Cyclopentane-1,2-dicarboxylic acid**	25	3 96	5 85
277	**4-Bromobenzoic acid**	25	3 97	
278	**(3-Nitrophenyl)acetic acid**	25	3 97	
279	***cis*-Tetrahydronaphthalene-2,3-dicarboxylic acid**	20	3 98	6 47
280	**4-Chlorobenzoic acid**	25	3 98	
281	**2,5-Dimethylbenzoic acid**	25	3 98	
282	**3-Bromopropionic acid**	18	3 99	
283	**2-Hydroxy-2-methylbutyric acid**	18	3 99	
284	**3-Cyanopropionic acid**	25	3 99	
285	**3-Chloropropionic acid**	25	3 996	
286	***trans*-Tetrahydronaphthalene-2,3-dicarboxylic acid**	20	4 00	5 70
287	**(2-Nitrophenyl)acetic acid**	25	4 004	
288	**3-Aminopentanoic acid**	25	4 02	10 40
289	**4-Aminobutyric acid**	25	4 03	
290	***cis*-Cyclobutane-1,3-dicarboxylic acid**	25	4 03	5 31
291	**2-Hydroxyisobutyric acid**	18	4 04	
292	**(2-Iodophenyl)acetic acid**	25	4 04	
293	***trans*-4-Nitrocinnamic acid**	25	4 05	
294	**(2-Bromophenyl)acetic acid**	25	4 05	
295	**(2-Chlorophenyl)acetic acid**	25	4 07	
296	**2-Methoxybenzoic acid**	20	4 08	
297	**3-Methoxybenzoic acid**	25	4 09	
298	**3-Iodopropionic acid**	18	4 09	
299	***cis*-Cyclohexane-1,3-dicarboxylic acid**	16	4 10	5 46
300	**Ethylsuccinic acid**	25	4 00	
301	**Iminodipropionic acid**	30	4 11	9 61
302	**Benzylsuccinic acid**	20	4 11	5 65
303	***trans*-3-Nitrocinnamic acid**	25	4 12	
304	**4-Fluorobenzoic acid**	25	4 14	
305	**(3-Chlorophenyl)acetic acid**	25	4 14	
306	**4,4,4-Trifluorobutyric acid**	25	4 15	
307	***trans*-2-Nitrocinnamic acid**	25	4 15	
308	**3-Isopropoxybenzoic acid**	20	4 15	
309	**2-Naphthoic acid**	25	4 16	
310	**Succinic acid**	25	4 16	5 61
311	**(3-Iodophenyl)acetic acid**	25	4 16	
312	**3-Ethoxybenzoic acid**	20	4 17	
313	**2,2-Diphenyladipic acid**	20	4 17	5 80
314	**(4-Iodophenyl)acetic acid**	25	4 18	
315	**2-Anthracenecarboxylic acid**	20	4 18	
316	***trans*-Cyclohexane-1,4-dicarboxylic acid**	16	4 18	
317	**4,4,5,5,6,6,6-Heptafluorohexanoic acid**	25	4 18	
318	**2,4-Dimethylbenzoic acid**	25	4 18	
319	***trans*-Cyclohexane-1,2-dicarboxylic acid**	19	4 18	5 93
320	**(4-Bromophenyl)acetic acid**	25	4 19	
321	**(4-Chlorophenyl)acetic acid**	25	4 19	
322	**Mesaconic acid**	18	4 20	
323	**Benzoic acid**	25	4 20	
324	**3-Propoxybenzoic acid**	20	4 20	
325	**2-Ethoxybenzoic acid**	20	4 21	
326	**3,4-Diphenyladipic acid**	25	4 22	5 19
327	***trans*-2-Chlorocinnamic acid**	25	4 23	
328	**3-Fluoromandelic acid**	25	4 24	
329	**(1-Naphthyl)acetic acid**	25	4 24	
330	**(2-Isopropoxy)benzoic acid**	20	4 24	
331	**2-Propoxybenzoic acid**	20	4 24	
332	**3-Butoxybenzoic acid**	20	4 25	
333	**(4-Fluorophenyl)acetic acid**	25	4 25	
334	**Acrylic acid**	25	4 25	
335	**3-Methylglutaric acid**	25	4 25	5 41
336	**(2-Naphthyl)acetic acid**	25	4 26	
337	***cis*-Cyclopentane-1,3-dicarboxylic acid**	25	4 26	5 51
338	**5-Aminopentanoic acid**	25	4 27	

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION
(Listed in order of increasing pKa) (Continued)

No	Name	T, °C	pK_1	pK_2	No	Name	T °C	pK_1	pK_2
339	3-Methylbenzoic acid	25	4 27		401	3-(2-Chlorophenyl)propionic acid	25	4 58	
340	2,2-Diphenylpimelic acid	25	4 28	5 39	402	3-(3-Chlorophenyl)propionic acid	25	4 58	
341	3-Ethylglutaric acid	25	4 29	5 33	403	4-Methyl-3-pentenoic acid	25	4 60	
342	Angelic acid	18	4 29		404	*cis*-3-Hydroxycyclohexanecarboxylic acid	25	4 60	
343	*trans*-3-Chlorocinnamic acid	25	4 29		405	2-Hydroxycinnamic acid	25	4 61	
344	3,5-Dimethylbenzoic acid	25	4 30		406	4-Hydroxybenzoic acid	27 8	4 61	9 31
345	3-Isopropylglutaric acid	25	4 30	5 51	407	Levulinic acid	18	4 64	
346	3-*n*-Propylglutaric acid	25	4 31	5 31	408	2-Methyl-3-hydroxybutyric acid	18	4 65	
347	Phenylacetic acid	25	4 31		409	3-(3-Methoxyphenyl)propionic acid	25	4 65	
348	*trans*-Cyclohexane-1,3-dicarboxylic acid	19	4 31	5 73	410	4-Acetylbutyric acid	18	4 66	
349	2,2-Diphenylsuberic acid	20	4 31	5 39	411	2-Methylacrylic acid	18	4 66	
350	*trans*-Cyclopentane-1,3-dicarboxylic acid	25	4 32	5 42	412	3-Phenylpropionic acid	25	4 66	
351	2,2-Diphenylazelaic acid	20	4 33	5 38	413	3-(2-Methylphenyl)propionic acid	25	4 66	
352	(3,4-Dimethoxyphenyl)acetic acid	25	4 33		414	4-Pentenoic acid	25	4 67	
353	3,4,5-Trihydroxybenzoic acid	30	4 33		415	4-Ureidobutyric acid	25	4 68	
354	*cis*-Cyclohexane-1,2-dicarboxylic acid	20	4 34	6 77	416	3-(3-Methylphenyl)propionic acid	25	4 68	
355	4-Isopropylbenzoic acid	25	4 35		417	3-(4-Methylphenyl)propionic acid	25	4 68	
356	Vinylacetic acid	25	4 35		418	(4-Isopropoxy)benzoic acid	20	4 68	
357	Glutaric acid	25	4 35	5 42	419	*trans*-2-Hydroxycyclohexanecarboxylic acid	25	4 68	
358	4-Ethylbenzoic acid	25	4 35						
359	(4-Methoxyphenyl)acetic acid	25	4 36		420	*trans*-4-Hydroxycyclohexanecarboxylic acid	25	4 68	
360	4-Methylbenzoic acid	25	4 37						
361	(4-Methylphenyl)acetic acid	25	4 37		421	3-(4-Methoxyphenyl)propionic acid	25	4 69	
362	(4-Ethylphenyl)acetic acid	25	4 37		422	2-Pentenoic acid	25	4 69	
363	4-Methoxycinnamic acid	25	4 38		423	*trans*-Crotonic acid	25	4 69	
364	*trans*-Cyclohexane-1,2-diacetic acid	20	4 38	5 42	424	4-Hydroxypentanoic acid	18	4 69	
365	(4-Isopropylphenyl)acetic acid	25	4 39		425	2-Hexenoic acid	25	4 70	
366	*trans*-4-Aminocyclohexanecarboxylic acid	25	4 39	10 55	426	4-Hexenoic acid	25	4 72	
367	3-Hydroxycinnamic acid	25	4 40		427	5-Hexenoic acid	25	4 72	
368	4-*tert*-Butylbenzoic acid	25	4 40		428	2-Ethylpentanoic acid	18	4 72	
369	*cis*-Crotonic acid	18	4 41		429	2-Ethylbutyric acid	25	4 75	
370	3,4-Di nethylbenzoic acid	25	4 41		430	4-Phenylbutyric acid	25	4 76	
371	*trans*-2-Bromocinnamic acid	25	4 41		431	Acetic acid	25	4 76	
372	*cis*-Cyclohexane-1,2-diacetic acid	20	4 42	5 45	432	Isovaleric acid	25	4 78	
373	*cis*-Cyclopentane-1,2-diacetic acid	20	4 42	5 42	433	4-Propoxybenzoic acid	20	4 78	
374	(4-*tert*-Butylphenyl)acetic acid	25	4 42		434	4,4-Dimethylpentanoic acid	18	4 79	
375	*trans*-Cyclopentane-1,2-diacetic acid	20	4 43	5 43	435	Cyclobutanecarboxylic acid	25	4 79	
376	*trans*-4-Chlorocinnamic acid	25	4 43		436	*d,l*-2-Methylpentanoic acid	18	4 79	
377	Adipic acid	25	4 43	5 42	437	5-Methyl-4-hexenoic acid	25	4 80	
378	4-Cyanobutyric acid	25	4 44		438	4-Methyl-2-pentenoic acid	25	4 80	
379	*trans*-Cinnamic acid	25	4 44		439	3-(2-Methoxyphenyl)propionic acid	25	4 80	
380	*trans*-3-Methylcinnamic acid	25	4 44		440	2-Methylbutyric acid	18	4 81	
381	3-(Acetylamino)propionic acid	25	4 45		441	*n*-Butyric acid (*n*-Butanoic acid)	25	4 82	
382	2-Ureidoisobutyric acid	25	4 46		442	*trans*-3-Hydroxycyclohexanecarboxylic acid	25	4 82	
383	4-Methoxybenzoic acid	25	4 47						
384	3-(4-Nitrophenyl)propionic acid	25	4 47		443	Nicotinic acid	25	4 82	11 98
385	Pimelic acid	25	4 48	5 42	444	Cyclopropanecarboxylic acid	25	4 83	
386	3-(1-Naphthoyl)propionic acid	20	4 48		445	*cis*-4-Aminocyclohexanecarboxylic acid	25	4 83	10 62
387	3-Methylcyclohexyl-1,1-diacetic acid	25	4 49	6 08	446	*d,l*-3-Methylpentanoic acid	18	4 84	
388	4-Methylcyclohexyl-1,1-diacetic acid	25	4 49	6 10	447	Isonicotinic acid	20	4 84	12 23
389	5,5,5-Trifluoropentanoic acid	25	4 49		448	*cis*-4-Hydroxycyclohexanecarboxylic acid	25	4 84	
390	3-Ureidopropionic acid	25	4 49		449	Isocaproic acid	18	4 84	
391	3-(2-Nitrophenyl)propionic acid	25	4 50		450	*n*-Pentanoic acid (*n*-Valeric acid)	25	4 84	
392	*trans*-2-Methylcinnamic acid	25	4 50		451	Isobutyric acid	25	4 86	
393	2-Methoxycinnamic acid	25	4 50		452	Propionic acid (Propanoic acid)	25	4 87	
394	3-Hexenoic acid	25	4 52		453	4-Hydroxyisocaproic acid	18	4 87	
395	Suberic acid	25	4 52	5 40	454	*n*-Hexanoic acid (*n*-Caproic acid)	25	4 88	
396	Azelaic acid	25	4 53	5 40	455	*n*-Heptanoic acid	25	4 89	
					456	*n*-Octanoic acid (*n*-Caprylic acid)	25	4 89	
398	Succinamic acid (Succinic acid monoamide)	25	4 54		457	Cyclohexylpropionic acid	25	4 91	
					458	*d,l*-2,3-Dimethylsuccinic acid	25	4 94	6 20
399	*trans*-4-Methylcinnamic acid	20	4 56		459	*n*-Nonanoic acid (Pelargonic acid)	25	4 94	
400	O-Acetylsalicylic acid (Aspirin)	17	4 57		460	Cyclohexylbutyric acid	25	4 95	

TABLE XXVII. ACID DISSOCIATION CONSTANTS OF ORGANIC ACIDS IN AQUEOUS SOLUTION
(Listed in order of increasing pKa) (Continued)

No	Name	T °C	pK_1	pK_2	No	Name	T °C	pK_1	pK_2
461	**Tiglic acid**	18	4 96		468	***cis*-3-Methyl-2-pentenoic acid**	25	5 15	
462	**3-(2-Naphthoyl)propionic acid**	20	4 96		469	**Itaconic acid**	18	5 54	
463	**Cyclopentanecarboxylic acid**	25	4 99		470	**Citraconic acid**	18	6 17	
464	**2,2-Dimethylbutyric acid**	18	5 03		471	**Ethylenediamine-N,N,N',N'-tetra-acetic acid**	25	6 27	10 95
465	**Trimethylacetic acid**	25	5 05						
466	**3,3-Dimethylacrylic acid** (3-Methyl-crotonic acid)	25	5 12		472	**Ethylenediamine-N,N'-diacetic acid**	30	6 42	9 46
					473	**Ethylenediamine-N,N'-dipropionic acid**	30	6 87	9 60
467	***trans*-3-Methyl-2-pentenoic acid**	25	5 13						

EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation

$$HA_{aq}^{\pm n} + H_2O \rightleftharpoons A_{aq}^{\pm n-1} + H_3O_{aq}^{+}$$

and the corresponding equilibrium constant K_e is given by

$$K_e = \frac{(a_{A\ aq}^{\pm n-1})(a_{H_3O^+})}{(a_{HA_{aq}^{\pm n}})(a_{H_2O})}$$

where the a's are the activities of the species At low electrolyte concentrations a_{H_2O} is virtually constant, and a second constant, K_a, the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{H_2O}) = \frac{(a_{A_{aq}^{\pm n-1}})(a_{H_3O^+})}{(a_{HA_{aq}^{\pm n}})} = \frac{(c_{A_{aq}^{\pm n-1}})(c_{H_3O^+})}{(c_{HA_{aq}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{HA_{aq}^{\pm n}}}$$

where the c's are the concentrations and the f's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient pK_a notation, where

$$pKa = -\log K_a$$

For Table XXVII, $HA^{\pm n}$ = RCOOH, and $A^{\pm n-1}$ = $RCOO^-$

For Table XXVIII, $HA^{\pm n}$ = ArOH, and $A^{\pm n-1}$ = ArO^-

For Table XXIX, $HA^{\pm n}$ = $RR'R''NH^+$ and $A^{\pm n-1}$ = RR'R''N(R, R' and R'' may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids $pK_a = pK_1$

For dicarboxylic acids both pK_1 and pK_2 are given, pK_1 is defined above, and pK_2 is the analogous dissociation constant of the monoanion, $A^{\pm n-1}$, obtained on the first dissociation For other dibasic acids such as the conjugate acids of amino acids, or diamines, pK_1 is as defined above, and pK_2 is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for pK determinations, *see* G Kortum, W Vogel and K Andrussow, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190–536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution *see* D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of pK, and data for both acids and bases *see* J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bently) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318–401, H C Brown, D H McDaniel and O Hafliger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS IN AQUEOUS SOLUTION

(Listed in order of increasing pKa)

No	Name	T °C	pK_1	pK_2
1	**Picric acid** (2,4,6-Trinitrophenol)	25	0 29 (0 71)	
2	**4-Hydroxypyrimidine**	20	1 85	8 59
3	**2-Hydroxypyrimidine**	20	2 24	9 17
4	**4-Chloro-2,6-dinitrophenol**	25	2 97	
5	**2,6-Dinitrophenol**	25	3 71	
6	**2,4-Dinitrophenol**	25	4 09	
7	**2,6-Dinitrohydroquinone**	21	4 42	9 14
8	**8-Hydroxyquinoline**	20	5 017	9 813
9	**2,5-Dinitrophenol**	25	5 04	
10	**3,4-Dinitrophenol**	25	5 42	
11	**8-Hydroxyquinaldine**	25	5 55	10 31
12	**4-Methyl-8-hydroxyquinoline**	25	5 58	10 00
13	**3,4-Dimethyl-8-hydroxyquinoline**	25	5 80	10 05
14	**5-Formyl-2-nitrophenol** (3-Hydroxy-4-nitrobenzaldehyde)	25	6 00	
15	**5-Chloro-2-nitrophenol**	25	6 05	
16	**5-Carboethoxy-2-nitrophenol** (Ethyl 3-hydroxy-4-nitrobenzoate)	25	6 11	
17	**5-Carbomethoxy-2-nitrophenol** (Methyl 3-hydroxy-4-nitrobenzoate)	25	6 15	
18	**2,4-Dimethyl-8-hydroxyquinoline**	25	6 20	10 60
19	**3-Nitrocatechol**	25	6 68	
20	**2-Nitro-5-phenylphenol** (3-Hydroxy-4-nitrobiphenyl)	25	6 74	
21	**2-Formylphenol** (Salicylaldehyde)	25	6 79	
22	**5-Methoxy-2-nitrophenol**	25	7 09	
23	**4-Nitrophenol**	25	7 16	
24	**2-Nitrophenol**	25	7 21	
25	**2,6-Dimethyl-4-nitrophenol**	25	7 22	
26	**5-Methyl-2-nitrophenol**	25	7 25	
27	**2,6-Dichlorohydroquinone**	25	7 30	9 99
28	**Vanillin** (4-Formyl-2-methoxyphenol 4-Hydroxy-3-methoxybenzaldehyde)	25	7 396	
29	**2-Nitrohydroquinone**	21	7 63	10 06
30	**4-Formylphenol** (4-Hydroxybenzaldehyde)	25	7 66	
31	**4-(Methylsulfonyl)phenol**	25	7 83	
33	***o*-Vanillin** (2-Formyl-6-methoxyphenol, 2-Hydroxy-3-methoxybenzaldehyde)	25	7 91	
34	**4-Cyanophenol** (4-Hydroxybenzonitrile)	25	7 95	
35	**3-Formylphenol** (3-Hydroxybenzaldehyde)	25	8 00	
36	**4-Acetylphenol**	25	8 05	
37	**3,5-Dimethyl-4-(methylsulfonyl)phenol**	25	8 13	
38	**4-Cyano-3,5-dimethylphenol** (2,6-Dimethyl-4-hydroxybenzonitrile)	25	8 21	
39	**3,5-Dimethyl-4-nitrophenol**	25	8 25	
40	**4-Cyano-2,6-dimethylphenol** (3,5-Dimethyl-4-hydroxybenzonitrile)	25	8 27	
41	**2-Carboxamidophenol** (Salicylamide)	20	8 37	
42	**3-Nitrophenol**	25	8 38	
43	**4-Carbobenzyloxyphenol** (Benzyl 4-hydroxybenzoate)	25	8 41	
44	**2-Bromophenol**	25	8 42	
45	**Phloroglucinol** (1,3,5-Trihydroxybenzene)	25	8 45 (7 0)	8 88
46	**2-Iodophenol**	25	8 46	
47	**4-Carbobutoxyphenol** (*n*-Butyl 4-hydroxybenzoate)	25	8 47	
48	**4-Carbomethoxyphenol** (Methyl 4-hydroxybenzoate)	25	8 47	
49	**2-Chlorophenol**	25	8 48	
50	**4-Carboethoxyphenol** (Ethyl 4-hydroxybenzoate)	25	8 50	
51	**2-Hydroxy-3-methoxybenzylamine**	25	8 70	10 52
52	**3-Hydroxypyridine**	20	8 72	
53	**2-Fluorophenol**	25	8 82	
54	**Isovanillin** (5-Formyl-2-methoxyphenol 3-Hydroxy-4-methoxybenzaldehyde)	25	8 889	
55	**3-Hydroxy-2-methoxybenzylamine**	25	8 89	10 52
56	**4-Hydroxy-3-methoxybenzylamine**	25	8 94	10 42
57	**3-Nitro-2,4,6-trimethylphenol**	25	8 98	
58	**Sodium 4-hydroxybenzenesulfonate**	25	9 01	
59	**Pyrogallol** (1 2 3-Trihydroxybenzene)	25	9 01	11 64
60	**2-Methylhydroquinone** (Toluhydroquinone)	25	9 05	11 62
61	**3-Chlorophenol**	25	9 08 (9 02)	
62	**3-Bromophenol**	25	9 11	
63	**3-Iodophenol**	25	9 17	
64	**3-Acetylphenol**	25	9 19	
65	**4-Iodophenol**	25	9 20	
66	**Sodium 3-hydroxybenzenesulfonate**	25	9 29	
67	**1-Naphthol**	20 5	9 30 (9 85)	
68	**3-(Methylsulfonyl)phenol**	25	9 33	
69	**4-Bromophenol**	25	9 34	
70	**3-Fluorophenol**	25	9 36 (9 28)	
71	**1,4-Naphthohydroquinone** (1 4 Dihydroxy naphthalene)	26 5	9 37	10 93
72	**4-Chlorophenol**	25	9 38 (9 42)	
73	**Sodium 4-hydroxybenzoate**	20	9 39	
74	**Resorcinol** (1 3 Dihydroxybenzene)	30	9 44	11 32
75	**Catechol** (1 2-Dihydroxybenzene)	30	9 48	12 08
76	**4-Phenylphenol** (4 Hydroxybiphenyl)	22 5	9 51	
77	**3-(Methylthio)phenol**	25	9 53	
78	**4-(Methylthio)phenol**	25	9 53	
79	**2,4,6-Trimethylolphenol**	25	9 56	
80	**2-Naphthol**	19 5	9 57, (9 93)	
81	**3-Phenylphenol** (3-Hydroxybiphenyl)	22 5	9 64	
82	**3-Methoxyphenol**	25	9 65	
83	**2,6-Dimethylolphenol**	25	9 66	
84	**2-Aminophenol** (2-Hydroxyaniline)	28	9 71	
85	**2,4-Dimethylolphenol**	25	9 77	
86	**4-Methylolphenol**	25	9 82	
87	**3-Methylolphenol**	25	9 83	
88	**3-Aminophenol** (3-Hydroxyaniline)	21 5	9 87	9 92
89	**Sodium 4-hydroxybenzenephosphonate**	25	9 90	
90	**3-Ethylphenol**	28	9 90	
91	**2,6-Dimethylol-4-methylphenol**	25	9 92	
92	**2-Methylolphenol**	25	9 92	
93	**4-Fluorophenol**	25	9 92	
94	**Sodium 3-hydroxybenzoate**	20	9 94	
95	**2-Methoxyphenol**	25	9 98	
96	**Phenol**	25	9 99, (9 95)	
97	**Eugenol** (4-Allyl-2-methoxyphenol)	25	10 00	
98	**2-Phenylphenol** (2-Hydroxybiphenyl)	22 5	10 01	
99	**4-Ethylphenol**	28	10 01	
100	**3-Methylphenol** (*m*-Cresol)	25	10 09	
101	**3-Ethyl-5-methylphenol**	28	10 10	
102	**3,5-Dimethylphenol**	25	10 15	
103	**4-Methyl-2-methylolphenol**	25	10 15	
104	**4-Methoxyphenol**	25	10 20	
105	**Sodium 3-hydroxybenzenephosphonate**	25	10 2	

TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS IN AQUEOUS SOLUTION

(Listed in order of increasing pKa)

No.	Name	T, °C	pK_1	pK_2	No	Name	T, °C	pK_1	pK_2
106	**2-Ethylphenol**	28	10 2		115	**2,6-Dimethylphenol**	25	10 59	
107	**2,5-Dimethylphenol**	24	10 22		116	**2,4,6-Trimethylphenol**	25	10 88, (10 99)	
108	**4-Methylphenol** (*p*-Cresol)	25	10 26						
109	**2-Methylphenol** (*o*-Cresol)	25	10 28		117	**Hydroquinone** (1,4-Dihydroxybenzene)	25	10 85, (9 96)	11 39
110	**4-Indanol**	25	10 32						
111	**3,4-Dimethylphenol**	25	10 32		118	**4-Hydroxypyridine**	20	11 09	
112	**2,4,5-Trimethylphenol**	25	10 45		119	**Tetramethylhydroquinone** (Durohydroquinone)	25	11 51	
113	**2,4-Dimethylphenol**	25	10 45						
114	**2,3-Dimethylphenol**	25	10 50		120	**2-Hydroxypyridine**	20	11 62	

EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation

$$HA_{aq}^{\pm n} + H_2O \rightleftharpoons A_{aq}^{\pm n-1} + H_3O_{aq}^{+}$$

and the corresponding equilibrium constant K_e is given by

$$K_e = \frac{(a_{A\ aq}^{\pm n-1})(a_{H_3O^+})}{(a_{HA_{aq}^{\pm n}})(a_{H_2O})}$$

where the a's are the activities of the species At low electrolyte concentrations a_{H_2O} is virtually constant, and a second constant, K_a, the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{H_2O}) = \frac{(a_{A_{aq}^{\pm n-1}})(a_{H_3O^+})}{(a_{HA_{aq}^{\pm n}})} = \frac{(c_{A_{aq}^{\pm n-1}})(c_{H_3O^+})}{(c_{HA_{aq}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{HA_{aq}^{\pm n}}}$$

where the c's are the concentrations and the f's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient pK_a notation, where

$$pKa = -\log K_a$$

For Table XXVII, $HA^{\pm n}$ = RCOOH, and $A^{\pm n-1}$ = $RCOO^-$

For Table XXVIII, $HA^{\pm n}$ = ArOH, and $A^{\pm n-1}$ = ArO^-

For Table XXIX, $HA^{\pm n}$ = $RR'R''NH^+$ and $A^{\pm n-1}$ = RR'R''N(R, R' and R'' may be alkyl or aryl groups or a hydrogen atom)

For monobasic acids $pK_a = pK_1$

For dicarboxylic acids both pK_1 and pK_2 are given, pK_1 is defined above, and pK_2 is the analogous dissociation constant of the monoanion, $A^{\pm n-1}$, obtained on the first dissociation For other dibasic acids such as the conjugate acids of amino acids, or diamines, pK_1 is as defined above, and pK_2 is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for pK determinations, *see* G Kortum, W Vogel and K Andrussow, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190–536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution *see* D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of pK, and data for both acids and bases *see* J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bently) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318–401, H C Brown, D H McDaniel and O Hafliger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pKa)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH^+) of the listed base (B))

No	Name	T °C	pK_1	pK_2	No	Name	T, °C	pK_1	pK_2
1	2,4,6-Trinitroaniline	25	−9 41		59	2-Amino-6-nitronaphthalene	25	2 62	
2	2,4-Dinitroaniline	25	−4 53		60	N,N-Dimethyl-3-nitroaniline	25	2 63	
3	2,6-Dinitro-4-methylaniline	25	−3 96		61	2-Chloroaniline	25	2 65	
4	2,4-Dichloro-6-nitroaniline	25	−3 61		62	2-Amino-4-cyanonaphthalene	25	2 66	
5	2,6-Dichloro-4-nitroaniline	20	−2 55		63	1-Amino-3-bromonaphthalene	25	2 67	
6	N-Cyanodiethylamine	25	−2 0		64	3-Bromoquinoline	25	2 69	
7	1-Amino-2-nitronaphthalene	25	−1 74		65	1-Amino-3-chloronaphthalene	25	2 69	
8	4-Chloro-2-nitroaniline	25	−1 02		66	5-Nitroquinoline	20	2 69	
9	Dicyanomethyl ethyl amine	25	−0 6		67	6-Nitroquinoline	20	2 72	
10	2-Fluoropyridine	25	−0 44		68	1-Amino-5-nitronaphthalene	25	2 73	
11	Pyrrole	25	−0 27		69	2-Amino-8-nitronaphthalene	25	2 73	
			(−3 8)		70	3-Cyanoaniline	25	2 748	
12	2-Nitroaniline	25	−0 26		71	1-Amino-8-nitronaphthalene	23	2 79	
13	Bis (cyanomethyl) amine	25	0 2		72	1-Amino-3-iodonaphthalene	25	2 82	
14	2-Chloropyridine	25	0 49,		73	3-Bromopyridine	25	2 84	
			(0 72)		74	3-Chloropyridine	25	2 84	
15	1-Amino-4-nitronaphthalene	20	0 54		75	1-Amino-6-nitronaphthalene	25	2 89	
16	Quinoxaline	20	0 56		76	4-Methyl-3-nitroaniline	25	2 96	
17	N,N-Dimethyl-4-nitroaniline	25	0 607		77	3-Cyano-N,N-dimethylaniline	25	2 969	
18	Pyrazine	27	0 65	−5 78	78	3-Fluoropyridine	25	2 97	
19	Diphenylamine	25	0 79		79	2-Amino-5-nitronaphthalene	25	3 01	
20	3-Nitropyridine	25	0 81		80	2-Methoxypyridine	25	3 06	
21	2-Bromopyridine	25	0 90		81	2-Amino-7-nitronaphthalene	25	3 10	
22	2-Cyanoaniline	25	0 95		82	1,3-Dimethylpyrazole	25	3 11	
23	2,6-Dimethyl-4-nitroaniline	22	0 98		83	2-Methoxyquinoline	20	3 16	
24	4-Nitroaniline	25	1 00		84	3-Acetylpyridine	25	3 18	
25	N-Chlorodiethylamine	25	1 02		85	4-Hydroxypyridine	20	3 20	11 12
26	2-Methyl-4-nitroaniline	24 5	1 04		86	2-Fluoroaniline	25	3 20	
27	2-Bromoquinoline	25	1 05		87	1-Amino-4-bromonaphthalene	25	3 21	
28	Tris (2-cyanoethyl) amine	25	1 1		88	3-Iodopyridine	25	3 25	
29	Pyrimidine	20	1 23		89	1-Amino-3-methoxynaphthalene	25	3 26	
			(1 31)		90	1-Amino-3-hydroxynaphthalene	25	3 30	
30	2-Amino-3-nitronaphthalene	25	1 48		91	1-Amino-5-chloronaphthalene	25	3 34	
31	3-Methyl-4-nitroaniline	25	1 50		92	2-Amino-4-chloronaphthalene	25	3 38	
32	2,5-Dichloroaniline	22	1 57		93	4-Aminofluorene	25	3 39	
33	4-Cyanoaniline	25	1 74		94	2-Amino-4-bromonaphthalene	25	3 40	
34	4-Cyano-N,N-dimethyl aniline	25	1 78		95	2-Amino-4-iodonaphthalene	25	3 41	
35	2-Iodopyridine	25	1 82		96	1-Amino-7-chloronaphthalene	25	3 48	
36	2,3-Dimethyl-4-nitroaniline	25	1 96		97	1-Amino-6-chloronaphthalene	25	3 48	
37	2,4-Dichloroaniline	25	2 00		98	Quinazoline	20	3 49	
38	1-Amino-3-nitronaphthalene	25	2 07		99	3-Chloroaniline	25	3 52	
39	3-Methoxy-5-nitroaniline	25	2 11		100	4-Bromo-2,6-dimethylaniline	25	3 54	
40	4-Aminobenzophenone (4-Benzoylaniline)	25	2 17		101	3-Methylpyrazole	25	3 56	
41	4-Aminoacetophenone (4-Acetylaniline)	25	2 19		102	3-Aminoacetophenone (3-Acetylaniline)	25	3 56	
			(2 75)		103	3-Fluoroaniline	25	3 57	
42	2-Aminoacetophenone (2-Acetylaniline)	25	2 22		104	4-Bromo-2-methylaniline	25	3 58	
43	Pyridazine	20	2 24		105	3-Bromoaniline	25	3 58	
44	1-Amino-3-cyanonaphthalene	25	2 26		106	2-(Methylthio)pyridine	20	3 59	
45	Cinnoline	20	2 27		107	3-Iodoaniline	25	3 61	
46	1,2,4-Triazole	25	2 30		108	5-Bromoquinoline	25	3 62	
47	2,4-Dibromoaniline	15	2 3		109	1-(Methylamino)naphthalene	27	3 67	
48	2,6-Dibromoaniline	25	2 34		110	2-Amino-7-chloronaphthalene	23	3 71	
49	7-Nitroquinoline	20	2 40		111	4-Bromopyridine	20	3 78	
50	2-Amino-4-nitronaphthalene	25	2 43		112	4-Iodoaniline	25	3 78	
51	Thiazole	20	2 44		113	2-Aminobiphenyl	22	3 82	
52	3-Nitroaniline	25	2 466		114	3,5-Dimethoxyaniline	25	3 82	
53	Pyrazole	25	2 48		115	4-Chloropyridine	20	3 84	
54	2-Bromoaniline	25	2 53		116	4-Bromoaniline	25	3 86	
55	1-Amino-7-nitronaphthalene	25	2 55		117	1-Aminofluorene	25	3 87	
56	8-Nitroquinoline	20	2 55		118	1-Amino-6-methoxynaphthalene	25	3 90	
57	3,5-Dimethyl-4-nitroaniline	25	2 59		119	1-Aminonaphthalene	25	3 92	
58	2-Iodoaniline	25	2 60		120	2,6-Dimethylaniline	25	3 95	

TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pKa) (Continued)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH^+) of the listed base (B))

No	Name	T,°C	pK_1	pK_2	No	Name	T °C	pK_1	pK_2
121	8-Aminoquinoline	20	3 95		183	8-Methylquinoline	25	4 91	
122	1-Amino-5-hydroxynaphthalene	25	3 96		184	3,5-Dimethylaniline	25	4 91	
123	1-Amino-3-methylnaphthalene	25	3 96		185	3-Aminoquinoline	20	4 91	
124	1-Amino-6-hydroxynaphthalene	25	3 97		186	3-Methoxypyridine	25	4 91	
125	4-Chloroaniline	25	4 00		187	4-*tert*-Butylaniline	25	4 95	
126	3-(Methylthio)aniline	25	4 00		188	3,5-Di-*tert*-butylaniline	25	4 97	
127	4-Iodopyridine	20	4 02		189	2-Vinylpyridine	25	4 98	
128	2-Amino-4-methoxynaphthalene	25	4 05		190	1,3-Diaminobenzene (*m*-Phenylenediamine)	25	4 98	2 41
129	2-Amino-5-hydroxynaphthalene	25	4 07						
130	1-Amino-7-methoxynaphthalene	25	4 07		191	N,3-Dimethylaniline	21	5 00	
131	3-Bromo-4-methoxyaniline	23	4 08		192	2-*tert*-Butylaniline	25	5 03	
132	1-Aminoanthracene	25	4 1		193	6-Methoxyquinoline	20	5 03	
133	2-Aminonaphthalene	25	4 16		194	N,N-Dimethylaniline	25	5 068	
134	N-Allylaniline	25	4 17		195	4-Methylaniline	25	5 08	
135	3-Ethoxyaniline	25	4 17		196	3-Hydroxypyridine	25	5 10	8 60
136	1-(Ethylamino)naphthalene	25	4 18		197	N-Ethylaniline	24	5 12	
137	2-Amino-7-methoxynaphthalene	25	4 19		198	N-*n*-Butylaniline	25	5 12	
138	1-Amino-7-hydroxynaphthalene	25	4 20		199	3,5,6-Trimethylaniline	20 5	5 12	
139	3-Methoxyaniline	25	4 20		200	2-Benzylpyridine	25	5 13	
140	4-Aminobiphenyl	29	4 22		201	6-Methylquinoline	25	5 15	
141	4-Bromo-N,N-dimethylaniline	25	4 232		202	2-Amino-5,6,7,8-tetrahydronaphthalene	17	5 17	
142	3-Aminobiphenyl	17	4 25		203	3,4-Dimethylaniline	25	5 17	
143	2-Amino-7-hydroxynaphthalene	25	4 25		204	4-Ethoxyaniline	28	5 20	
144	2,3,5,6-Tetramethylaniline	25	4 30		205	4-Methylquinoline	25	5 20, (5 59)	
145	2-Bromo-N,N-dimethylaniline	25	4 31						
146	4-(Methylthio)aniline	25	4 35		206	Pyridine	25	5 25	
147	2-*n*-Propylaniline	25	4 36		207	Bis(2-cyanoethyl)amine	25	5 26	
148	Tris(2-chloroethyl)amine	25	4 37		208	7-Methylquinoline	25	5 29	
149	2-Ethylaniline	25	4 37		209	N-Cyclopentylaniline	25	5 30	
150	2,4,6-Trimethylaniline	25	4 37		210	5-Aminoindane	16	5 31	
151	3,5-Dimethylpyrazole	25	4 38		211	4-Methoxyaniline	25	5 31	
152	3-(Methylthio)pyridine	20	4 42		212	Aminoacetonitrile	25	5 34	
153	2-Isopropylaniline	25	4 42		213	N,N,3-Trimethylaniline	25	5 344	
154	N-Isobutylaniline	25	4 43		214	N,4-Dimethylaniline	23	5 36	
155	2-Ethoxyaniline	28	4 43		215	Isoquinoline	20	5 42	
156	2-Methylaniline	25	4 44		216	N-*n*-Hexylaniline	19	5 42	
157	1-Amino-5,6,7,8-tetrahydronaphthalene	16	4 47		217	5-Aminoquinoline	20	5 42	
158	Phenanthridine	20	4 48		218	2,2,2-Trichloroethylamine	20	5 47	
159	2-Methoxyaniline	25	4 52		219	Benzimidazole	25	5 53	
160	2,5-Dimethylaniline	25	4 53		220	1-Methylbenzimidazole	25	5 54	
161	1-(Cyanomethyl)pyridine	25	4 55		221	3-Ethylpyridine	25	5 56	
162	(Cyanomethyl) diethyl amine	25	4 55		222	1-Ethylbenzimidazole	25	5 59	
163	Bis(2-Cyanoethyl) ethyl amine	25	4 55		223	6-Aminoquinoline	20	5 59	
164	2-(Dimethylamino)naphthalene	25	4 566		224	N-Cyclohexylaniline	25	5 60	
165	Aniline	25	4 603		225	4-Vinylpyridine	25	5 62	
166	5-Methylquinoline	25	4 62		226	N,N,4-Trimethylaniline	25	5 627	
167	N,2-Dimethylaniline	23	4 62		227	3-Methylpyridine	25	5 63	
168	2-Aminofluorene	25	4 64		228	4-Methylbenzimidazole	25	5 65	
169	2-Amino-6-methoxynaphthalene	25	4 64		229	N,N-Di-*n*-propylaniline	23	5 68	
170	4-Fluoroaniline	25	4 65		230	2-Methylquinoline	25	5 69	
171	3-*tert*-Butylaniline	25	4 66		231	1-Isopropylbenzimidazole	25	5 71	
172	3-Isopropylaniline	25	4 67		232	3-Isopropylpyridine	25	5 72	
173	2,3-Dimethylaniline	25	4 70		233	2-*tert*-Butylpyridine	25	5 76	
174	3-Methylaniline	25	4 70		234	N-Isopropylaniline	25	5 77	
175	3-Ethylaniline	25	4 70		235	5-Methylbenzimidazole	25	5 78	
176	1,2-Diaminobenzene (*o*-Phenylenediamine)	25	4 74	0 6	236	3-*tert*-Butylpyridine	25	5 82	
177	N-*n*-Propylaniline	25	4 79		237	2-Isopropylpyridine	25	5 83	
178	Quinoline	25	4 81		238	4-Ethylpyridine	25	5 87	
179	3-Aminofluorene	25	4 82		239	2-Ethylpyridine	25	5 89	
180	1-(Dimethylamino)naphthalene	28	4 83		240	2-Methylpyridine	25	5 94	
181	N-Methylaniline	25	4 848		241	4-(Methylthio)pyridine	20	5 94	
182	2,4-Dimethylaniline	25	4 89		242	2-Hexylpyridine	25	5 95	

TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

(Listed in order of increasing pKa) (Continued)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH^+) of the listed base (B))

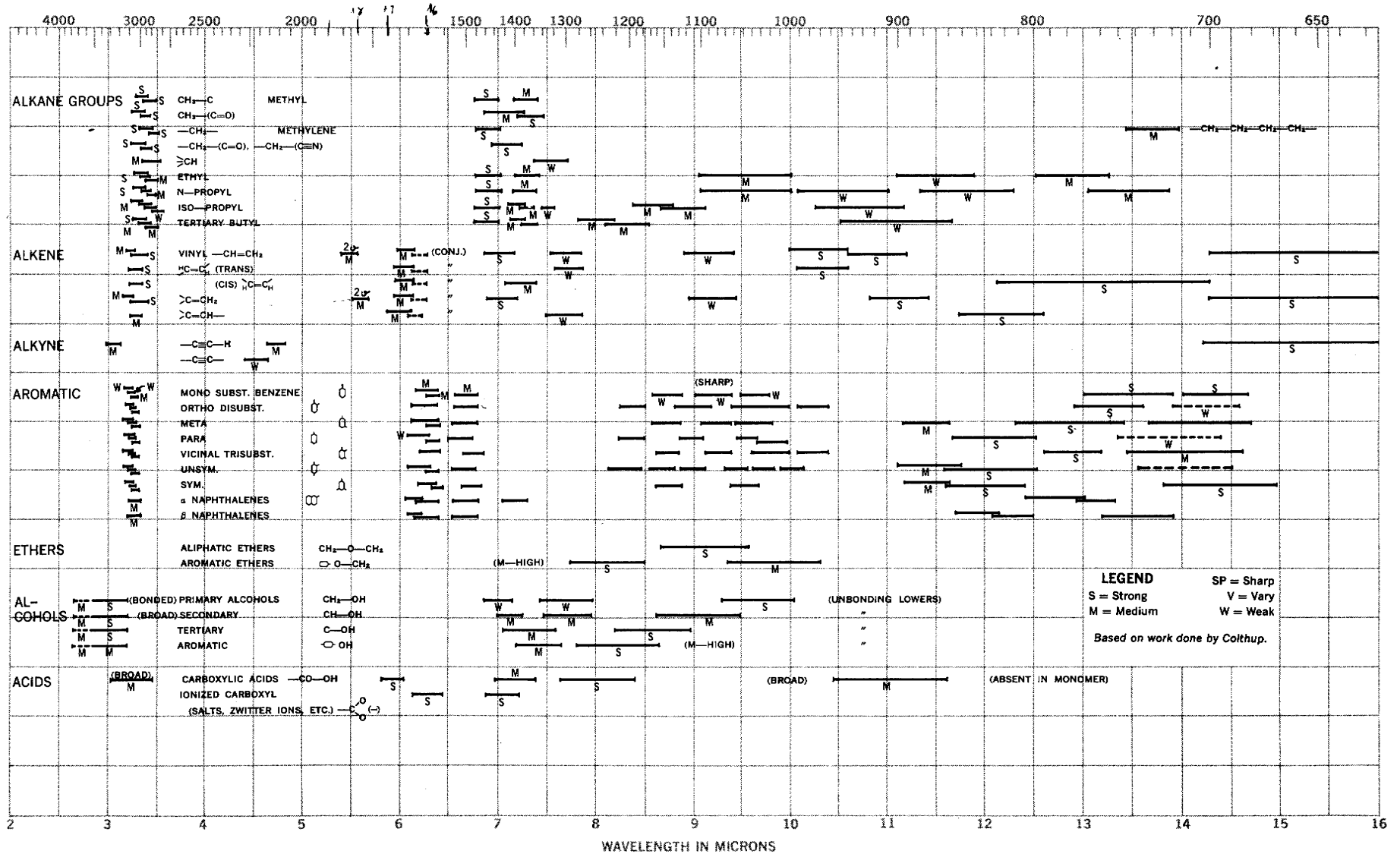
No	Name	T °C	pK_1	pK_2	No	Name	T °C	pK_1	pK_2
243	2-*n*-Propylpyridine	25	5 97		305	Bis(2-hydroxyethyl)amine	25	8 88	
244	4-*tert*-Butylpyridine	25	5 99		306	N,N-Dimethylbenzylamine	25	8 91	
245	2-Pentylpyridine	25	6 00		307	3-Bromopropylamine	21	8 93	
246	4-Isopropylpyridine	25	6 02		308	1,2-Bis(dimethylamino)ethane	30	8 97	5 85
247	4-Methylpyridine	25	6 03		309	1-(Aminoethyl)benzene	25	9 08	
248	3-Aminopyridine	25	6 03		310	2-Acetoxyethylamine	25	9 1	
249	N,N,2-Trimethylaniline	25	6 11		311	4-Aminopyridine	25	9 114	
250	N,2,6-Trimethylaniline	25	6 12		312	4-Aminoquinoline	20	9 13	
					313	(3-Cyanopropyl) diethyl amine	25	9 13	
252	2-Methylbenzimidazole	25	6 19		314	3-Methoxybenzylamine	25	9 15	
253	1,4-Diaminobenzene (*p*-Phenylenediamine)	25	6 2	2 67	315	2-Methylbenzylamine	25	9 19	
254	2-Isopropylbenzimidazole	25	6 21		316	1-Aminoindane	22 5	9 21	
255	2-Ethylbenzimidazole	25	6 27		317	*trans*-1-Amino-2-hydroxycyclopentane	25	9 28	
256	N,N-Di-*n*-butylaniline	19	6 30		318	Diallylamine	25	9 29	
257	2,5-Dimethylpyridine	25	6 40		319	Dimethyl (2-hydroxyethyl) amine	20	9 31	
258	2-Phenylimidazole	25	6 40		320	3-Methylbenzylamine	25	9 33	
259	Bis(2-chloroethyl)methyl amine	25	6 43		321	Benzylamine	25	9 35, (9 62)	
260	4-Methoxyquinoline	30	6 45						
261	3,4-Dimethylpyridine	25	6 46		322	4-Methylbenzylamine	25	9 36	
262	4-Methoxypyridine	25	6 47		323	3,4-Dimethoxybenzylamine	25	9 39	
263	Bis(2-chloroethyl) ethyl amine	25	6 55		324	2,3-Dimethoxybenzylamine	25	9 41	
264	1,2-Dimethylbenzimidazole	25	6 55		325	2-(Phenethylamino)ethylamine	25	9 44	6 59
265	2,3-Dimethylpyridine	25	6 57		326	N,N-Diethylbenzylamine	25	9 44	
266	2,6-Dimethylpyridine	25	6 60		327	4-Methoxybenzylamine	25	9 47	
267	7-Aminoquinoline	20	6 61		328	2-(Methylthio)ethylamine	20	9 49	
268	N,N-Diethylaniline	22	6 61		329	2-Hydroxyethylamine	25	9 498	
269	4-Ethoxypyridine	20	6 67		330	2-(Dimethylamino)ethylamine	25	9 53	6 63
270	2-Aminopyridine	25	6 71		331	N-Methylbenzylamine	25	9 54	
271	2,4-Dimethylpyridine	25	6 77		332	1,2-Bis(diethylamino)ethane	25	9 55	6 18
272	Imidazole	25	6 95		333	2-Aminoindane	21 5	9 57	
273	N-*tert*-Butylaniline	25	7 00		334	N-Propylbenzylamine	25	9 58	
274	(2-Cyanoethyl) dimethyl amine	29	7 0		335	1,2,3-Triaminopropane	20	9 59	7 95, pK_3 = 3 72
275	2-Benzyl-2-pyrroline	25	7 06						
276	2-Aminoquinoline	20	7 30						
277	N,N-Di-isopropylaniline	25	7 37		336	2-Methoxyethylamine	20	9 61	
278	N-Methylmorpholine	25	7 38		337	5-Bromo-*n*-pentylamine	21	9 62	
279	2,4,6-Trimethylpyridine	25	7 43		338	*trans*-1-Amino-2-hydroxycyclohexane	25	9 63	
280	4-Methylimidazole	25	7 518		339	1-Amino-1,2,3,4-tetrahydronaphthalene	20	9 63	
281	1,3-Triazine	25	7 6		340	N-Ethylbenzylamine	25	9 64	
282	N-Ethylmorpholine	25	7 67		341	3,3,3-Trichloro-*n*-propylamine	20	9 65	
283	2-Cyanoethylamine	29	7 7		342	1-Allylpiperidine	25	9 65	
284	Tris(2-hydroxyethyl)amine	25	7 762		343	2-Methoxybenzylamine	25	9 70	
285	2-Methylimidazole	25	7 85		344	*cis*-1-Amino-2-hydroxycyclopentane	25	9 70	
286	N-Methylaziridine	25	7 86		345	2-(Furfurylamino)ethylamine	20	9 72	6 20
287	N-*n*-Butylaziridine	25	7 86		346	*cis*-1-Amino-2-hydroxycyclohexane	25	9 72	
288	2-Ethyl-2-pyrroline	25	7 87		347	Piperazine	25	9 81	5 55
289	2,3,5,6-Tetramethylpyridine	20	7 90		348	Trimethylamine	25	9 81	
290	2-Cyclohexyl-2-pyrroline	25	7 91		349	Phenethylamine ((2-Aminoethyl)benzene)	25	9 84	
291	N-Ethylaziridine	24	7 93		350	Diethyl 2-hydroxyethyl amine	20	9 87	
292	Aziridine	25	8 01		351	1-Methyl-3-pyrroline	25	9 88	
293	N,2-Diethylaziridine	25	8 18		352	1,2-Diaminoethane (1,2-Ethylenediamine)	25	9 928	6 848
294	2-Ethylaziridine	25	8 29		353	*cis*-1,2-Diaminocyclohexane	20	9 93	6 13
295	Triallylamine	25	8 31		354	2-Amino-1,2,3,4-tetrahydronaphthalene	17	9 93	
296	Morpholine	25	8 33		355	Tri-*n*-butylamine	25	9 93	
297	2,4-Dimethylimidazole	25	8 36		356	4,4,4-Trichloro-*n*-butylamine	20	9 93	
298	2-Bromoethylamine	24	8 49		357	*trans*-1,2-Diaminocyclohexane	20	9 94	6 47
299	Bis(2-hydroxyethyl) methyl amine	25	8 52		358	3-Hydroxypropylamine	25	9 96	
300	1,2-Bis(furfurylamino)ethane	20	8 61	5 74	359	*meso*-2,3-Diaminobutane	25	9 97	6 92
301	2,2-Dimethylaziridine	25	8 64		360	*d,l*-2,3-Diaminobutane	25	10 00	6 91
302	*trans*-2,3-Dimethylaziridine	24	8 69		361	1,2-Diaminopropane (1,2-Propylenediamine)	25	10 00	7 13
303	*cis*-2,3-Dimethylaziridine	23	8 72						
304	(2-Chloroethyl) diethyl amine	25	8 80		362	*cis*-Neobornylamine	25	10 01	

TABLE XXIX. DISSOCIATION CONSTANTS OF ORGANIC BASES IN AQUEOUS SOLUTION

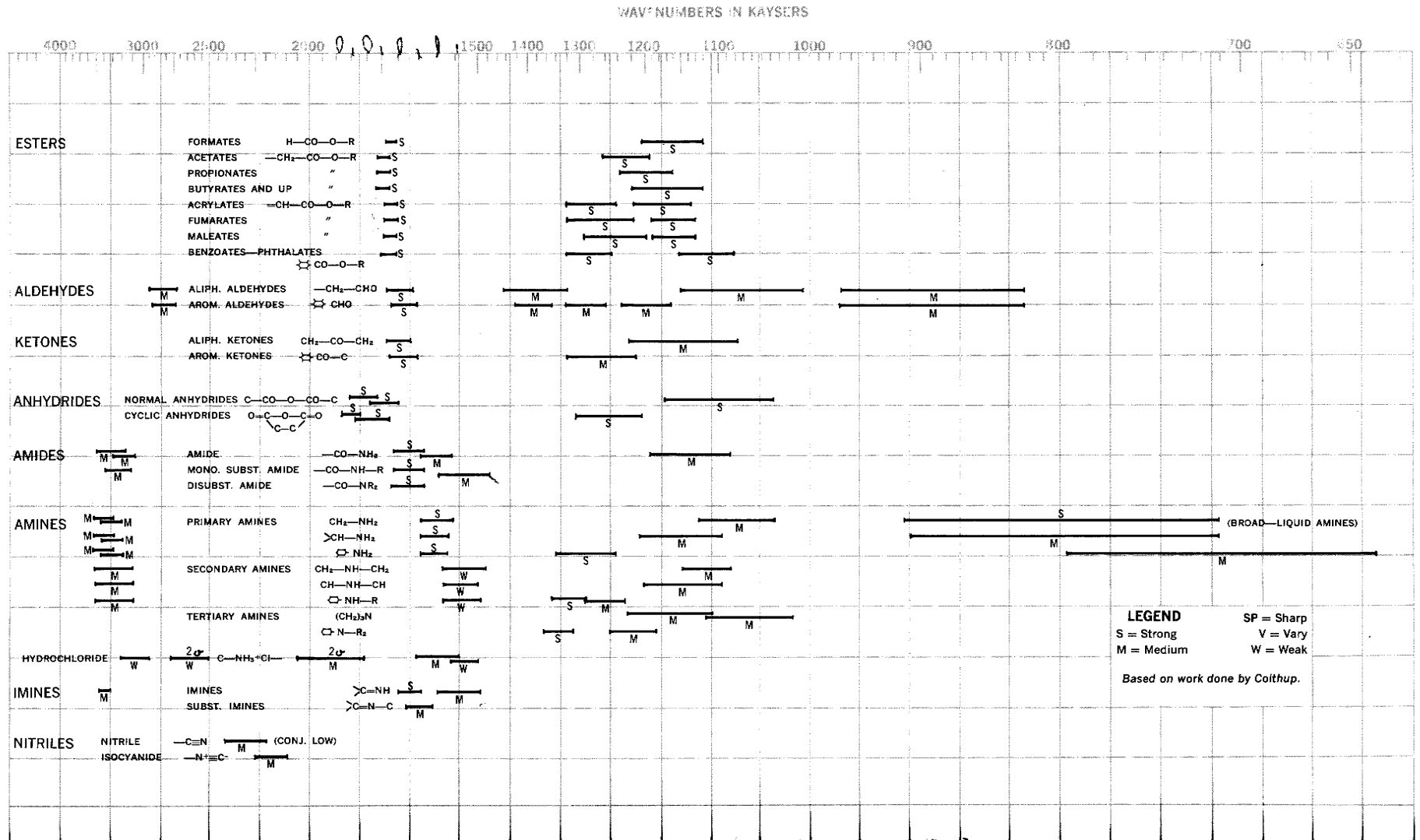
(Listed in order of increasing pKa) (Continued)

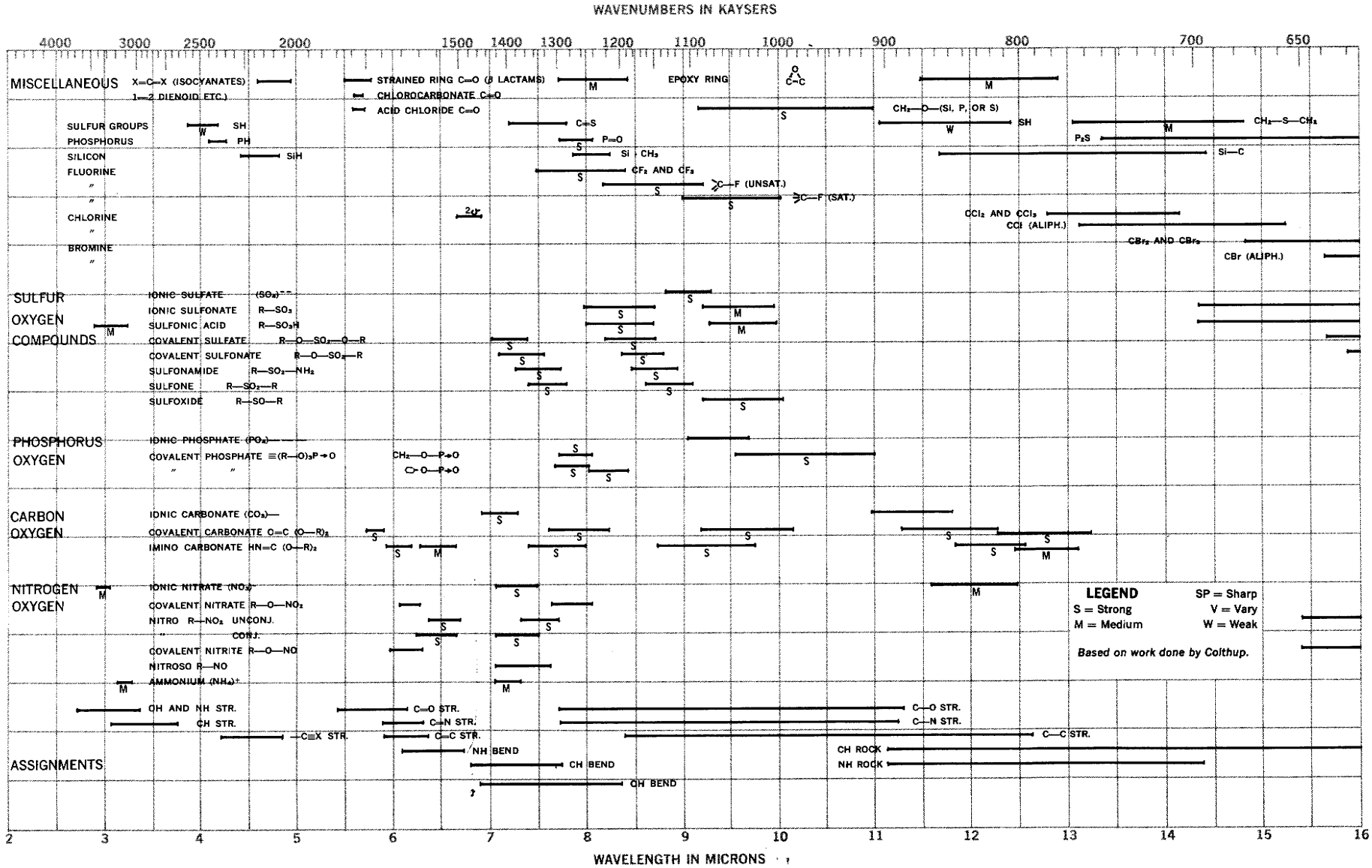
(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH^+) of the listed base (B))

No	Name	T °C	pK_1	pK_2	No	Name	T,°C	pK_1	pK_2
363	2-(Diethylamino)ethylamine	25	10 02	7 07	417	*n*-Pentylamine	25	10 63	
364	1-Methylpiperidine	25	10 08		418	*n*-Undecylamine (*n*-Hendecylamine)	25	10 63	
365	Dimethyl isobutyl amine	20	10 08		419	*n*-Nonylamine	25	10 64	
366	5,5,5-Trichloro-*n*-pentylamine	20	10 12		420	Acridine	25	10 65	
367	2-(Methylamino)ethylamine	20	10 15	6 86	421	*n*-Octylamine	25	10 65	
368	*cis*-1,2,6-Trimethylpiperidine	30	10 15		422	Methylamine	25	10 657	
369	2,2-Dimethyl-*n*-propylamine	25	10 15		423	1-Ethyl-2-methylpiperidine	25	10 66	
370	1,2-Bis(methylamino)ethane	25	10 16	7 40	424	*n*-Heptylamine	25	10 66	
371	Dimethyl propyl amine	20	10 16		425	2-Aminoheptane	25	10 67	
372	Dimethyl ethyl amine	20	10 16		426	Cyclohexylamine	25	10 68	
373	*trans*-Bornylamine	25	10 17		427	*tert*-Butylamine	25	10 68	
374	1,2,2,4-Tetramethylpiperidine	30	10 18		428	*tert*-Butyl dimethyl amine	20	10 69	
375	*n*-Butyl dimethyl amine	25	10 19		429	*n*-Propylamine	25	10 69	
376	1,2-Dimethylpyrrolidine	26	10 20		430	1,2,2,6-Tetramethylpiperidine	30	10 70	
377	1,2-Dimethylpiperidine	25	10 22		431	Ethylamine	25	10 70	
378	1,5-Diaminopentane	25	10 25	9 13	432	Isobutylamine	25	10 72	
379	Tri-*n*-propylamine	25	10 26		433	3-(Trimethylsilyl)-*n*-propylamine	25	10 73	
380	1,2-Bis(propylamino)ethane	25	10 27	7 53	434	Dimethylamine	25	10 73	
381	2-(Butylamino)ethylamine	25	10 30	7 53	435	Triethylamine	25	10 75	
382	1,3-Diaminopropane (1,3-Propylenediamine)	25	10 30	8 29	436	2-Cyclohexylpyrrolidine	25	10 76	
					437	1,4-Diaminobutane	20	10 80	9 35
383	2-Benzylpyrrolidine	25	10 31		438	Di-isobutylamine	21	10 91	
384	Tri-isobutylamine	25	10 32		439	1,6-Diaminohexane	25	10 93	9 83
385	N-Methylpyrrolidine	25	10 32		440	Di-isoamylamine	27 8	10 94	
386	2-(propylamino)ethylamine	25	10 34	7 54	441	Quinuclidine	25	10 95	
387	4-Hydroxy-*n*-butylamine	20	10 35		442	2-Methylpiperidine	25	10 95	
388	1,2-Bis(isopropylamino)ethane	25	10 40	7 59	443	2-(Trimethylsilyl)ethylamine	25	10 97	
389	1-*n*-Propylpiperidine	26 5	10 41		444	Di-*n*-tridecylamine	25	11 00	
390	3-Aminopentane	25	10 42		445	Di-*n*-octadecylamine	25	11 00	
391	3-Aminocyclohexene	25	10 42		446	1,8-Diaminooctane	20	11 00	10 1
392	1-*n*-Butylpiperidine	26	10 43		447	Di-*n*-propylamine	25	11 00	
393	1-Ethylpiperidine	23	10 45		448	Di-*n*-dodecylamine	25	11 00	
394	1,2-Bis(ethylamino)ethane	25	10 46	7 70	449	Di-*n*-pentadecylamine	25	11 00	
395	Diethyl methyl amine	20	10 46		450	Di-*n*-hexylamine	25	11 01	
396	5-Hydroxy-1-pentylamine	23	10 46		451	Di-*n*-octylamine	25	11 01	
397	Dimethyl isopropyl amine	20	10 47		452	2,2,4-Trimethylpiperidine	30	11 04	
398	*trans*-1-Amino-4-methylcyclohexane	25	10 48		453	Cyclohexyl methyl amine	25	11 04	
399	(Aminomethyl)cyclohexane	25	10 49		454	Diethylamine	25	11 04	
400	*cis*-1-Amino-2-methylcyclohexane	25	10 49		455	2,2,6,6-Tetramethylpiperidine	25	11 07	
401	2-Aminooctane	25	10 49		456	Azepine	25	11 07	
402	*trans*-1-Amino-2-methylcyclohexane	25	10 51		457	*cis*-2,6-Dimethylpiperidine	25	11 07	
403	*cis*-1-Amino-3-methylcyclohexane	25	10 56		458	3-Methylpiperidine	25	11 07	
404	2-(Ethylamino)ethylamine	25	10 56	7 63	459	Piperidine	25	11 123	
405	Dimethyl *sec*-butyl amine	20	10 57		460	Di-isopropylamine	21	11 13	
406	6-Hydroxy-*n*-hexylamine	21	10 60		461	Di-*n*-pentylamine	26	11 16	
407	6-Bromo-*n*-hexylamine	21	10 60		462	2,2,6-Trimethylpiperidine	30	11 21	
408	1-Aminoheptadecane	25	10 60		463	(*tert*-Butylamino)cyclohexane	25	11 23	
409	1-Aminodocosane	25	10 60		464	Di-*n*-butylamine	25	11 25	
410	1-Aminooctadecane	25	10 60		465	1,2,2,4,4-Pentamethylpiperidine	25	11 25	
411	1-Aminopentadecane	25	10 61		466	Pyrrolidine	25	11 27	
412	*n*-Butylamine	25	10 61		467	Azetidine	25	11 29	
413	1-Aminohexadecane	25	10 61		468	Isopropylamine	25	11 54, (10 63)	
414	*trans*-1-Amino-3-methylcyclohexane	25	10 61						
415	1-Aminotetradecane	25	10 62		469	1,2-Dimethyl-2-pyrroline	25	11 90	
416	2-(Isopropylamino)ethylamine	25	10 62	7 70	470	Acetamidine (Methylamidine)	25	12 40	



INFRARED CORRELATION CHART No. 1 (Con't.)

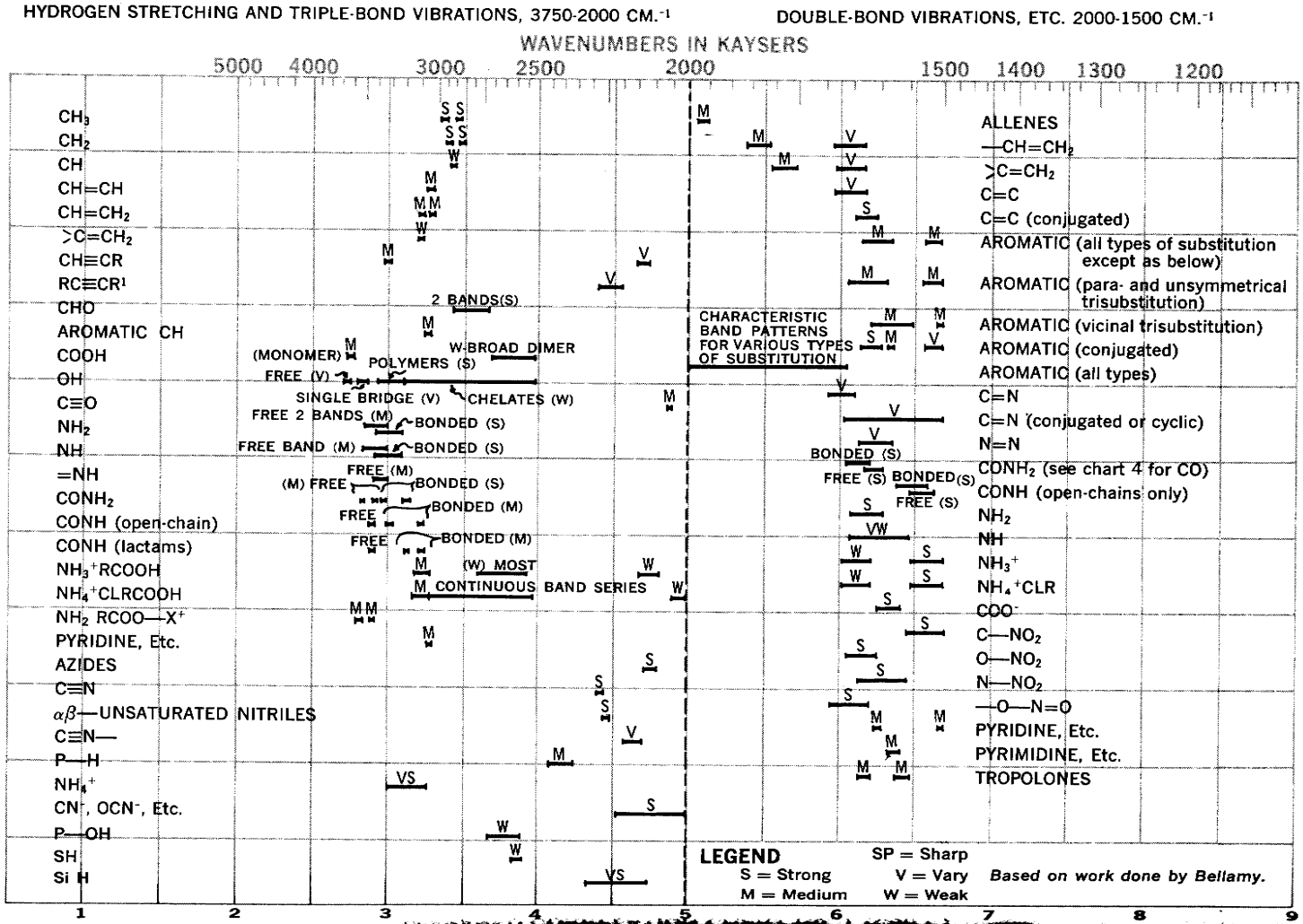



WAVENUMBERS IN KAYSERS
4000
3000
2500
2000
1500
1400
1300
1200
1100
1000
900
800
700
650
MISCELLANEOUS
X=C=X (ISOCYANATES)
1—2 DIENOID ETC.)
STRAINED RING C=O (β LACTAMS)
CHLOROCARBONATE C=O
ACID CHLORIDE C=O
EPOXY RING
SULFUR GROUPS
SH
PHOSPHORUS
PH
SILICON
SiH
FLUORINE
CHLORINE
BROMINE
C=S
P=O
Si—CH3
CF2 AND CF3
C—F (UNSAT.)
C—F (SAT.)
CH2—O—(Si, P, OR S)
SH
CH2—S—CH3
P2S
Si—C
CCl2 AND CCl3
CCl (ALIPH.)
CBr2 AND CBr3
CBr (ALIPH.)
SULFUR
OXYGEN
COMPOUNDS
IONIC SULFATE (SO4)=
IONIC SULFONATE R—SO3
SULFONIC ACID R—SO3H
COVALENT SULFATE R—O—SO2—O—R
COVALENT SULFONATE R—O—SO2—R
SULFONAMIDE R—SO2—NH2
SULFONE R—SO2—R
SULFOXIDE R—SO—R
PHOSPHORUS
OXYGEN
IONIC PHOSPHATE (PO4)≡
COVALENT PHOSPHATE ≡(R—O)3P→O
CH2—O—P→O
C—O—P→O
CARBON
OXYGEN
IONIC CARBONATE (CO3)=
COVALENT CARBONATE O=C (O—R)2
IMINO CARBONATE HN=C (O—R)2
NITROGEN
OXYGEN
IONIC NITRATE (NO3)−
COVALENT NITRATE R—O—NO2
NITRO R—NO2 UNCONJ.
CONJ.
COVALENT NITRITE R—O—NO
NITROSO R—NO
AMMONIUM (NH4)+
LEGEND
S = Strong
M = Medium
SP = Sharp
V = Vary
W = Weak
Based on work done by Colthup.
OH AND NH STR.
CH STR.
C≡X STR.
C=O STR.
C=N STR.
C—C STR.
NH BEND
CH BEND
OH BEND
C—O STR.
C—N STR.
C—C STR.
CH ROCK
NH ROCK
ASSIGNMENTS
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
WAVELENGTH IN MICRONS

INFRARED CORRELATION CHART No. 2

Prepared from information supplied by Beckman Instruments

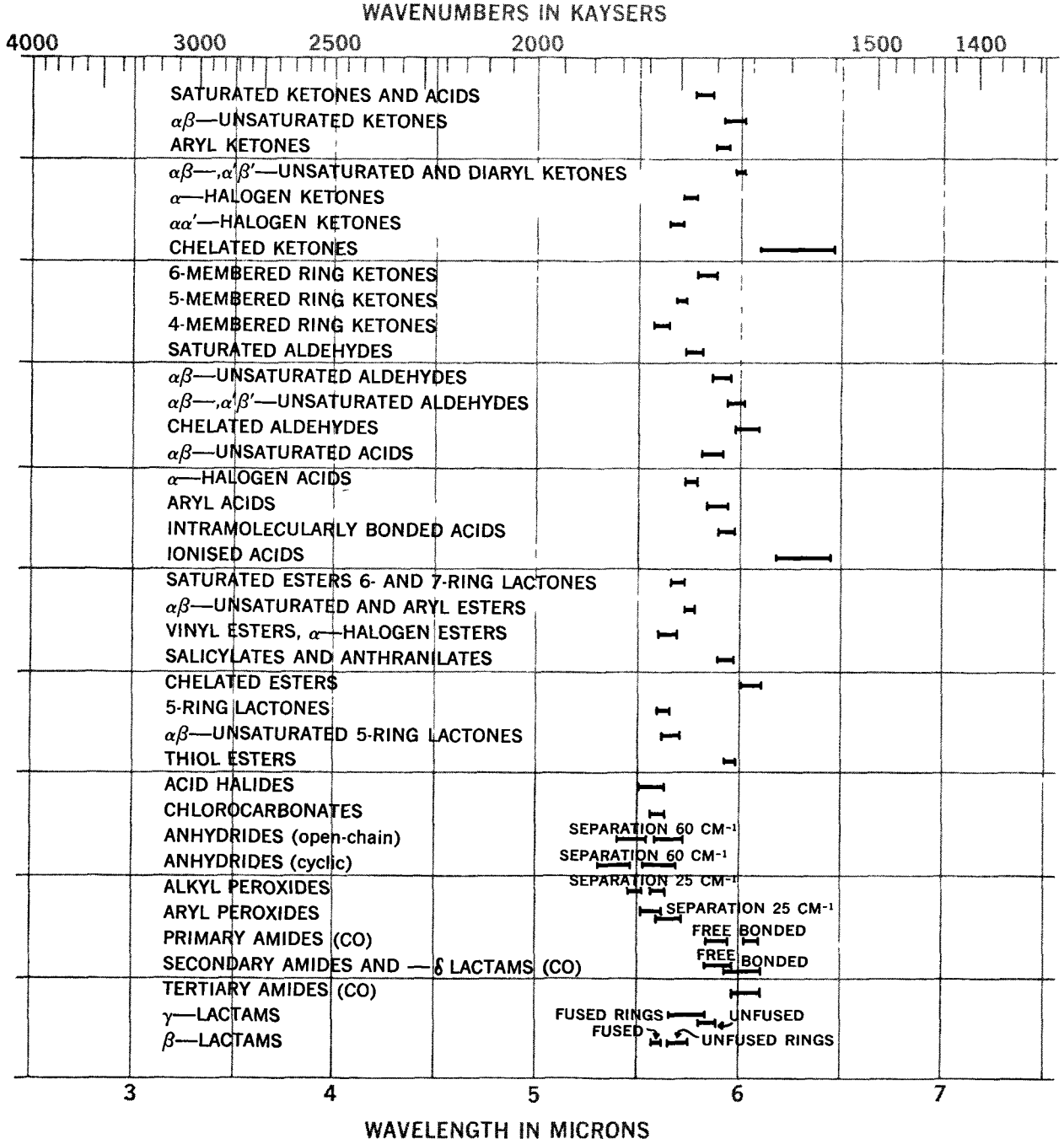
This chart presents some information regarding structure, double-bond vibrations, hydrogen stretching and triple-bond vibrations.



INFRARED CORRELATION CHART No. 3

Prepared from information supplied by Beckman Instruments

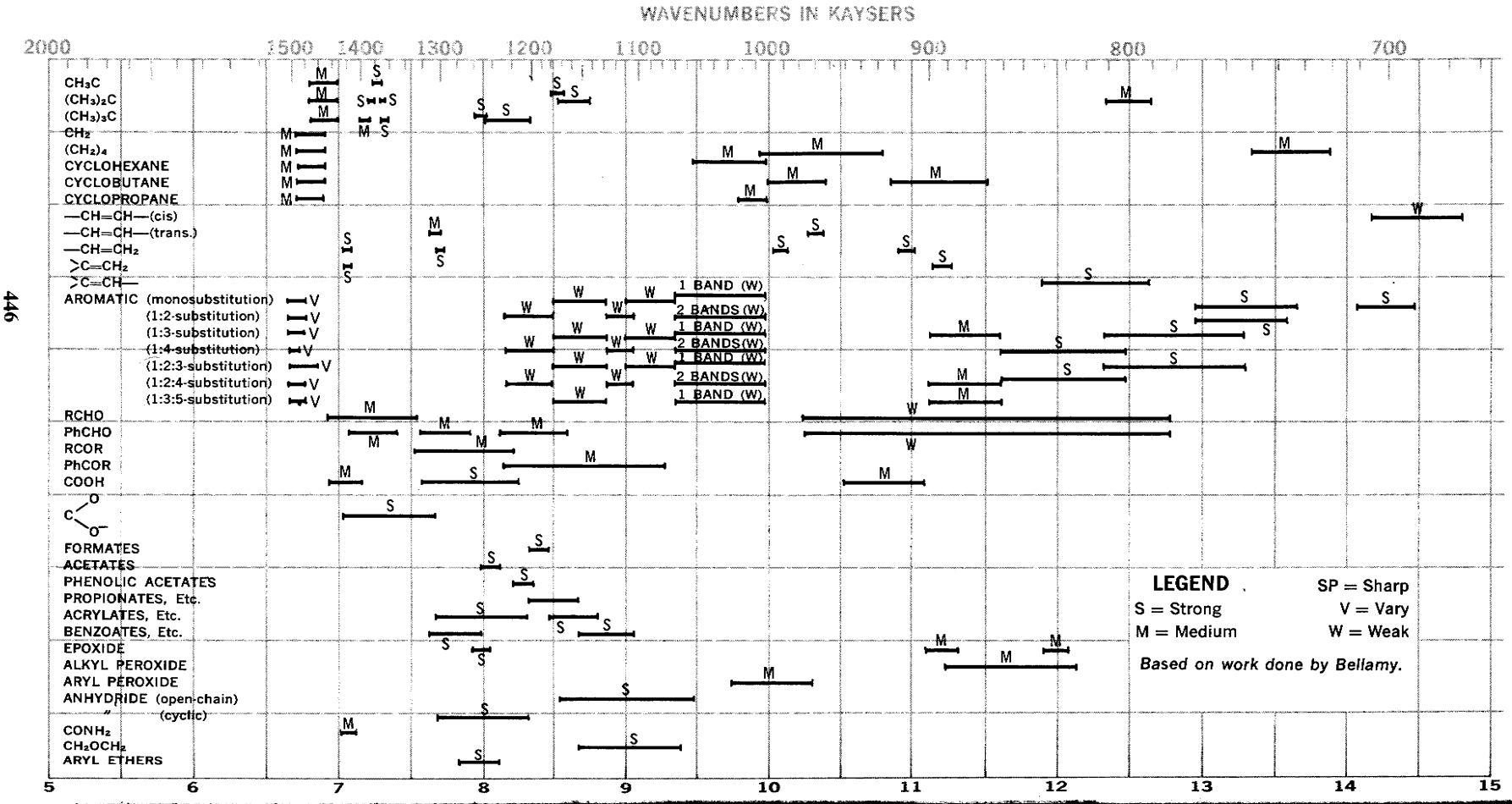
This chart presents some correlations between structure and the carbonyl vibrations of some classes of organic compounds. In all cases the absorption bands are strong and fall within the range of 1900-1500 cm^{-1}.



INFRARED CORRELATION CHART No. 4

Prepared from information supplied by Beckman Instruments

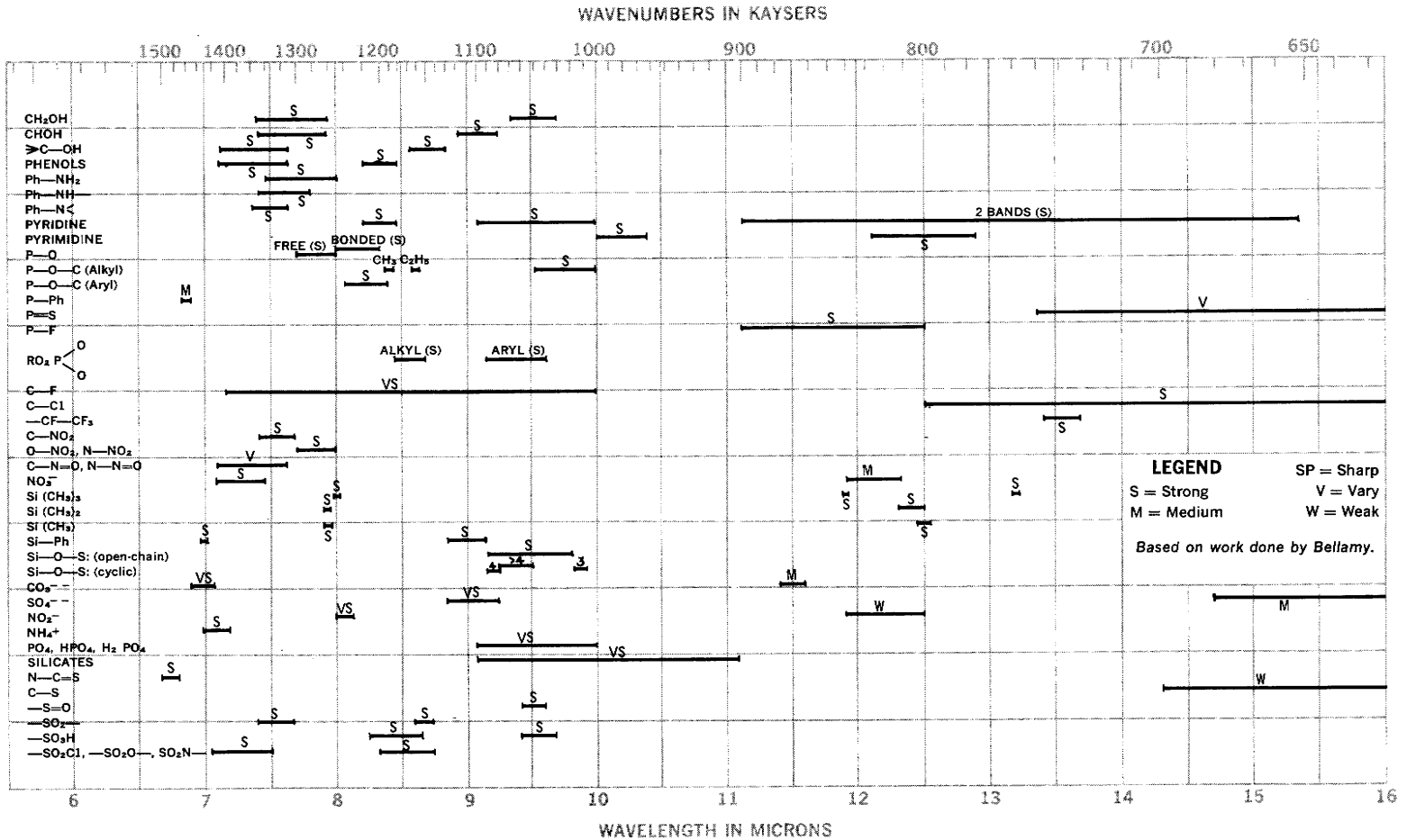
This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650 cm^{-1}.



INFRARED CORRELATION CHART No. 4 (Con't.)

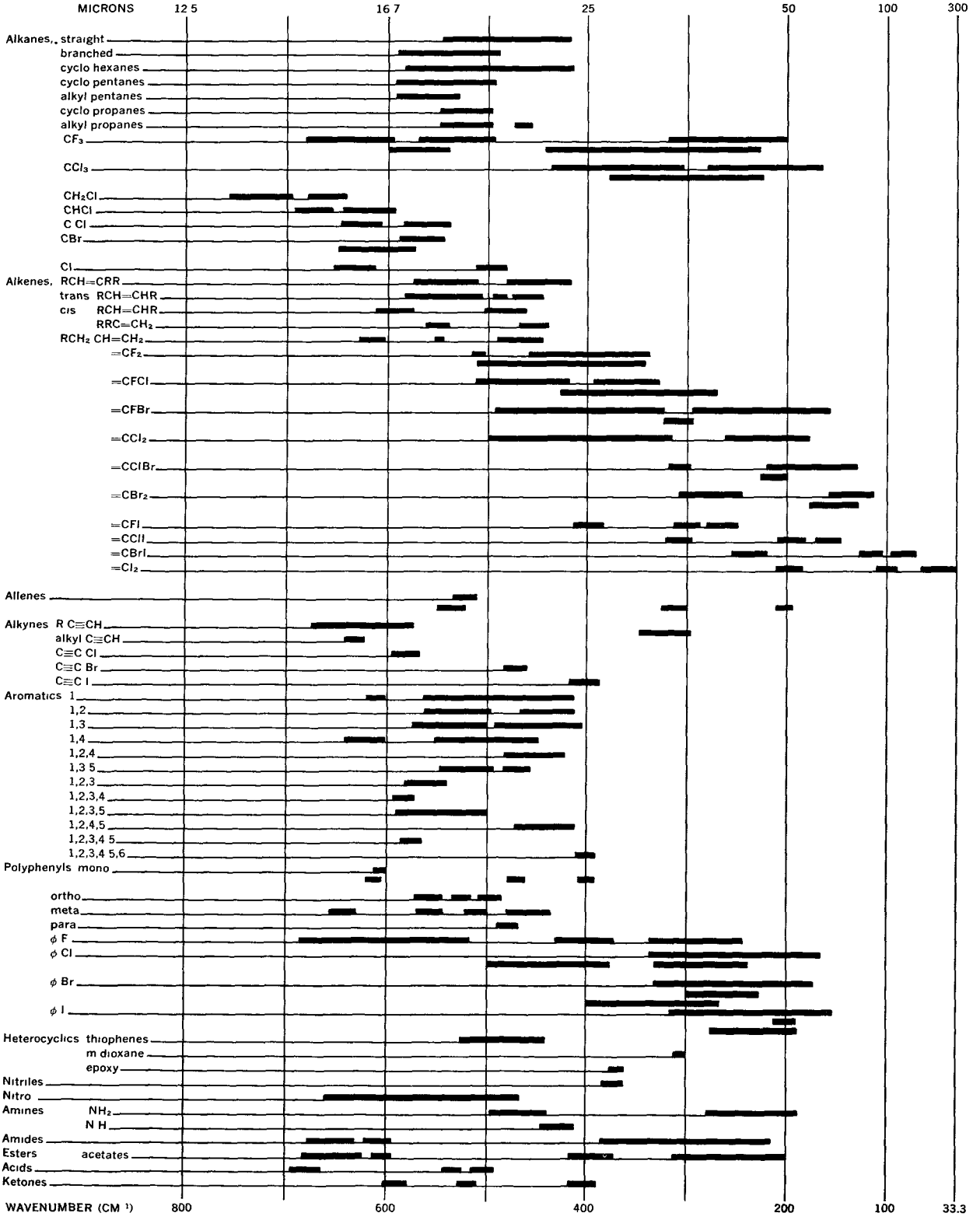
Prepared from information supplied by Beckman Instruments

This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650 cm^{-1}.

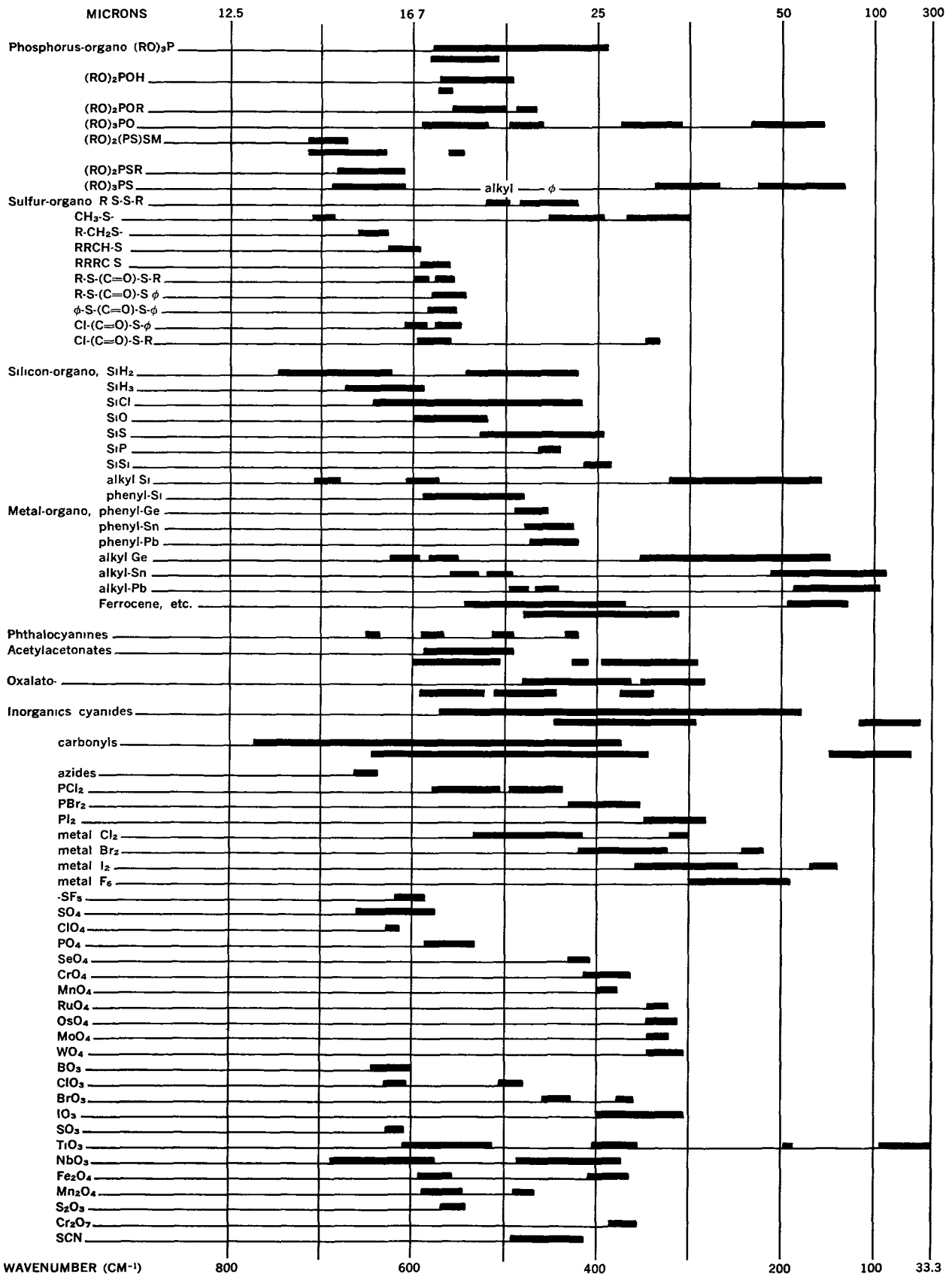


FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART

Based on evidence compiled by James E. Stewart of Beckman Instruments.
This chart shows the vibrational frequency correlation in the far infrared region. Because research is continuing in the far infrared region, this chart is not all-inclusive.



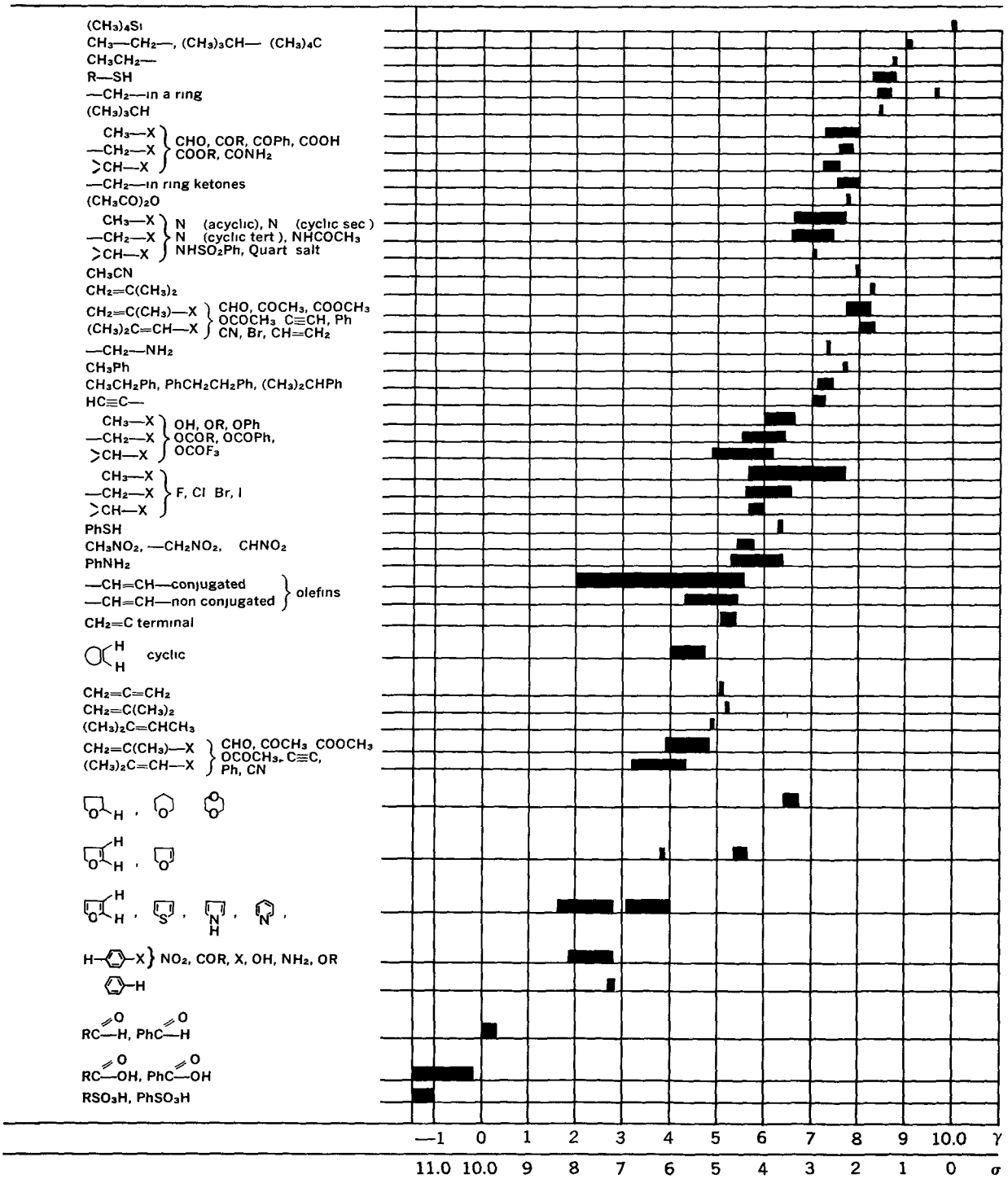
FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART (Con't.)



CHARACTERISTIC NMR SPECTRAL POSITIONS FOR HYDROGEN IN ORGANIC STRUCTURES

By permission from Erno Mohacsi, J. of Chemical Education, 41, 38 (1964)

This table is useful for quick qualitative determination of proton spectrum lines by providing a tabulation of line positions obtained using tetramethylsilane as an internal reference. The listing has been kept as simple as possible for this purpose. The proton spectrum lines are arranged according to the chemical shift relative to tetramethylsilane and are given in values of τ and σ. The purpose of this table is to supplement tables available in standard references and to summarize information available in the literature.



MISCIBILITY OF ORGANIC SOLVENT PAIRS

Table A

Doctor J. S. Drury

Industrial and Engineering Chemistry Vol. 44, No. 11, Nov. 1952

(Reprinted by permission)

The classifications were made by shaking together 5 ml. of each of the solvents listed in a test table for 1 minute, then allowing the mixture to settle. If no interfacial meniscus was observed, the solvent pair was considered miscible. If such a meniscus was present, the solvent pair was regarded as immiscible. The classification of immiscible is a qualitative one since solvent pairs may exhibit some degree of partial miscibility while existing as separate phases. Solvent pairs possessing a pronounced degree of partial miscibility are designated by the symbol Is.

Compound number	Compounds	Acetone	Acetyl acetone	2-Amino-2-methyl-1-propanol	Aniline	Benzaldehyde	Benzene	Benzin	Benzyl alcohol	Butyl acetate	Butyl alcohol	*n*-Butyl ether	Capryl alcohol	Carbon tetrachloride	Diacetone alcohol	Diethanolamine	Diethyl cellosolve	Diethyl ether	Dimethylaniline	Ethyl alcohol	Ethyl benzoate	Ethylene glycol	2-Ethylhexanol	Formamide	Furfuryl alcohol	Glycerol	Hydroxyethylethylenediamine	Isoamyl alcohol	Methyl isobutyl ketone	Nitromethane	Dibutoxytetraethylene glycol	Pyridine	Triethanolamine	Trimethylene glycol
1	Acetone	. .	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	. .	M
2	Acetyl acetone	M	. .	R	. .	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	I	R	M	M	M	M	M	. .	M
3	Adiponitrile	M	M	M	M	. .	M	. .	M	M	M	I	. .	I	M	. .	M	I	M	M	M	I	I	M	M	I	M	I	M	. .	M	M	M	M
4	2-Amino-2-methyl-1-propanol	M	R	. .	. .	M	M	I	M	M	M	Is	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M
5	Benzaldehyde	M	M	M	. .	. .	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	Is	M	M	M	Is	R	M	M	M	M	M	. .	M
6	Benzene	M	M	M	. .	M	. .	M	M	M	M	M	M	M	Is	I	M	M	M	M	M	I	M	I	M	I	I	M	M	I	M	M	. .	I
7	Benzin	M	M	I	. .	M	M	. .	I	M	M	M	M	M	I	I	M	M	M	M	M	M	M	I	I	I	Is	M	M	M	M	M	. .	I
8	Benzonitrile	M	M	M	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	I	M	I	M	I	M	M	M	. .	M	M	M	I
9	Benzothiazole	M	M	M	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	M	M	I	M	I	M	M	M	. .	M	M	M	M
10	Benzyl alcohol	M	M	M	. .	M	M	I	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M
11	Benzyl mercaptan	M	M	I	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	I	M	I	M	I	M	M	M	. .	M	M	R	I
12	Butyl acetate	M	M	M	. .	M	M	M	M	. .	M	M	M	M	M	I	M	M	M	M	M	Is	M	I	M	I	I	M	M	M	M	M	. .	Is
13	Butyl alcohol	M	M	M	. .	M	M	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M
14	*n*-Butyl ether	M	M	Is	. .	M	M	M	M	M	M	. .	M	M	M	I	M	M	M	M	M	I	M	I	M	I	I	M	M	I	M	M	. .	I
15	Capryl alcohol	M	M	M	. .	M	M	M	M	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	I	M	I	M	M	M	Is	M	M	. .	M
16	Carbon tetrachloride	M	M	M	. .	M	M	M	M	M	M	M	M	. .	Is	I	M	M	M	M	M	I	M	I	M	I	I	M	M	M	M	M	. .	I
17	Diacetone alcohol	M	M	R	. .	M	Is	I	M	M	M	M	M	Is	. .	M	M	M	M	M	M	M	M	M	M	I	R	M	M	M	M	M	. .	M
18	Diethanolamine	M	R	M	. .	I	I	I	M	I	M	I	M	I	M	. .	I	I	Is	M	M	M	M	M	M	M	M	M	I	I	I	M	. .	M
19	Diethyl Cellosolve	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	I	. .	M	M	M	M	M	M	M	M	I	I	M	M	M	M	M	. .	M
20	Diethyl ether	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	I	M	. .	M	M	M	I	M	I	M	I	I	M	M	M	M	M	. .	I
21	Dimethylaniline	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	Is	M	M	. .	M	M	I	M	I	M	I	I	M	M	M	M	M	. .	I
22	Di-*N*-propylaniline	M	M	I	M	. .	M	. .	M	M	M	M	. .	M	I	. .	M	M	M	M	M	I	M	I	M	I	I	M	M	. .	M	M	I	I
23	Ethyl alcohol	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M
24	Ethyl benzoate	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	I	M	I	M	I	M	M	M	M	M	M	. .	Is
25	Ethyl isothiocyanate	M	M	R	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	I	M	I	M	I	R	M	M	. .	M	M	M	I
26	Ethyl thiocyanate	M	M	M	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	I	M	I	M	I	M	M	M	. .	M	M	M	I
27	Ethylene glycol	M	M	M	. .	Is	I	M	M	Is	M	I	M	I	M	M	M	I	I	M	I	. .	M	M	M	M	M	M	I	I	M	M	. .	M
28	2-Ethylhexanol	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	I	M	I	M	M	M	I	M	M	. .	M
29	Formamide	M	M	M	. .	M	I	I	M	I	M	I	I	I	M	M	M	I	I	M	I	M	I	. .	M	M	M	M	Is	M	M	M	. .	M
30	Furfuryl alcohol	M	M	M	. .	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M	M	M	M	M	M	M	. .	M
31	Glycerol	I	I	M	. .	I	I	I	M	I	M	I	I	I	I	M	I	I	I	M	I	M	I	M	M	. .	M	I	I	I	I	M	. .	M
32	Hydroxyethylethylenediamine	M	R	M	. .	R	I	Is	M	I	M	I	M	I	R	M	I	I	I	M	M	M	M	M	M	M	. .	M	M	M	M	M	. .	M
33	Isoamyl alcohol	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	. .	M	M	M	M	. .	M
34	Isoamyl sulfide	M	M	I	M	. .	M	. .	M	M	M	M	. .	M	I	. .	M	M	M	M	M	I	M	I	I	I	I	M	M	. .	M	M	I	I
35	Isobutyl mercaptan	M	M	M	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	I	M	I	M	I	I	M	M	. .	M	M	R	R
36	Methyl disulfide	M	M	M	M	. .	M	. .	M	M	M	M	. .	M	M	. .	M	M	M	M	M	I	M	I	M	I	I	M	M	. .	M	M	I	R
37	Methyl isobutyl ketone	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	I	M	Is	M	I	M	M	. .	M	M	M	. .	I
38	Nitromethane	M	M	M	. .	M	I	M	M	M	M	I	Is	M	M	I	M	M	M	M	M	I	I	M	M	I	M	M	M	. .	M	M	. .	I
39	Dibutoxytetraethylene glycol	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	I	M	M	M	M	. .	M	. .	M
40	Pyridine	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	. .	M
41	Tri-*n*-butylamine	M	M	I	I	. .	M	. .	M	M	M	M	. .	M	I	. .	M	M	M	M	M	I	M	I	M	I	I	M	M	. .	M	M	I	I
42	Trimethylene glycol	M	M	M	. .	M	I	I	M	Is	M	I	M	I	M	M	M	I	I	M	Is	M	M	M	M	M	M	I	I	M	M	. .	. .

MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)

Tables B and C

W. M. Jackson and J. S. Drury

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The classifications were made at 20°C in the following manner. One-milliliter portions of each solvent comprising a pair were shaken together for approximately a minute. If no interfacial meniscus was observed after the contents of the tube were allowed to settle, the solvent pair was considered to be miscible, M. If a meniscus was observed without apparent change in the volume of either solvent, the pair was regarded as immiscible, I. This classification is a qualitative one since solvent pairs may exhibit various degrees of partial miscibility while existing as separate phases. If an obvious change occurred in the volume of each solvent but a meniscus was present, the pair was classified as partially miscible, S. The designation R indicates that the two solvents reacted.

Table B

Compound number	Compounds	Acetone	Isoamyl acetate	*n*-Amyl cyanide	Benzene	Benzyl ether	2-Bromoethyl acetate	Chloroform	Cinnamaldehyde	Di-*n*-amylamine	Di-*n* butyl carbonate	Diethylacetic acid	Diethylenetriamine	Diethyl formamide	Diisobutyl ketone	Diisopropylamine	Di-*n*-propyl aniline	Ethyl alcohol	Ethyl benzoate	Ethyl ether	Ethyl phenylacetate	Heptadecanol[a]	3-Heptanol	*n*-Heptyl acetate	*n*-Hexyl ether	Methyl isopropyl ketone	4-Methyl *n*-valeric acid	*o*-Phenetidine	Sulfuric acid (concd.)	Tetradecanol[a]	Tri-*n*-butyl phosphate	Triethylene glycol	Triethylenetetramine	2,6,8-Trimethyl 4-nonanone	Compound number
1	Acetone		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	1
2	Isoamyl acetate	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	I	M	M	2
3	*n*-Amyl cyanide	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	3
4	Benzene	M	M	M		M	S	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	S	M	M	4
5	Benzyl ether	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	I	M	M	5
6	2-Bromoethyl acetate	M	M	M	S	M		M	M	R	M	M	R	R	M	R	M	M	M	M	M	M	M	M	S	M	M	M	R	M	M	M	R	M	M	6
7	Chloroform	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	R	M	M	7
8	Cinnamaldehyde	M	M	M	M	M	M	M		M	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	R	M	M	M	R	M	M	8
9	Di-*n*-amylamine	M	M	M	M	M	R	M	M		M	R	I	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	S	I	M	M	9
10	Di-*n*-butyl carbonate	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	I	I	M	M	10
11	Diethylacetic acid	M	M	M	M	M	M	M	M	R	M		R	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	R	M	M	11
12	Diethylenetriamine	M	M	M	M	M	R	M	M	R	I	M	R		R	M	M	M	M	M	M	M	M	R	I	R	R	M	R	M	M	M	M	I	M	12
13	Diethyl formamide	M	M	M	M	M	R	M	M	R	M	M	M	R		M	M	M	M	M	M	M	M	M	I	M	M	M	R	M	M	M	R	M	M	13
14	Diisobutyl ketone	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	I	M	M	M	14
15	Diisopropylamine	M	M	M	M	M	R	M	M	M	M	R	M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	15
16	Di-*n*-propylaniline	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	I	M	M	M	16
17	Ethyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	17
18	Ethyl benzoate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	18
19	Ethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	M	R	M	M	I	M	M	M	19
20	Ethyl phenylacetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	M	R	M	M	M	M	M	M	20
21	Heptadecanol[a]	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	M	R	M	M	I	M	M	M	21
22	3-Heptanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		M	M	M	M	M	R	M	M	M	M	M	M	22
23	*n*-Heptyl acetate	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	M		M	M	M	M	R	M	M	I	R	M	M	23
24	*n*-Hexyl ether	M	M	M	M	M	S	M	M	M	M	M	I	I	M	M	M	M	M	M	M	M	M	M		M	M	M	R	M	M	I	I	M	M	24
25	Methyl isopropyl ketone	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M		M	M	R	M	M	M	R	M	M	25
26	4-Methyl-*n*-valeric acid	M	M	M	M	M	M	M	M	M	M	M	R	M	M	R	M	M	M	M	M	M	M	M	M	M		M	R	M	M	M	R	M	M	26
27	*o*-Phenetidine	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		R	M	M	M	M	M	M	27
28	Sulfuric acid (concd.)	R	R	R	I	R	R	I	R	R	R	R	R	R	R	R	R	M	M	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	28
29	Tetradecanol[a]	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R		M	I	M	M	M	29
30	Tri-*n*-butyl phosphate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M		M	M	M	M	30
31	Triethylene glycol	M	I	M	S	I	M	M	M	S	I	M	M	M	I	M	I	M	M	I	M	I	M	I	I	M	M	M	R	I	M		M	I	I	31
32	Triethylenetetramine	M	M	M	M	M	R	M	R	I	I	R	M	R	M	M	M	M	M	M	M	M	M	R	I	R	R	M	R	M	M	M		I		32
33	2,6,8-Trimethyl 4-nonanone	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	I	I			33

[a] Union Carbide name.

MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)

Table C

Compound number	Compounds	Acetone	Isoamyl acetate	n-Amyl cyanide	Anisaldehyde	Benzene	Benzyl ether	Chloroform	o-Cresol	Diisobutyl ketone	Diethylacetic acid	Diethyl formamide	Di-n-propyl aniline	Ethyl alcohol	Ethyl ether	3-Heptanol	n-Heptyl acetate	n-Hexyl ether	α-Methylbenzylamine	α-Methylbenzyldiethanolamine	α-Methylbenzyldimethylamine	α-Methylbenzylethanolamine	2-Methyl-5-ethylpyridine	Methyl isopropyl ketone	4-Methyl-n-valeric acid	o-Phenetidine	2-Phenylethylamine	Isopropanolamine	Pyridine	Salicylaldehyde	Tetradecanol[a]	Tri-n-butyl phosphate	Triethylenetetramine	2,6,8-Trimethyl 4-nonanone
1	1,3-Butylene glycol	M	I	M	I	I	I	M	M	I	M	M	I	M	S	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I
2	2,3-Butylene glycol	M	M	M	M	S	I	M	M	M	M	M	I	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I
3	2-Chloroethanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	R	M	M	M	R	R	M	M	M	M	M	M	M
4	3-Chloro-1,2-propanediol	M	M	M	M	I	M	M	M	M	M	M	I	M	M	M	M	I	R	M	M	M	M	M	M	M	R	R	M	M	S	M	R	S
5	Dibutyl hydrogen phosphite	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
6	Diethylene glycol dibutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	S	M	M	M	M	M	R	R	M	M	M	M	R	M	M
7	Diethylene glycol diethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
8	Diethylene glycol monobutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
9	Diethylene glycol monoethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
10	Diethylene glycol monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
11	Dipropylene glycol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
12	Ethylene diacetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
13	Ethylene glycol	M	I	I	I	I	I	S	M	I	M	M	I	M	I	M	I	I	M	M	M	M	I	M	M	M	M	M	I	I	S	M	I	
14	Ethyl glycol ethylbutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
15	Ethylene glycol monobutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
16	Ethylene glycol monoethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
17	Ethylene glycol monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
18	Ethylene glycol monophenyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
19	Glycerol	I	I	I	I	I	I	I	M	I	I	M	I	M	I	I	I	I	M	M	I	M	M	I	I	I	M	M	M	I	I	I	M	I
20	1,2-Propanediol	M	M	M	M	I	I	M	M	I	M	M	I	M	S	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I
21	1,3-Propanediol	M	I	I	I	I	I	M	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	M	M	M	M	M	M	I	S	M	M	I
22	Triethylene glycol	M	I	M	M	S	I	M	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	I
23	Triethyl phosphate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
24	Trimethylene chlorohydrin	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	R	M	M	M	R	R	M	M	M	M	R	M	

[a] Union Carbide name.

EMERGENT STEM CORRECTION FOR LIQUID-IN-GLASS THERMOMETERS

Accurate thermometers are calibrated with the entire stem immersed in the bath which determines the temperature of the thermometer bulb. However, for reasons of convenience it is common practice when using a thermometer to permit its stem to extend out of the apparatus. Under these conditions both the stem and the mercury in the exposed stem are at a temperature different from that of the bulb. This introduces an error into the observed temperature. Since the coefficient of thermal expansion of glass is less than that of mercury, the observed temperature will be less than the true temperature if the bulb is hotter than the stem and greater than the true temperature, providing the thermal gradient is reversed. For exact work the magnitude of this error can only be determined by experiment. However, for most purposes it is sufficiently accurate to apply the following equation which takes into account the difference of the thermal expansion of glass and mercury:

$$T_c = T_o + F \times L(T_o - T_m)$$

Where T_c = corrected temperature

T_o = observed temperature

T_m = mean temperature of exposed stem. The mean temperature of the exposed stem may be determined by fastening the bulb of a second thermometer against the midpoint of the exposed liquid column.

L = the length of the exposed column in degrees above the surface of the substance whose temperature is being determined.

F = correction factor. For approximate work and when the liquid in the thermometer is mercury a value for F of 0.00016 is generally used. For more accurate work with mercury filled thermometers values as given in the following table are used. For thermometers filled with organic liquids it is customary to use 0.001 for the value of F.

Values of F for various glasses

Tm°C.	Corning 0041	Corning 8800	Corning 8810	Jena 16 III	Jena 59 III
50	0.000157	0.000166	0.000156	0.000158	0.000164
150	0.000159	0.000167	0.000157	0.000158	0.000165
250	0.000163	0.000168	0.000161	0.000161	0.000170
350	0.000168	0.000173	0.000166	.....	0.000177

CORRECTION OF BOILING POINTS TO STANDARD PRESSURE

By H. B. Hass and R. F. Newton

This correction may be made by using the equation:

$$\Delta t = \frac{(273.1 + t)(2.8808 - \log p)}{\phi + .15(2.8808 - \log p)} \tag{1}$$

where Δt = degrees C to be added to the observed boiling point.
t = the observed boiling point.
$\log p$ = the logarithm of the observed pressure in millimeters of mercury.
ϕ = the entropy of vaporization at 760 mm.

The value of ϕ may be estimated from the graph and the table. Substances not included in the table may be classified by grouping them with compounds which bear a close physical or structural resemblance to them.

Example 1. Benzene boils at 20°C. at 75 mm pressure. What is its normal boiling point? We do not find benzene in the table but we find hydrocarbons in group 2, and a group 2 compound with a boiling point of 20° has a ϕ of 4.6.

Substituting in the equation

$$\Delta t = \frac{(273.1 + 20)(2.8808 - 1.8751)}{4.60 + .15(2.8808 - 1.8751)} = 62°$$

Adding this to 20° gives 82° as a first approximation.

The graph shows that the ϕ for a compound of group 2 boiling at 82° is 4.72 instead of 4.60 which we originally used. Since ϕ is in the denominator, this increase will lower our Δt by the ratio, 4.60/4.72, or the corrected Δt is $62 \times 4.60/4.72 = 60.4$. Adding Δt to t, gives 80.4° as a second approximation.

The formula can best be used in a slightly different form when the reverse calculation is desired, *i.e.*, when one calculates the vapor pressure at a given temperature, lower than the normal boiling point.

$$2.8808 - \log p = \frac{\phi \Delta t}{273.1 + t - .15\Delta t} \tag{2}$$

Example 2. Alcohol boils at 78.4°C. What is its vapor pressure at 20°C.? Substituting in equation 2:

$$2.8808 - \log p = \frac{6.06 \times 58.4}{293.1 - (.15 \times 58.4)} = 1.245$$

$$\log p = 2.8808 - 1.245 = 1.6358$$

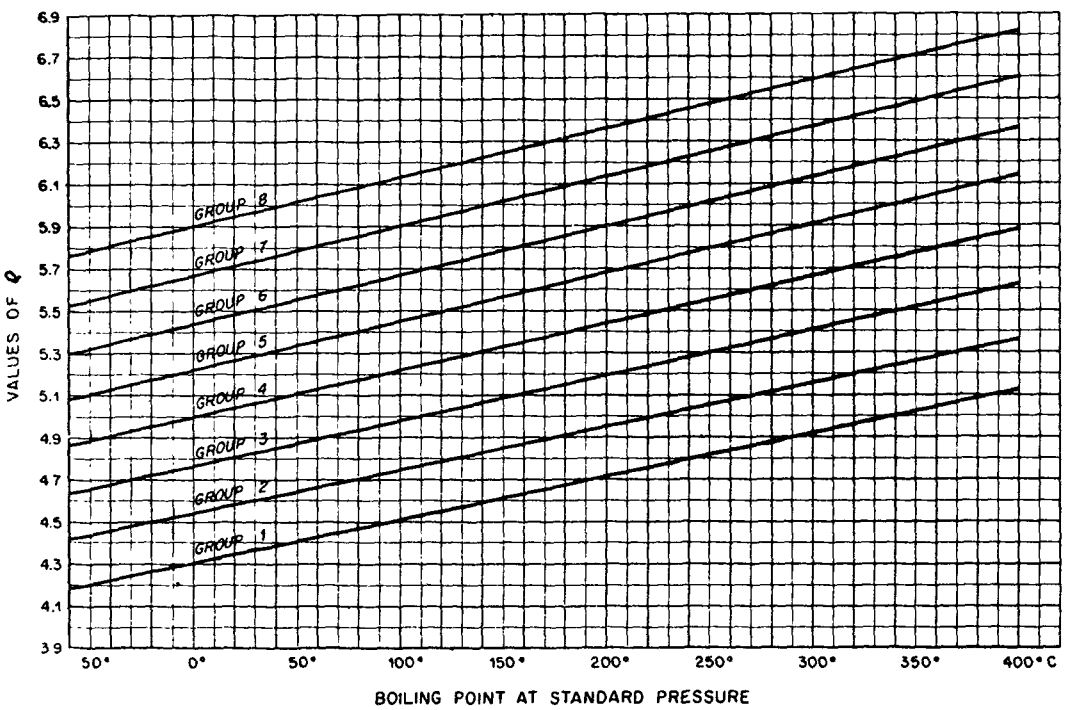
$$p = 43.2 \text{ mm.}$$

Here no second approximation is necessary, since the correct value of ϕ was taken immediately, the normal boiling point having been known.

Compound	Group	Compound	Group
Acetaldehyde	3	Benzyl alcohol	5
Acetic acid	4	Butylethylene	1
Acetic anhydride	6	Butyric acid	7
Acetone	3	Camphor	2
Acetophenone	4	Carbon monoxide	1
Amines	3	Carbon oxysulfide	2
n-Amyl alcohol	8	Carbon suboxide	2
Anthracene	1	Carbon sulfoselenide	2
Anthraquinone	1	*m.p.* Chloroanilines	3
Benzaldehyde	2	Chlorinated derivatives	Same group as though Cl was H
Benzoic acid	5		
Benzonitrile	2	*o.m.p.* Cresols	4
Benzophenone	2	Cyanogen	4

CORRECTION OF BOILING POINTS (Continued)

Compound	Group	Compound	Group
Cyanogen chloride	3	Methyl benzoate	3
Dibenzyl ketone	2	Methyl ether	3
Dimethyl amine	4	Methyl ethyl ether	3
Dimethyl oxalate	4	Methyl ethyl ketone	2
Dimethyl silicane	2	Methyl fluoride	3
Esters	3	Methyl formate	4
Ethanol	8	Methyl salicylate	2
Ethers	2	Methyl silicane	1
Ethylamine	4	α,β Naphthols	3
Ethylene glycol	7	Nitrobenzene	3
Ethylene oxide	3	Nitromethane	3
Formic acid	3	o.m.p. Nitrotoluenes	2
Glycol diacetate	4	o.m.p. Nitrotoluidines	2
Halogen derivatives	Same group as though halogen were hydrogen.	Phenanthrene	1
		Phenol	5
		Phosgene	2
Heptylic acid	7	Phthalic anhydride	2
Hydrocarbons	2	Propionic acid	5
Hydrogen cyanide	3	*n*-Propyl alcohol	8
Isoamyl alcohol	7	Quinoline	2
Isobutyl alcohol	8	Sulfides	2
Isobutyric acid	6	Tetranitromethane	3
Isocaproic acid	7	Trichloroethylene	1
Methane	1	Valeric acid	7
Methanol	7	Water	6
Methyl amine	5		



MOLECULAR ELEVATION OF THE BOILING POINT

(Most values from Hoyt, C.S. and Fink, C.K., Journal of Physical Chemistry, Vol. 41, No. 3., March, 1937.)
Molecular elevation of the boiling point showing the elevation of the boiling point in degrees C due to the addition of one gram molecular weight of the dissolved substance to 1000 grams of any one of the solvents below. The correction in the last column gives the number of degrees to be subtracted for each mm. of difference between the barometric reading and 760 mm.

Solvent	K_B	Barometric Correction per mm.
Acetic acid	3.07	0.0008
Acetone	1.71	0.0004
Aniline	3.52	0.0009
Benzene	2.53	0.0007
Bromobenzene	6.26	0.0016
Carbon bisulfide	2.34	0.0006
Carbon tetrachloride	5.03	0.0013
Chloroform	3.63	0.0009
Cyclohexane	2.79	0.0007
Ethanol (ethyl alcohol)	1.22	0.0003
Ethyl acetate	2.77	0.0007
Ethyl ether	2.02	0.0005
n-Hexane	2.75	0.0007
Methanol (methyl alcohol)	0.83	0.0002
Methyl acetate	2.15	0.0005
Nitrobenzene	5.24	0.0013
n-Octane	4.02	0.0010
Phenol	3.56	0.0009
Toluene	3.33	0.0008
Water	0.512	0.0001

MOLECULAR DEPRESSION OF THE FREEZING POINT

Showing the depression of the freezing point due to the addition of one gram molecular weight of solute, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C	Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C
Acetic acid	3.90	Diphenyamine	8.60
Acetophenone	5.65	Diphenyl ether	8.00
Aniline	5.87	Ethylene dibromide	11.80
Anthracene	14.65	Ethyl ether	11.79
Anthraquinone	14.80	Formic acid	2.77–2.80
Benzene	4.90–5.23	Hexachlorobenzene	20.75
Benzoic acid	7.85–8.79	Menthol	12.4
Benzophenone	9.88	Naphthalene	6.90–7.10
d-Bromocamphor	11.87	*β*-Naphthol	11.25
Bromoform	14.25	Nitrobenzene	6.89–7.10
tert-Butyl alcohol	12.80	Phenenthrene	12.0
Camphor	49.80	Phenol	7.20–7.50
Carbazole	12.30	Phenylhydrazine	5.86
Carbon disulfide	3.83	Pyridine	4.97
Carbon tetrachloride	29.8–34.8	Stearic acid	4.50
Chloroform	4.67–4.90	Triphenylmethane	12.45
Cyclohexane	20.0–20.30	Urethane	5.00–5.14
Dicyclohexyl	14.50	Water	1.85–1.87
m-Dinitrobenzene	10.60	*p*-Xylene	4.30
Diphenyl	8.00–8.35		

CARBOHYDRATES

These data for carbohydrates were compiled originally for the Biology Data Book by M L Wolfram, G G Maher and R G Pagnucco (1964) Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D C pp 351–359

All data are for crystalline substances, unless otherwise specified Selection of substances was restricted to natural carbohydrates found free (or in chemical combination and released on hydrolysis) and to biological oxidation products of the natural carbohydrates The nomenclature conforms with that of the British-American report as published in the *Journal of Organic Chemistry*, 28 281 (1963) Substances have been arranged alphabetically under the name of the parent sugar within groups formulated according to increasing carbon content (excluding carbon in substituents), with synonymous common names in parentheses **Melting Point:** b p = boiling point, d = decomposes, s = sinters **Specific Rotation** was determined in water at concentrations of 1–5 g per 100 ml of solution and at 20°–25°C, unless otherwise specified, other temperatures or wavelengths are shown in brackets *c* = grams solute per 100 ml of solution

Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Aldoses			
1	D-Glyceraldehyde	$C_3H_6O_3$		+13 5 ± 0 5 (syrup)
2	D-Glyceraldehyde, 3-deoxy-3,3-*C*-bis-(hydroxymethyl)- (Cordycepose)	$C_5H_{10}O_4$		−26 (*c* 0 6, C_2H_5OH
3	D-Glyceraldehyde, 3,3-bis(*C*-hydroxymethyl)- (Apiose)	$C_5H_{10}O_5$		+5 6 (*c* 10) [15°] syrup
4	β-D-Arabinose	$C_5H_{10}O_5$	155	−175 → −103
5	D-Arabinose, 2-*O*-methyl-	$C_6H_{12}O_5$	Syrup	−102
6	α-L-Arabinose	$C_5H_{10}O_5$	158 amorphous	+55 4 → +105
7	β-L-Arabinose	$C_5H_{10}O_5$	160	+190 6 → +104 5
8	DL-Arabinose	$C_5H_{10}O_5$	163 5–164 5	None
9	α-L-Lyxose	$C_5H_{10}O_5$	105	+5 8 → +13 5
10	L-Lyxose, 5-deoxy-3-*C*-formyl- (Streptose)	$C_6H_{10}O_5$		
11	L-Lyxose, 3-*C*-formyl- (Hydroxystreptose)	$C_6H_{10}O_6$		
12	Pentose, 4,5-anhydro-5-deoxy-D-*erythro*-	$C_5H_8O_3$		
13	Pentose, 2-deoxy-D-*erythro*-	$C_5H_{10}O_4$	96–98	−91 → −58
14	D-Ribose	$C_5H_{10}O_5$	87	−23 1 → −23 7
15	D-Ribose, 2-*C*-hydroxymethyl- (Hamamelose)	$C_6H_{12}O_6$		−7 1 [λ578]
16	α-D-Xylose	$C_5H_{10}O_5$	145	+93 6 → +18 8
17	D-Xylose, 5-deoxy-	$C_5H_{10}O_4$		+16
18	β-D-Xylose, 2-*O*-methyl-	$C_6H_{12}O_5$	137–138	−21 → +34
19	α-D-Xylose, 3-*O*-methyl-	$C_6H_{12}O_5$	95	+45 → +19
20	D-Allose, 6-deoxy-	$C_6H_{12}O_5$	140–143 146–148	+1 6 [18°] (*c* 0 6) −4 7 → 0
21	D-Allose, 6-deoxy-2,3-di-*O*-methyl- (Mycinose)	$C_8H_{16}O_5$	102–106	−46 → −29
22	Amicetose (a trideoxy hexose)	$C_6H_{12}O_3$	Oil, b p 65–70	+28 6 ($CHCl_3$)
23	Antiarose	$C_6H_{12}O_5$		Levo
24	α-D-Galactose	$C_6H_{12}O_6$	167	+150 7 → +80 2
25	β-D-Galactose	$C_6H_{12}O_6$	143–145	+52 8 → +80 2
26	D-Galactose, 3,6-anhydro-	$C_6H_{10}O_5$		+21 3 [10°]
27	α-D-Galactose, 6-deoxy- (D-Fucose, Rhodeose)	$C_6H_{12}O_5$	140–145	+127 → +76 3 (*c* 10)
28	D-Galactose, 6-deoxy-3-*O*-methyl- (Digitalose)	$C_7H_{14}O_5$	106[1], 119[2]	+106

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Aldoses (Con t)			
29	D-Galactose, 6-deoxy-4-*O*-methyl-	$C_7H_{14}O_5$	131–132	+82
30	D-Galactose, 6-deoxy-2,3-di-*O*-methyl-	$C_8H_{16}O_5$		+73
31	α-D-Galactose, 3-*O*-methyl-	$C_7H_{14}O_6$	144–147	+150 6 → +108 6
32	α-D-Galactose, 6-*O*-methyl-	$C_7H_{14}O_6$	122–123	+117 → +77 3
33	L-Galactose	$C_6H_{12}O_6$		*See* D-Galactose
34	α-L-Galactose, 3,6-anhydro-	$C_6H_{10}O_5$		−39 4 → −25 2
35	α-L-Galactose, 6-deoxy- (L-Fucose)	$C_6H_{12}O_5$	145	−124 1 → −76 4
36	L-Galactose, 6-deoxy-2-*O*-methyl-	$C_7H_{14}O_5$	149–150	−75 ± 4 (*c* 0 5)
37	L-Galactose, 6-sulfate	$C_6H_{12}O_9S$		−47 (*c* 0 2) (Na salt)
38	DL-Galactose	$C_6H_{12}O_6$	143–144, 163	None (racemic)
39	α-D-Glucose	$C_6H_{12}O_6$	146, 83 (H_2O)	+112 → +52 7
40	β-D-Glucose	$C_6H_{12}O_6$	148–150	+18 7 → +52 7
41	D-Glucose, 6-acetate	$C_7H_{14}O_7$	135	+48
42	D-Glucose, 2,3-di-*O*-methyl-	$C_8H_{16}O_6$	85–86, 121	+50
43	D-Glucose, 6-*O*-benzoyl- (Vaccinin)	$C_{13}H_{16}O_7$	Amorphous	+48 (C_2H_5OH)
44	α-D-Glucose, 6-deoxy- (Chinovose, Epirhamnose, Glucomethylose, Isorhamnose, Isorhodeose Quinovose)	$C_6H_{12}O_5$	139–140	+73 3 → +29 7 (*c* 8)
45	α-D-Glucose, 6-deoxy-3-*O*-methyl- (D-Thevetose)	$C_7H_{14}O_5$	116	+84 → +33
46	D-Glucose, 6-sulfonic acid, 6-deoxy- (6-Sulfoquinovose)	$C_6H_{12}O_8S$	173–174	+87[3]
47	D-Glucose, 3-*O*-methyl-	$C_7H_{14}O_6$	162–167	+98 → +59 5
48	α-L-Glucose	$C_6H_{12}O_6$	141–143	−95 5 → −51 4
49	L-Glucose, 6-deoxy-3-*O*-methyl- (L-Thevetose)	$C_7H_{14}O_5$	126–129	−36 9 ± 2
50	D-Gulose, 6-deoxy-	$C_6H_{12}O_5$		
51	Hexose, 2-deoxy-D-*arabino*-[4]	$C_6H_{12}O_5$	148	+46 6 [18°]
52	Hexose, 2,6-dideoxy-3-*O*-methyl-D-*arabino*- (D-Oleandrose)	$C_7H_{14}O_4$		−11
53	Hexose, 3,6-dideoxy-D-*arabino*- (Tyvelose)	$C_6H_{12}O_4$		+24 ± 2
54	Hexose, 2,6-dideoxy-3-*O*-methyl-L-*arabino*- (L-Oleandrose)	$C_7H_{14}O_4$	62–63	+11 9 ± 2 5
55	Hexose, 3,6-dideoxy-L-*arabino*- (Ascarylose)	$C_6H_{12}O_4$		−24 ± 2
56	Hexose, 2,6-dideoxy-3-*O*-methyl-D-*lyxo*- (Diginose)	$C_7H_{14}O_4$	90–92	+56 ± 4
57	Hexose, 2,6-dideoxy-L-*lyxo*- (L-Fucose, 2-deoxy-)	$C_6H_{12}O_4$	103–106	−61 6
58	Hexose, 2,6-dideoxy-3-*O*-methyl-L-*lyxo*-	$C_7H_{14}O_4$	78–85	−65
59	Hexose, 2,6-dideoxy-D-*ribo*- (Digitoxose, D-Altrose, 2,6-dideoxy-)	$C_6H_{12}O_4$	110	+46 4
60	Hexose, 2,6-dideoxy-3-*O*-methyl-D-*ribo*- (Cymarose)	$C_7H_{14}O_4$	93	+52
61	Hexose, 3,6-dideoxy-D-*ribo*- (Paratose)	$C_6H_{12}O_4$		+10 ± 2 (*c* 0 9)
62	Hexose, 4,6-dideoxy-3-*O*-methyl-D-*ribo*- (D-Gulose, 4,6-dideoxy-3-*O*-methyl-, Chalcose)	$C_7H_{14}O_4$	96–99	+120 → +76
63	Hexose, 2,6-dideoxy-D-*xylo*- (Boivinose)	$C_6H_{12}O_4$	96–98	−3 9 → +3 9

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Aldoses (Con't)			
64	Hexose, 2,6-dideoxy-3-*O*-methyl-D-*xylo*- (Sarmentose)	$C_7H_{14}O_4$	78–79	+12 → +15 8
65	Hexose, 3,6-dideoxy-D-*xylo*- (Abequose)	$C_6H_{12}O_4$		−3 2 ± 0 6
66	Hexose, 2,6-dideoxy-3-*C*-methyl-L-*xylo*- (Mycarose)	$C_7H_{14}O_4$	129–129	−31 1
67	Hexose, 2,6-dideoxy-3-*C*-methyl-3-*O*-methyl-L-*xylo*-(Cladinose)	$C_8H_{16}O_4$	oil, b p 120–132 (0 25 mm)	−23 1
68	Hexose, 3,6-dideoxy-L-*xylo*- (Colitose)	$C_6H_{12}O_4$		+4 (H_2O), −51 ± 2 (CH_3OH)
69	D-Idose[5]	$C_6H_{12}O_6$		
70	L-Idose, 1,6-anhydro-	$C_6H_{10}O_5$		
71	α-D-Mannose	$C_6H_{12}O_6$	133	+29 3 → +14 5
72	β-D-Mannose	$C_6H_{12}O_6$	132	−16 3 → +14 5
73	D-Mannose, 6-deoxy- (D-Rhamnose)	$C_6H_{12}O_5$	86–90	−7 0
74	α-L-Mannose, 6-deoxy-monohydrate (L-Rhamnose)	$C_6H_{14}O_6$	93–94	−8 6 → +8 2
75	β-L-Mannose, 6-deoxy-	$C_6H_{12}O_5$	123–125	+38 4 → +8 9
76	L-Mannose, 6-deoxy-2-*O*-methyl-	$C_7H_{14}O_5$		
77	L-Mannose, 6-deoxy-3-*O*-methyl- (L-Acofriose)	$C_7H_{14}O_5$	114–115	+30 [18°]
78	L-Mannose, 6-deoxy-2,4-di-*O*-methyl-	$C_8H_{16}O_5$	82	−19 [16°]
79	L-Mannose, 6-deoxy-5-*C*-methyl-4-*O*-methyl-(Noviose)	$C_8H_{16}O_5$	128–130	+19 9 (50% C_2H_5OH)
80	Rhodinose (a 2,3,6-trideoxyhexose)	$C_6H_{12}O_3$		−11 ± 1 6
81	D-Talose	$C_6H_{12}O_6$	128–132	+16 9
82	D-Talose, 6-deoxy- (D-Talomethylose)	$C_6H_{12}O_5$	129–131	+20 6
83	L-Talose, 6-deoxy- (L-Talomethylose)	$C_6H_{12}O_5$	116–118	−19 5 ± 2 [18°]
84	L-Talose, 6-deoxy-2-*O*-methyl- (L-Acovenose)	$C_7H_{14}O_5$		−19 4
85	Heptose, D-*glycero*-D-*galacto*-	$C_7H_{14}O_7$	139–140	+47 → +64 (*c* 0 5)
86	Heptose, D-*glycero*-D-*manno*-	$C_7H_{14}O_7$		
87	Heptose, D-*glycero*-L-*manno*-	$C_7H_{14}O_7$		
	Ketoses			
88	Dihydroxyacetone	$C_3H_6O_3$	80 (dimer)	None
89	Tetrulose, L-*glycero*-[8] (L-Erythrulose, Ketoerythritol, L-Threulose)	$C_4H_8O_4$	Syrup	+12
90	Pentulose, D-*erythro*- (Adonose, D-Ribulose)	$C_5H_{10}O_5$	Syrup	+16 6 [27°]
91	Pentulose, L-*erythro*- (L-Ribulose)	$C_5H_{10}O_5$		−16 6
92	Pentulose, D-*threo*- (D-Xylulose)	$C_5H_{10}O_5$		−33
93	Pentulose, 5-deoxy-D-*threo*-	$C_5H_{10}O_4$		−5 ± 1 (CH_3OH)
94	Pentulose, L-*threo*- (L-Xylulose, L-Lyxulose, Xyloketose)	$C_5H_{10}O_5$	Syrup	+33 1
95	Hexulose, β-D-*arabino*-(β-D-Fructose, Levulose)	$C_6H_{12}O_6$	102–104[7]	−133 5 → −92
96	Hexulose, 6-deoxy-D-*arabino*- (D-Rhamnulose)	$C_6H_{12}O_5$		−13 ± 2
97	Hexulose, D-*lyxo*- (D-Tagatose)	$C_6H_{12}O_6$	131–132	+2 7 → −4, −5
98	5-Hexulose, D-*lyxo*	$C_6H_{12}O_6$	158	−86 6
99	Hexulose, 6-deoxy-L-*lyxo*- (L-Fuculose)	$C_6H_{12}O_5$		

Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Ketoses (Con't)			
100	Hexulose, D-*ribo*- (D-Psicose)	$C_6H_{12}O_6$	Amorphous	+4 7
101	Hexulose, L-*xylo*- (L-Sorbose)	$C_6H_{12}O_6$	159–161	−43 1
102	Hexulose, 6-deoxy-L-*xylo*-	$C_6H_{12}O_5$	88	−25 ± 2 (*c* 0 7)
103	Heptulose, D-*altro*- (Sedoheptulose, Sedoheptose)	$C_7H_{14}O_7$	Amorphous	+2 5 (*c* 10)
104	Heptulose·hemihydrate, L-*galacto*- (Perseulose)	$C_7H_{14}O_7 \cdot \frac{1}{2}H_2O$	110–115	−90 → −80
105	Heptulose, L-*gulo*-	$C_7H_{14}O_7$		−28
106	Heptulose, D-*ido*-	$C_7H_{14}O_7$	172	−34 ± 8 (*c* 0.3)
107	Heptulose, D-*manno*- (Mannoketoheptose, D-Mannotagatoheptose)	$C_7H_{14}O_7$	152	+29.4
108	Heptulose, D-*talo*-	$C_7H_{14}O_7$		
109	Octulose, D-*glycero*-L-*galacto*-	$C_8H_{16}O_8$		−57, −43.4 → −13 4
110	Octulose, D-*glycero*-D-*manno*-	$C_8H_{16}O_8$		+20 (CH_3OH)

[1] Original melting point. [2] Melting point after four-months' storage [3] As a methyl glycoside cyclohexylamine salt. [4] Included because of speculations concerning it in biological processes. [5] Either D-idose or L-altrose is in the polysaccharide varianose. [6] Early literature refers to this as D-erythrose. [7] The $\cdot\frac{1}{2}H_2O$ and $\cdot 2H_2O$ forms also exist.

Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Aldosamines			
1	D-Ribose, 3-amino-3-deoxy-	$C_5H_{11}NO_4$	158–158.5 d.	−24 6 (hydrochloride)
2	D-Galactose, 2-amino-2-deoxy- (Galactosamine; Chondrosamine)	$C_6H_{13}NO_5$	185	+121 → +80 (hydrochloride)
3	α-L-Galactose, 2-amino-2,6-dideoxy- (L-Fucosamine)	$C_6H_{13}NO_4$	192–193 d.	−119 → −92 [27°] (hydrochloride)
4	α-D-Glucose, 2-amino-2-deoxy- (Glucosamine; Chitosamine)	$C_6H_{13}NO_5$	88	+100 → +47.5
5	β-D-Glucose, 2-amino-2-deoxy-	$C_6H_{13}NO_5$	110–111	+28 → +47.5
6	D-Glucose, 3-amino-3-deoxy- (Kanosamine)	$C_6H_{13}NO_5$	128 d.	+19 [14°]
7	D-Glucose, 6-amino-6-deoxy-	$C_6H_{13}NO_5$	161–162 d.	+23 → +50.1 (hydrochloride)
8	D-Glucose, 2,6-diamino-2,6-dideoxy- (Neosamine C)	$C_6H_{14}N_2O_4$	>230	+61.5 (dihydrochloride)
9	D-Glucose, 3,6-dideoxy-3-dimethylamino- (Mycaminose)	$C_8H_{17}NO_4$	115–116	+31 (hydrochloride)
10	D-Glucose, 4,6-dideoxy-4-dimethylamino-	$C_8H_{17}NO_4$	192–193	+45.5 (hydrochloride)
11	L-Glucose, 2-deoxy-2-methylamino-	$C_7H_{15}NO_5$	130–132	−64
12	D-Gulose, 2-amino-1,6-anhydro-2-deoxy-	$C_6H_{11}NO_4$	250–260 d.	+41 ± 2 (hydrochloride)
13	D-Gulose, 2-amino-2-deoxy-	$C_6H_{13}NO_5$	152–162 d.	+5.6 → −18.7 (hydrochloride)

Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Aldosamines (Con't)			
14	Hexose, 3,4,6-trideoxy-3-dimethylamino-D-*xylo*- (Desosamine, Picrocine)	$C_8H_{17}NO_3$	189–191 d	+49 5 (*c* 10) (hydrochloride)
15	Hexose, a 4-acetamido-2-amino-2,4,6-trideoxy-	$C_8H_{16}N_2O_4$	216–219	+115 → +94 [26°] (*c* 0 05)
16	Hexose, an amino-deoxy-3-*O*-carboxyethyl-	$C_9H_{17}NO_7$		
17	Hexose, a 2,6-diamino-2,6-dideoxy- (Neosamine B, Paramose)	$C_6H_{14}N_2O_4$	135–150 d	+17 5 (*c* 0 9 (hydrochloride)
18	Hexose, a 3-dimethylamino-2,3,6-trideoxy- (Rhodosamine)	$C_8H_{17}NO_3$		
19	D-Mannose, 2-amino-2-deoxy- (Mannosamine)	$C_6H_{13}NO_5$	142 d	−4 3 (*c* 9) (hydrochloride)
20	D-Mannose, 3-amino-3,6-dideoxy- (Mycosamine)	$C_6H_{13}NO_4$	162	−11 5 (hydrochloride)
21	D-Talose, 2-amino-2-deoxy- (Talosamine)	$C_6H_{13}NO_5$	151–153	+3 4 → −5 7 (*c* 0 9) (hydrochloride)
22	L-Talose, 2-amino-2,6-dideoxy- (Pneumosamine)	$C_6H_{13}NO_4$	162–163	+6 9 → +10 4 (hydrochloride)
	Ketosamines			
23	Pentulose, 1-(*o*-carboxyanilino)-1-deoxy-D-*erythro*-	$C_{12}H_{14}NO_6$		
24	Hexulose, 1-(*o*-carboxyanilino)-1-deoxy-D-*arabino*-	$C_{13}H_{16}NO_7$		
25	Hexulose, 5-amino-5-deoxy-L-*xylo*-	$C_6H_{13}NO_5$	174–176	−62
26	Hexulose, 6-deoxy-6-(*N*-methylacetamido)-L-*xylo*-	$C_9H_{17}NO_6$		

Part III. NATURAL ALDITOLS AND INOSITOLS (with Inososes and Inosamines)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Alditols			
1	Glycerol	$C_3H_8O_3$	20	None
2	Glycerol, 1-deoxy- (1,2-Propane-diol)[1]	$C_3H_8O_2$	Oil, b p 188–189	None (racemic)
3	Erythritol	$C_4H_{10}O_4$	118–120	None (meso)
4	Erythritol, 1,4-dideoxy- (2,3-Butyleneglycol)	$C_4H_{10}O_2$	25, 34	None (meso)
5	D-Threitol, 1,4-dideoxy-	$C_4H_{10}O_2$	19	−13 0
6	L-Threitol, 1,4-dideoxy-	$C_4H_{10}O_2$		+10 2
7	DL-Threitol, 1,4-dideoxy-	$C_4H_{10}O_2$	7 6	None (racemic)
8	D-Arabinitol	$C_5H_{12}O_5$	103	+7 82 (*c* 8, borax solution)
9	L-Arabinitol	$C_5H_{12}O_5$	101–102	−32 (*c* 0 4, 5% molybdate)
10	Ribitol (Adonitol)	$C_5H_{12}O_5$	102	None (meso)
11	Galactitol (Dulcitol)	$C_6H_{14}O_6$	186–188	None (meso)

CARBOHYDRATES (Continued)
Part III. NATURAL ALDITOLS AND INOSITOLS
(with Inososes and Inosamines) (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Alditols (Con't)			
12	D-Glucitol (Sorbitol)	$C_6H_{14}O_6$	112	−1.8 [15°]
13	D-Glucitol, 1,5-anhydro- (Polygalitol)	$C_6H_{12}O_5$	140–141	+42.4
14	L-Iditol	$C_6H_{14}O_6$	73.5	−3 5 (*c* 10)
15	D-Mannitol	$C_6H_{14}O_6$	166	−0.21
16	D-Mannitol, 1,5-anhydro- (Styracitol)	$C_6H_{12}O_5$	157	−49.9
17	Heptitol, D-*glycero*-D-*galacto*- (Heptitol, L-*glycero*-D-*manno*-; Perseitol)	$C_7H_{16}O_7$	183–185, 188	−1.1
18	Heptitol, D-*glycero*-D-*gluco*- (Heptitol, L-*glycero*-D-*talo*-; β-Sedoheptitol)	$C_7H_{16}O_7$	131–132	+46 (5% NH_4 molybdate)
19	Heptitol, D-*glycero*-D-*manno*- (Heptitol, D-*glycero*-D-*talo*-; Volemitol)	$C_7H_{16}O_7$	153	+2.65
20	Octitol, D-*erythro*-D-*galacto*-	$C_8H_{18}O_8$. H_2O	169–170	−11 (5% NH_4 molybdate)
	Inositols			
21	Betitol (a dideoxy inositol)	$C_6H_{12}O_4$	224	
22	Bioinosose (*scyllo*-Inosose; *myo*-Inosose-2, a deoxy keto inositol)	$C_6H_{10}O_6$	198–200	None (meso)
23	*h*-Bornesitol (a *myo*-inositol monomethyl ether)	$C_7H_{14}O_6$	200	+31.6
24	*l*-Bornesitol (a *myo*-inositol monomethyl ether)	$C_7H_{14}O_6$	205–206	−32.1
25	Conduritol (a 2,3-dehydro-2,3-dideoxyinositol)	$C_6H_{10}O_4$	142–143	None (meso)
26	Cordycepic acid (a tetrahydroxycyclohexanecarboxylic acid)[2]	$C_7H_{12}O_6$		
27	Dambonitol (a *myo*-inositol dimethyl ether)	$C_8H_{16}O_6$	206	None (meso)
28	DL-Inositol	$C_6H_{12}O_6$	253	None (racemic)
29	*d*-Inositol	$C_6H_{12}O_6$		+60
30	*l*-Inositol	$C_6H_{12}O_6$	240	−65
31	Laminitol (a *C*-methyl *myo*-inositol)	$C_7H_{14}O_6$	266–269	−3
32	Liriodendritol (a *myo*-inositol dimethyl ether)	$C_8H_{16}O_6$	224	−25
33	*muco*-Inositol monomethyl ether	$C_7H_{14}O_6$	322–325	
34	*myo*-Inositol (*meso*-Inositol)	$C_6H_{12}O_6$	217–218	None (meso)
35	*d*-*myo*-Inosose-1 (a deoxy keto inositol)	$C_6H_{10}O_6$	138–139	+19.6
36	Mytilitol (a *C*-methyl *scyllo*-inositol)	$C_7H_{14}O_6$	259	None (meso)
37	*neo*-Inosamine-2 (a deoxy amino inositol)	$C_6H_{13}O_5N$	239–241 d.	None (meso)
38	*d*-Ononitol (a *myo*-inositol monomethyl ether)	$C_7H_{14}O_6$	172	+6.6
39	*h*-Pinitol (a *dextro*-inositol monomethyl ether)	$C_7H_{14}O_6$	186	+65.5
40	*l*-Pinitol (a *levo*-inositol monomethyl ether)	$C_7H_{14}O_6$	186	−65
41	*l*-Quebrachitol (a *levo*-inositol monomethyl ether)	$C_7H_{14}O_6$	190–191	−80.2 [28°]
42	*d*-Quercitol (a deoxy *dextro*-inositol)	$C_6H_{12}O_5$	235	+24.2
43	*d*-Quinic acid (a trideoxy carboxy *dextro*-inositol)	$C_7H_{12}O_6$	164	+44 (*c* 10)

CARBOHYDRATES (Continued)

Part III. NATURAL ALDITOLS AND INOSITOLS (with Inososes and Inosamines) (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Inositols (Con't)			
44	*l*-Quinic acid (a trideoxy carboxy *levo*-inositol)	$C_7H_{12}O_6$	162	−42.1
45	Quinic acid, 5-dehydro-	$C_7H_{10}O_6$	140–142 (138 s.)	−82.4 [28°]
46	Scyllitol (*scyllo*-Inositol; Cocositol)	$C_6H_{12}O_6$	352–353	None (meso)
47	Sequoyitol (a *myo*-inositol monomethyl ether)	$C_7H_{14}O_6$	234–235	None (meso)
48	Shikimic acid (a 3,4-anhydro-quinic acid)	$C_7H_{10}O_5$	183–184	−200 [16°]
49	Shikimic acid, 5-dehydro-	$C_7H_8O_5$	150–152	−57.5 [28°] (EtOH)
50	Streptamine (2,4-diaminodideoxy-scyllitol)	$C_6H_{14}O_4N_2$	88, 210–250 d.	None (meso)
51	Streptamine, 2-deoxy-	$C_6H_{14}O_3N_2$	.....	None (meso)
52	Streptadine (1,3-Dideoxy-1,3-diguanidino-scyllitol)	$C_8H_{18}N_6O_4$	.....	None (meso)
53	Viburnitol (a deoxy *levo*-inositol)[3]	$C_6H_{12}O_5$	174	−73.9

[1] The 1-phosphate ester of this diol is said to occur in brain tissue and sea-urchin eggs. [2] Strong evidence that cordycepic acid is really D-mannitol. [3] Not an enantiomorph of *d*-quercitol; other isomeric relationship is involved.

Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Aldonic Acids			
1	D-Glyceric acid	$C_3H_6O_4$	Gum	Dextro
2	L-Glyceric acid	$C_3H_6O_4$	Gum	Levo
3	D-Arabinonic acid	$C_5H_{10}O_6$	114–116	+10.5 (*c* 6)
4	L-Arabinonic acid	$C_5H_{10}O_6$	118–119	−9.6 → −41.7[1]
5	L-Arabinonic-1,4-lactone	$C_5H_8O_5$	97–99	−72
6	D-Ribonic acid	$C_5H_{10}O_6$	112–113	−17.0
7	D-Xylonic acid	$C_5H_{10}O_6$	.....	−2.9 → +20.1[1]
8	L-Xylonic acid	$C_5H_{10}O_6$	.....	−91.8[1]
9	D-Altronic acid	$C_6H_{12}O_7$	.....	+11.5 → +24.8[1] (Ca salt, *N* HCl)
10	D-Galactonic acid	$C_6H_{12}O_7$	122	−11.2 → +57.6[1]
11	D-Gluconic acid	$C_6H_{12}O_7$	130–132 (110–112 s.)	−6.7 → +11.9[1]
12	L-Gulonic acid	$C_6H_{12}O_7$	Exists only in soln.	[ca. 0°]
13	Hexsonic acid, 2-deoxy-D-*arabino*-	$C_6H_{12}O_6$	93–95	+68 (lactone)
14	2-Hexulosonic acid, D-*arabino*-	$C_6H_{10}O_7$	.....	−81.7 (Na salt)
15	2-Hexulosonic acid, 3-deoxy-D-*erythro*-	$C_6H_{10}O_6$	.....	−29.2 (*c* 6, Ca salt)
16	2-Hexulosonic acid, D-*lyxo*-	$C_6H_{10}O_7$	169	−5
17	5-Hexulosonic acid, D-*arabino*-	$C_6H_{10}O_7$	108–109	.....
18	5-Hexulosonic acid, D-*xylo*-	$C_6H_{10}O_7$	.....	−14.5
19	D-Mannonic acid	$C_6H_{12}O_7$	.....	−15.6
20	D-Gluconic acid, *O*-β-D-galactopyranosyl- (1 → 4)- (Lactobionic acid)	$C_{12}H_{22}O_{12}$	.....	+25.1 (Ca salt)

Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS (Continued)

	Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation $[\alpha]_D$
	(A)	(B)	(C)	(D)
	Uronic Acids			
21	L-Lyxuronic acid	$C_5H_8O_6$		
22	β-D-Galacturonic acid	$C_6H_{10}O_7$	160	+27 → +55 6
23	α-D-Galacturonic acid·monohydrate	$C_6H_{12}O_8$	159–160 (110–115 s)	+97 9 → +50 9
24	D-Galacturonic acid, 2-amino-2-deoxy-	$C_6H_{11}O_6N$	160 d.	+84 5 (pH 2 HCl)
25	β-D-Glucuronic acid	$C_6H_{10}O_7$	156	+11 7 → +36.3
26	D-Glucuronic acid, 2-amino-2-deoxy-	$C_6H_{11}O_6N$	120–172 d.	+55
27	D-Glucuronic acid, 3-*O*-methyl-	$C_7H_{12}O_7$	Syrup	+6
28	L-Guluronic acid	$C_6H_{10}O_7$		
29	L-Iduronic acid	$C_6H_{10}O_7$		+30
30	β-D-Mannuronic acid	$C_6H_{10}O_7$	165–167	−47 9 → −23.9
31	α-D-Mannuronic acid·monohydrate	$C_6H_{12}O_8$	110 s , 120–130 d.	+16 → −6 1 (*c* 6.8)
	Aldaric Acids			
32	D-Tartaric acid	$C_4H_6O_6$	170	−15
33	L-Tartaric acid	$C_4H_6O_6$	170	+15 [15°]
34	L-Malic acid	$C_4H_6O_5$	100	−2 3 (*c* 8.4)

[1] Equilibrates with the lactone.

FATS AND OILS

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Values are typical rather than average, and frequently were derived from specific analyses for particular samples (especially the constituent fatty acids). Extreme variations may occur, depending on a number

	Fat or Oil	Source	Constants				
			Melting (or Solidification) Point, °C	Specific Gravity (or Density)	Refractive Index $n_D^{40°}$	Iodine Value	Saponification Value
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
	Land Animals						
1	Butterfat	*Bos taurus*	32 2	0 911$^{40°/15°}$	1 4548	36 1	227
2	Depot fat	*Homo sapiens*	(15)	0 918$^{15°}$	1 4602	67 6	196 2
3	Lard oil	*Sus scrofa*	(30 5)	0 919$^{15°}$	1 4615	58 6	194 6
4	Neat's-foot oil	*B. taurus*		0 910$^{25°}$	1 464$^{25°}$	69–76	190–199
5	Tallow, beef	*B. taurus*				49 5	197
6	Tallow, mutton	*Ovis aries*	(42 0)	0 945$^{15°}$	1 4565	40	194
	Marine Animals						
7	Cod-liver oil	*Gadus morhua*		0 925^{25}	1 481$^{25°}$	165	186
8	Herring oil	*Clupea harengus*		0 900$^{60°}$	1 4610$^{60°}$	140	192
9	Menhaden oil	*Brevoortia tyrannus*		0 903$^{60°}$	1 4645$^{60°}$	170	191
10	Sardine oil	*Sardinops caerulea*		0 905$^{60°}$	1 4660$^{60°}$	185	191
11	Sperm oil, body	*Physeter macrocephalus*				76–88	122–130
12	Sperm oil, head	*P. macrocephalus*				70	140–144
13	Whale oil	*Balaena mysticetus*		0 892^{60}	1 460$^{60°}$	120	195
	Plants						
14	Babassu oil	*Attalea funifera*	22–26	(0 893$^{60°}$)	1 443$^{60°}$	15 5	247
15	Castor oil	*Ricinus communis*	(−18 0)	0 961$^{15°}$	1 4770	85 5	180 3
16	Cocoa butter	*Theobroma cacao*	34 1	0 964$^{15°}$	1 4568	36 5	193 8
17	Coconut oil	*Cocos nucifera*	25 1	0 924$^{15°}$	1 4493	10 4	268
18	Corn oil	*Zea mays*	(−20 0)	0 922$^{15°}$	1 4734	122 6	192 0
19	Cotton seed oil	*Gossypium hirsutum*	(−1 0)	0 917$^{25°}$	1 4735	105 7	194 3
20	Linseed oil	*Linum usitatissimum*	(−24 0)	0 938$^{15°}$	1 4782$^{25°}$	178 7	190 3
21	Mustard oil	*Brassica hirta*		0 9145$^{15°}$	1 475	102	174
22	Neem oil	*Melia azadirachta*	−3	0 917$^{15°}$	1 4615	71	194 5
23	Niger-seed oil	*Guizotia abyssinica*		0 925$^{15°}$	1 471	128 5	190
24	Oiticica oil	*Licania rigida*		0 974$^{25°}$		140–180	
25	Olive oil	*Olea europaea sativa*	(−6 0)	0 918$^{15°}$	1 4679	81 1	189 7
26	Palm oil	*Elaeis guineensis*	35 0	0 915$^{15°}$	1 4578	54 2	199 1
27	Palm-kernel oil	*E. guineensis*	24 1	0 923$^{15°}$	1 4569	37 0	219 9
28	Peanut oil	*Arachis hypogaea*	(3 0)	0 914$^{15°}$	1 4691	93 4	192 1
29	Perilla oil	*Perilla frutescens*		(0 935$^{15°}$)	1 481$^{25°}$	195	192
30	Poppy-seed oil	*Papaver somniferum*	(−15)	0 925$^{15°}$	1 4685	135	194
31	Rapeseed oil	*Brassica campestris*	(−10)	0 915$^{15°}$	1 4706	98 6	174 7
32	Safflower oil	*Carthamus tinctorius*		(0 900$^{60°}$)	1 462$^{60°}$	145	192
33	Sesame oil	*Sesamum indicum*	(−6 0)	0 919$^{25°}$	1 4646	106 6	187 9
34	Soybean oil	*Glycine soja*	(−16 0)	0 927$^{15°}$	1 4729	130 0	190 6
35	Sunflower-seed oil	*Helianthus annuus*	(−17 0)	0 923$^{15°}$	1 4694	125 5	188 7
36	Tung oil	*Aleurites fordi*	(−2 5)	0 934$^{15°}$	1 5174$^{25°}$	168 2	193 1
37	Wheat-germ oil	*Triticum aestivum*				125	

[1] Caproic. [2] Capryli. [3] Capric. [4] Butyric. [5] Decenoic. [6] C_{12} monoethenoic. [7] C_{14} monoethenoic. [8] Gadoleic plus erucic. [9] C_{12} n-pentadecanoic. [10] C_{17} margaric. [11] 12-Methyl tetradecanoic. [12] C_{20} polyethenoic.

of variables such as source, treatment, and age of a fat or oil **Specific Gravity** (column D) was calculated at the specified temperature (degrees centigrade) and referred to water at the same temperature, unless otherwise specified **Density**, shown in parentheses (column D), was measured at the specified temperature (degrees centigrade) **Refractive Index** (column E) was measured at 50°C, unless otherwise specified

Constituent Fatty Acids, g/100 g total fatty acids

	Saturated						Unsaturated				
	Lauric	Myristic	Palmitic	Stearic	Arachidic	Other	Palmitoleic	Oleic	Linoleic	Linolenic	Other
	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
1	2 5	11 1	29 0	9 2	2 4	2 0[1], 0 5[2], 2 3[3]	4 6	26 7	3 6		3 6[4], 0 1[5], 0 1[6], 0.9 7 1 4[8], 1 0[9], 1 0[10], 0 4[11]
2		2 7	24 0	8 4			5	46 9	10 2		2 5[8]
3		1 3	28 3	11 9			2 7	47 5	6		0 2[7], 2 1[8]
4			17–18	2 3				74 76			
5		6 3	27 4	14 1				49 6	2 5		
6		4 6	24 6	30 5				36 0	4 3		
7		5 8	8 4	0 6			20 0	←29 1→			25 4[12], 9 6[13]
8		7 3	13 0	Trace			4 9			20 7	30 1[12], 23 2[13]
9		5 9	16 3	0 6	0 6		15 5			29 6	19 0[12], 11 7[13], 0 8[14]
10		3 1	14 6	3 2			11 8	←17 8→			18 1[12], 14 0[13], trace[7], 15 4[15]
11	1	5	6 5				26 5	37	19		1[13], 4[7], 19[16]
12	16	14	8	2		3 5[3]	15	17	6 5		4[6], 14[7], 6 5[16]
13	0 2	9 3	15 6	2 8			14 4	35 2			13 6[12], 5 9[13], 2 5[7], 0 2[17]
14	44 1	15 4	8 5	2 7	0 2	0 2[1], 4 8[2], 6 6[3]		16 1	1 4		
15	←2 4→							7 4	3 1		8 7[18]
16			24 4	35 4				38 1	2 1		
17	45 4	18 0	10 5	2 3	0 4[19]	0 8[1], 5 4[2], 8 4[3]	0 4	7 5	Trace		
18		1 4	10 2	3 0			1 5	49 6	34 3		
19		1 4	23 4	1 1	1 3		2 0	22 9	47 8		
20			6 3	2 5	0 5			19 0	24 1	47 4	0 2[11]
21		1 3[20]						27 2[20]	16 6[20]	1 8[20]	1 1[11], 1 0[21], 51 0[22]
22		2 6[20]	14 1[20]	24 0[20]	0 8[20]			58 5[20]			
23		3 3[20]	8 2[20]	4 8[20]	0 5[20]			30 3[20]	57 3[20]		
24	←11 3[23]→							6 2			82 5[21]
25		Trace	6 9	2 3	0 1			84 4	4 6		
26		1 4	40 1	5 5				42 7	10 3		
27	46 9	14 1	8 8	1 3		2 7[2], 7 0[3]		18 5	0 7		
28			8 3	3 1	2 4			56 0	26 0		3 1[11], 1 1[21]
29	←9 6[23]→							17 8		17 5	
30			4 8[20]	2 9[20]				30 1[20]	62 2[20]		
31			1					32	15	1	50[22]
32	←6 8[23]→							18 6	70 1	3 4	
33			9 1	4 3	0 8			45 4	40 4		
34	0 2	0 1	9 8	2 4	0 9		0 4	28 9	50 7	6 5	0 1[7]
35			5 6	2 2	0 9			25 1	66 2		
36	←4 6[23]→							4 1	0 6		90 7[25]
37	←16 0[23]→							28 1	52 3	3 6	

[13] C_{22} polyethenoic [14] Behenic [15] C_{14} polyethenoic [16] Gadoleic [17] C_{24} polyethenoic. [18] Ricinoleic. [19] Includes behenic and lignoceric [20] Percent by weight [21] Lignoceric [22] Erucic [23] Includes behenic [24] Licanic [25] Eleostearic

WAXES

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Specific Gravity (column C) was calculated at the specified temperature, degrees centigrade, and referred to water at the same temperature **Density.** shown in parentheses (column C), and **Refractive Index** (column D) were measured at the specified temperature, degrees centigrade

	Wax	Melting Point °C	Specific Gravity or (Density)	Refractive Index $n\frac{°C}{D}$	Iodine Value	Acid Value	Saponification Value
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	Bamboo leaf	79–80	(0 961$^{25°}$)		7 8[1]	14 5	43 4
2	Bayberry (myrtle)	46 7–48 8	(0 985$^{15°}$)	1 436$^{80°}$	2 9[2]–3 9[3]	3 5	20 5–21 7
3	Beeswax, crude	62–66	(0 927–0 970$^{15°}$)	1 439–1 483$^{40°}$	6 8–16 4[2]	16 8–35 8	89 3–149 0
4	Beeswax, white, U S P	61–69	(0 959–0 975$^{15°}$)	1 447–1 465$^{65°}$	7–11[3]	17–24	90–96
5	Beeswax, yellow	62–65	(0 960–0 964$^{15°}$)	1 443–1 449$^{65°}$	6–11	18–24	90–97
6	Candelilla, refined	67–69	(0 982–0 986$^{15°}$)	1 454–1 463$^{85°}$	14 4–20 4	12 7–18 1	35–86
7	Cape berry[4]	40 5–45 0	(1 004–1 007$^{15°}$)	1 450$^{45°}$	0 6–2 4	2 5–3 7	211–215
8	Carandá	79 7–84 5	(0 990$^{25°}$)		8 0–8 9	5 0–9 5	64 5–78 5
9	Carnauba	83–86	0 990–1 001$^{15°}$	1 467–1 472$^{40°}$	7 2–13 5	2 9–9 7	78–95
10	Castor oil, hydrogenated	83–88	(0 980–0 990$^{20°}$)		2 5–8 5	1 0–5 0	177–181
11	Chinese insect	81 5–84 0	0 950–0 970$^{15°}$	1 457$^{40°}$	1 4	0 2–1 5	73–93
12	Cotton	68–71	0 959$^{15°}$		24 5	32	70 6
13	Cranberry	207–218	(0 970–0 975$^{15°}$)		44 2–53 2[2]	42 2–59 1	131–134
14	Douglas-fir bark	59 0–72 8	(1 030$^{25°}$)	1 468$^{80°}$	25 8–62 5	58 6–80 7	112–200
15	Esparto	67 5–78 1	0 988$^{15°}$		22–23	22 7–23 9	69 8–79 3
16	Flax	61 5–69 8	0 908–0 985$^{15°}$		21 6–28 8	17 5–48 3	77 5–101 5
17	Ghedda, E Indian beeswax	60 5–66 4	0 956–0 973$^{15°}$	1 440$^{50°}$	5 6–12 6	5 8–7 9	84 5–118 3
18	Indian corn	80–81			4 2[2]	1 9	120 3
19	Japan wax	48–53	0 975–0 993$^{15°}$		4 5–12 5	6–20	206 5–237 5
20	Jojoba	11 2–11 8	0 864–0 899$^{25°}$	1 465$^{25°}$	81 7–88 4[2]	0 2–0 6	92 2–95 0
21	Madagascar	88			3 2–5 3	17 7–28 0	140 0–159 6
22	Microcrystalline, amber	64–91	0 913–0 943$^{15°}$	1 424–1 452$^{80°}$	0	0	0
23	Microcrystalline, white	71–89	0 928–0 941$^{15°}$	1 441$^{80°}$	0	0	0
24	Montan, crude	76–86	(1 010–1 020$^{25°}$)		13 9–17 6	22 7–31 0	59 4–92 0
25	Montan, refined	77–84	(1 010–1 030$^{25°}$)		10–14	24–43	72–103
26	Orange peel	44 0–46 5	0 985$^{15°}$	1 502$^{20°}$	115 7[2]	48 3	120 9
27	Ouricury, refined	79 0–83 8	1 053$^{15°}$		6 9–7 8[2]	3 4–21 1	61 8–85 8
28	Ozocerite, refined	74 4–75 0	0 907–0 920$^{15°}$		0	0	0
29	Palm	74–86	(0 991–1 045$^{15°}$)		8 9–16 9[2]	5 0–10 6	64 5–104 0
30	Paraffin, American	49–63	0 896–0 925$^{15°}$	1 442–1 448$^{80°}$	0	0	0
31	Peat wax, natural	73–76	0 980$^{15°}$		16–40	60 0–73 3	73 9–136 0
32	Rice bran, refined	75 3–79 9		1 469$^{30°}$	11 1–19 4	15–17	56 9–104 4
33	Shellac wax	79–82	0 971–0 980$^{15°}$		6 0–8 8[3]	12 1–24 3	63 8–83 0
34	Sisal hemp	74–81	1 007–1 010$^{15°}$		28–29[2]	16–19[2]	56–58
35	Sorghum grain	77–82			15 7–20 9	10 1–16 2	16–44
36	Spanish moss	79–80			33 0	25 0	120 4
37	Spermaceti	42–50	0 905–0 945$^{15°}$	1 440$^{70°}$	4 8–5 9	2 0–5 2	108–134
38	Sugarcane, crude	52–67	0 988–0 998$^{25°}$		32–84	24–57	128–177
39	Sugarcane, double-refined	77–82	0 961–0 979$^{25°}$	1 510$^{25°}$	13–29	8–23	55–95
40	Wool wax, refined	36–43	0 932–0 945$^{15°}$	1 478–1 482$^{40°}$	15 0–46 9	5 6–22 0	80–127

[1] Wijs test [2] Hanus test [3] Hubl test [4] *Myrica cordifolia*

DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS

Compiled by George W Smith

The following table contains values for the molar susceptibility of χ_M, specific susceptibility χ and volumetric susceptibility k. The cgs Gaussian system of units is employed. In the Gaussian units the relation between magnetic induction B and magnetic field strength H is

$$B = H + 4\pi I \qquad (1)$$

where I is the magnetization or magnetic moment per unit volume. Actually the quantities involved in equation (1) are all vectors but one may assume that all three are collinear, a reasonable assumption for organic diamagnetic substances in the liquid state. For crystals I may vary with crystal orientation. Equation (1) may be rewritten

$$B = H + 4\pi kH = (I + 4\pi k)H \qquad (2)$$

Here, K is the magnetic susceptibility often called the volumetric susceptibility and is a unitless quantity.

Other susceptibilities of use to chemists and physicists are the specific or mass susceptibility which is defined

$$\chi = k/\rho \qquad (3)$$

where ρ is the density of the sample in grams per cc., and the molar susceptibility which is defined as

$$\chi_M = M\chi = Mk/\rho \qquad (4)$$

where M is the molecular weight of the substance in grams.

Temperatures, when listed, are enclosed in parentheses and are listed in degrees C.

Literature references for values contained in this table may be found in General Motors Research Laboratories publication GMR-317.

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-k \times 10^6$	Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Acenaphthanthracene	184	73		Amyl iodide	(118 7)	5996 (18°)	(910) (20°)
Acenaphthene	109 3	(709)	(726) (99°)	n-Amyl methyl ketone	80 50	705_3	(580) (15°)
Acetal	81 39	688 (32°)	(568) (32°)	Amyl nitrate	(76 4)	574	
Acetaldehyde	22 70	515_3	(403) (18°)	iso-Amyl propionate	101 73	705_4 (25°)	(609) (25°)
Acetamide	34 1	577	(618) (20°)	n-Amyl valerate	124 55	723_9	(638) (0°)
Acetic acid	31 54	525 (32°)	(551) (32°)	Anethole	(96 0)	648	(644) (15°)
Acetic anhydride	(52 8)	517	(562) (15°)	Aniline	62 95	(676)	(691) (20°)
Acetoaminofluorene	(141)	63		Anisidine	(80 5)	654	(72) (20°)
Acetone	33 7_8	581_4	(460) (20°)	Anisole	72 79	(673)	(672) (15°)
Acetonitrile	28 0	(682)	(534) (20°)	Anthanthrene	204 2	739	
Acetonylacetone	62 51	547_6	(531) (20°)	Anthanthrone	178 1	581	
Acetophenone	72 05	599_8	(615) (20°)	Anthracene	(130)	731	(914) (27°)
Acetophenone oxime	79 9_0	592_0		Anthracenedinitrile	154 6	(678)	
Acetophenone oxime-O-methyl ether	92 3_1	618_8		Anthracenonitrile	142 1	(700)	
Acetoxime	44 4_9	607_6	(480) (20°)	Anthraquinone	(119 6)	575	(825) (20°)
Acetoxime-O-benzyl ether	104 8_9	642		Anthrazine	245 7	646	
Acetoxime-O-methyl ether	54 8	629_8		Arabinose	85 70	571	(905) (20°)
Acetylacetone	54 88	548_1	(535) (20°)	Arbutoside	158 0	(589)	
Acetyl chloride	38 9	496	(548) (20°)	Asarone	131 4	(631)	(735) (18°)
Acetylene	12 5	(480)		Asparagine	69 5	(526)	(812) (15°)
Acetylphenylacetylene	86 9	508		Aspartic acid	64 2 ± 4	(482)	(800) (12°)
Acetylthiophene	71 7	(568)		Aurin	(161 4)	556	
Acridine	(123 3)	688	(757) (20°)	p-Azoanisole	(147 7)	610	
Adonitol	91 30	600		Azobenzene	(106 8)	586	611 (70 5°)
Alanine	50 5	(567)		p-Azophenetole	(171 7)	635	
Allyl acetate	(56 7)	566	(525) (20°)	m-Azotoluene	(127 8)	608	643 (58°)
Allyl alcohol	36 70	632	540 (20°)	Azulene	98 5	768	
1-Allylpyrrole	73 80	685 (20°)		Barbituric acid (Anh.)	53 8	(420)	
Aminoazobenzene	(118 3)	600		Barbituric acid ($2H_2O$)	78 6	(4 79)	
Aminoazotoluene	(142 2)	631		Benzalazine	(123 7)	594	
o-Aminoazotoluene	(138)	61 ± 02		Benzaldehyde	60 78	(573)	(602) (15°)
α-Aminobutyric acid	62 1	(602)		Benzaldoxime	(69 8)	576	(639) (20°)
Aminomethyldiethyldiazine	114 8	(696)		Benzamide	(72 3)	597	(801) (4°)
4-Aminostilbene	122 5	(628)		Benzanthrone	142 9	620	
2-Aminothiazole	56 0	564		Benzene	54 84	702 (32°)	611
n-Amyl acetate	89 06	684_2	5979 (20 7°)	Benzidine	110 9	603	(754) (20°)
iso-Amyl acetate	89 40	687	599 (20°)	Benzil	(118 6)	564	616 (100°)
n-Amyl alcohol	(67 5)	766	(624) (20°)	Benzoic acid	70 28	(575)	(728) (15°)
γ-Amyl alcohol	(71 0)	8060	(655) (25°)	Benzoic anhydride	(124 9)	552	(662) (15°)
Inactive Amyl alcohol	69 06	783_3 (25°)		Benzonitrile	65 19	(632)	(638) (15°)
iso-Amyl alcohol	68 96	782_3 (25°)	(64) (15°)	Benzophenone	109 60	601_3	(66) (50°)
sec-Amyl alcohol	69 1	785	(635) (20°)	3,4-Benzopyrene	135 7	538	
tert-Amyl alcohol	(70 9)	804	(654) (15°)	Benzopyrene	194 0		
n-Amylamine	69 4	(796)	(606) (20°)	Benzoyl acetone	(95 0)	586	(639) (60°)
iso-Amylamine	71 6	(821)	(616) (20°)	Benzoyl chloride	(75 8)	539 (20°)	(657) 15°)
n-Amylbenzene	112 55	(759)	(652) (20°)	Benzyl acetate	93 18	(620)	(655) (16°)
iso-Amyl bromide	(88 7)	587	(706) (20°)	Benzyl alcohol	71 83	(664)	(697) (15°)
iso-Amyl-n-butyrate	113 52	717_4 (25°)	(616) (25°)	Benzylamine	75 26	(702)	(690) (19°)
iso-Amyl chloride	(79 0)	741	(662) (20°)	Benzyl chloride	81 98	(647)	(713) (18°)
iso-Amyl cyanide	73 4	(755)	(609) (20°)	Benzyl formate	81 43	(598)	(646) (20°)
iso-Amylene	53 7	766		Benzylideneaniline	(100 4)	554	
Amylene bromide	(114 5)	498		Benzylidene chloride	(97 9)	608	(763) (14°)
Amylene chloride	(95 2)	675		Benzylidenemethylamine	(73 1)	613	
iso-Amyl ether	(129)	813	(635) (15°)	Benzyl methyl ketone	83 44	621_9	(624) (20°)
iso-Amyl formate	78 38	674_8	(591) (25°)	Bibenzyl	(126 8)	696	671 (54 5°)
Amylidene chloride	(93 4)	662					

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
3,4-Bis (p-hydroxyphenyl)-2,4-hexadiene	(157)	59	
m,m -Bitolyl	(127 4)	6993 (27 4°)	(699) (16°)
m,m'-Bitolyl sulfide	(140 0)	6530 (27 4°)	
Borneol	126 0	(817)	(826) (20°)
Bromobenzene	78 92	5030 (20°)	(753) (20°)
Bromobenzenediazocyanide	86 88	(414)	
Bromochloromethane	55 0 ± 6	(425)	(846) (19°)
Bromodichloromethane	66 3 ± 3	(405)	(812) (15°)
Bromoform	82 60	327	948 (20°)
Bromonaphthalene	(123 8)	598	
α-Bromonaphthalene	115 90	560	840 (20°)
m-Bromotoluene	(93 4)	546	(770) (20°)
Bromotrichloromethane	73 1 ± 7	(369)	(758) (0°)
Butane	57 4	(988)	
iso-Butane	51 7	(890)	
1 4-Butanediol	61 5	(682)	(696) (20°)
2-Butene (cis)	42 6	(759)	
2 Butene (trans)	43 3	(772)	
1-Butene 3 4-diacetate	95 5	(555)	
2-Butene-1 4 diacetate (cis)	95 2	(553)	
2-Butene 1 4 diacetate trans)	95 1	(552)	
2-Butene 1 4 diol (cis)	54 3	(616)	
2-Butene 1 4 diol (trans)	53 5	(607)	
n-Butyl acetate	77 47	666_6 (25°)	(583) (25°)
iso Butyl acetate	78 52	676_9	(584) (25°)
n-Butyl alcohol	56 536 (20°)	(7627)	(6176) (20°)
iso-Butyl alcohol	57 704 (20°)	(7785)	(624) (20°)
sec Butyl alcohol	57 683 (20°)	(7782)	(629) (20°)
tert-Butyl alcohol	57 42	774 (25°)	(611) (20°)
n-Butylamine	58 9	(805)	(596) (20°)
iso-Butylamine	59 8	(818)	(599) (20°)
9 Butyl anthracene	176 0	(751)	
n Butylbenzene	100 79	(751)	(646) (20°)
iso-Butylbenzene	101 81	(759)	(648) (20°)
tert Butylbenzene	102 5	(764)	(662) (20°)
n Butyl benzoate	116 69	654_8	(656) (25°)
Butyl bromide	77 14	563 (20°)	(730) (20°)
iso-Butyl bromide	79 88	583 (20°)	(737) (20°)
1-n Butyl chloride	67 10	725	642 (20°)
2-n-Butyl chloride	67 40	728	635 (20°)
n-Butyl cyanide	(62 8)	7358 (27 4°)	(606) (20°)
tert-Butyl cyclohexane	115 09	8205	6670 (20°)
1,4-Butyl diacetate	103 4	(594)	
n Butyl ethyl ketone	80 73	707_0	(579) (20°)
n Butyl formate	65 83	644_7	(571) (25°)
iso Butyl formate	66 79	654_9	(574) (25°)
iso Butylideneazine	(95 8)	683	
Butyl iodide	(93 6)	5086 (18°)	(822) (20°)
iso-Butyl methyl ketone	70 05	699_5	(561) (20°)
tert-Butyl methyl ketone	69 86	697_9	(558) (16°)
n Butyl perfluor n-butyrate	126 7	(469)	
p tert Butylphenol	108 0	(719)	(653) (114°)
Butyl sulfide	(113 7)	7774 (27 4°)	(652) (16°)
Butyl thiocyanate	(79 38)	6891 (27 4°)	(659) (25°)
2 Butyne 1 4 diacetate	95 9	(564)	
2 Butyne 1 4 dibenzoate	169 0	(561)	
2 Butyne-1 4-diol	50 3	(584)	
n Butyraldehyde	46 08	639_4	(522) (20°)
iso-Butyraldehyde	46 38	643_6	(511) (20°)
iso Butyraldoxime	56 1•	644_3	(576) (20°)
n-Butyric acid	55 10	625	598 (20°)
iso Butyric acid	56 06	636_3 (25°)	(601) (25°)
Butyronitrile	49 4	(715)	(569) (15°)
Butyrylphenylacetylene	(106 4)	618	
Cacodyl	(99 9)	476	(689) (15°)
Cacodylic acid	(79 9)	579	
Camphor	(103)	68	(67) (25°)
Camphoric acid	129 0	(644)	(791) (20°)
Camphoric anhydride	(113)	620	(740) (20°)
n Caproic acid	78 55	676_0	(624) (25°)
Caprolphenylacetylene	(130 4)	651	
n-Caprylic acid	101 60	7053	(642) (20°)
Carbanilide	134 05	(6316)	(783) (20°)
Carbazole	117 4	(702)	
Carbon disulfide	42 2	554	699) (22°)
Carbon tetrabromide	93 73	2826 (20°)	(966)
Carbon tetrachloride	66 60	433	691 (20°)
Carbon tetraiodide	(136)	261	1 13) (20°)
Carvacrol	(109 1)	726	(709) (20°)
Carvone	(92 2)	614	(590) (20°)
Cetyl alcohol	(183 5)	757 (17 5°)	(619) (50°)
Cetyl mercaptan	390 4	1 510)	
Chloral	(67 7)	459	(694) (20°)
Chloranil	(112 6)	458	
Chloracetic acid	48 1	(509)	(804) (20°)
Chloroacetone	(50 9)	550	(633) (20°)
Chloroacetylchloride	53 7	(475)	(710) (0°)
p-Chloranisole	89 1	(625)	
Chlorobenzene	69 97	(6216)	(688) (20°)
Chlorobenzene diazocyanide	65 02	(393)	
Chlorodibromomethane	75 1 ± 4	(361)	(883) (15°)
Chlorodifluoromethane	38 6	446	
1-Chloro-2 3-dihydroxypropane	(77 9)	604	
Chlorodiphenylmethane	(131 9	(651)	
Chloroethylene	35 9	574	(528) (liq , 15°)
Chloroform	59 30	497	740 (20°)
Chlorofumaric acid	67 02	(445)	
p-Chloroiodo benzene	90 42	(417)	(786) (57°)
Chloromaleic acid	67 36	(448)	
Chloromethylstilbene	144 8	(633)	
α-Chloronaphthalene	107 60	661	789 (20°)
m Chloronitrobenzene	(74 8)	475	638 (48°)
o-Chlorophenol	77 4	(602)	(747) (18°)
p-Chlorophenol	77 6	(604)	(789) (20°)
1-(o-Chlorophenylazo) 2 napthol	161 0	(570)	
1 (p-Chlorophenylazo) 2 napthol	161 4	(571)	
Chlorotrifluoroethylene	49 1	422	
Chlorotrifluoromethane	45 3 ± 1 5	(434)	
Cholesterol	(284 2)	735	(784) (20°)
Chrysene	166 67	731	
Chrysoidine	(126 3)	595	
Cinnamic acid	78 36	529	(660) (4°)
Cinnamic acid (α trans)	78 2	(528)	
Cinnamic acid (β trans)	79 0	(533)	
Cinnamic acid (cis MP 68°)	77 6	(524)	
Cinnamic acid (cis-MP 58°)	77 9	(526)	
Cinnamic acid (cis-MP 42°)	83 2	(562)	
Cinnamic aldehyde	(74 8)	566	(629) (15°)
Cinnamyl alcohol	(87 2)	650	(679) (20°)
Cinnamylideneaniline	123 2	(595)	
Citral	(98 9)	650	(577) (20°)
Coronene	(243 3)	810	
Coumarin	82 5	(565)	(528) (20°)
o-Cresol	72 90	675	(706) (20°)
m Cresol	72 02	667 (26°)	(690) (20°)
p-Cresol	72 1	667 (26°)	(690) (20°)
o-Cresylmethyl ether	81 94	671 (40°)	(661) (15°)
m Cresylmethyl ether	77 91	638 (40°)	(623) (15°)
p-Cresylmethyl ether	79 13	648 (40°)	(629) (19°)
Cumene	89 53	744_9	(642)
Cyamelide	(56 1)	435	490) (15°)
Cyameluric acid	101 1 (10°)	(457)	
9-Cyanoanthracene	142 1	(699)	
Cyanogen	(21 6)	415	(359) (liq 17°)
Cyanuric acid	61 5	476	(842) (0°)
Cyclobutanecarboxylic acid	58 16	5816 (30°)	(613) (30°)
1 3-Cyclohexadiene	48 6	(607)	(510) (20°)
1,4-Cyclohexadiene	48 7	(608)	(515) (20°)
Cyclohexane	68 13	8100 (27 5°)	(627) (20°)
Cyclohexanecarboxylic acid	83 24	6499 (30°)	(668) (30°)
Cyclohexanol	73 40	732	694 (20°)
Cyclohexanone	62 0$_4$	632_3	(599) (20°)
Cyclohexanone oxime	71 5$_0$	632_1	
Cyclohexanoneoxime O-methyl ether	82 9$_6$	652_3	
Cyclohexene	57 5	(700)	(567) (20°)
Cyclohexenol	64 1	(653)	
Cyclooctane	91 4	(815)	(684) (20°)
Cyclooctene	84 6	(769)	(654) (20°)
Cyclooctatetraene	(53 9)	518	
Cyclopentane	59 18	8439	6290 (20°)
Cyclopentanecarboxylic acid	73 48	6446 (30°)	(677) (30°)
Cyclopentanone	51 63	6141 (30°)	(582) (30°)
Cyclopropane	39 9	(948)	(683) (−79°)
Cyclopropanecarboxylic acid	45 33	5271 (30°)	(569) (30°)
p-Cymene	102 8	766 (20°)	(656) (20°)
Decalin	106 70	7718	6814 (20°)
cis Decalin	(107 0)	774	(686) (35°)
trans-Decalin	(107 7)	779	(670) (35°)
n-Decane	119 74	(8416)	(6143) (20°)
l-Deuterio pyrrole	48 75	716 (20°)	
Deuteromdene	80 88	690	(692) (13°)
Diacetal	(153 8)	668	
Di-iso-amylamine	(133 1)	846	(649) (21°)
Diazoacetic ester	57	(50)	(54) (24°)
Dibenzocoronene	289 4	778	
1 2,5 6 Dibenzofluorene	184	69 ± 03	
3,4 5,6-Dibenzophenanthrene	(203)	73 ± 03	
Dibenzphenanthrone	200 5	716	
Dibenzpyrene	213 6	706	
Dibenzpyrenequinone	183 1	551	
iso-Dibenzpyrenequinone	194 6	586	
Dibenzyl ketone	131 70	626_0	
p-Dibromobenzene	(101 4)	430	786 (100°)
2,3 Dibromo-2-butene-1,4-diol	94 2	(383)	
Dibromodichloromethane	81 1 ± 4	(334)	(808) (25°)
1,2-Dibromodiiodoethylene	(140 1)	320	
1,2-Dibromoethylene	(71 7)	386	(877) (17 5°)
1,2-Dibromo-2-fluoroethane	(78 0)	379	(855) (17°)
Dibromo-4-nitrophenol	(167 5)	564	
1,2-Dibromotetrachloroethane	(126 0)	387	(1 049)
Di-n-butylamine	103 7	(802)	(767) (20°)
Di iso-butylamine	105 7	(817)	(609) (20°)
Di-sec-butylamine	105 9	(819)	(641) (0°)
Di-iso-butyl ketone	104 30	733_5	(591) (20°)
Di-tert-butyl ketone	104 06	732_1	
2 6-Di-tert-butyl-4-methyl phenol	165 3	(750)	
2,4-Di-tert-butyl phenol	155 6	(754)	
Dibutyl phthalate	175 1	(629)	(657) (21°)
Di-iso-butyralacetylene	(125 6)	738	
Dicetyl sulfide	401 7	(832)	
Dichloroacetic acid	58 2	(451)	(705) (20°)
Dichloroacetyl chloride	69 0	(468)	

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
o-Dichlorobenzene	84 26	5734	(748) (20°)
m-Dichlorobenzene	83 19	5661	(729) (20°)
p-Dichlorobenzene	82 93	5644	(823) (20 5°)
1,4-Dichloro-2-butyne	74 2	(603)	
1,2-Dichloro-1,2-dibromoethane	(108 6)	423	
1,1-Dichloro-difluoroethylene	60 0	451	
Dichlorodifluoromethane	52 2	432	(642) (−30°)
1,1-Dichloroethylene	49 2	508	(635) (15°)
cis-1,2-Dichloroethylene	51 0	526	(679) (15°)
trans 1,2-Dichloroethylene	48 9	504	(638) (15°)
1,3-Dichloro-2-hydroxypropane	(80 1)	621	
Dicyandiamide	44 55	(530)	(742) (14°)
Dicyclohexanol acetylene	(151 6)	682	
Dicyclohexyl	129 31	7776	6889 (20°)
1,1-Dicyclohexylnonane	231 98	7930	7001 (20°)
Diethanolacetylene	(75 3)	660	
Diethyl acetaldehyde	70 71	705_9	(576) (20°)
Diethylallylacetophenone	146 2	(676)	(663) (16°)
Diethyl allylmalonate	118 8	(593)	(602) (14°)
Diethylamine	56 8	(777)	(552) (18°)
Diethylcyclohexylamine	(124 5)	802	(699) (0°)
Diethyl ethylmalonate	115 2	(612)	(614) (20°)
Diethyl ketone	58 1_4	675_1	(551) (19°)
Diethyl ketoxime	68 3_1	6754	
Diethyl malonate	(92 6)	5782	(611) (20°)
Diethyl-3-(1-methyl butane) ethyl-malonate	175	(677)	
Diethyl oxalate	81 71	5595	(603) (15°)
Diethyl phthalate	127 5	(574)	(645) (25°)
Diethyl sebacate	(177 0)	685	(661) (20°)
Diethylstilbestrol	172 0	(547)	
Diethylstilbestrol dipropionate	265 2	720	
Diethyl succinate	105 07	6035	(628) (20°)
Diethyl sulfate	(86 8)	563	(667) (15°)
Diethyl sulfide	(67 9)	753	(630) (20°)
Diethyl tartrate	(113 4)	550	(662) (20°)
Difluoroacetamide	(41 2)	433	
1-Difluoro-2-dibromoethane	(85 5)	382	(883) (20°)
1,1-Difluoro-2,2 dichloroethyl amyl ether	129 84	(587)	(694) (20°)
1,1-Difluoro-2,2-dichloroethyl butyl ether	119 48	(577)	(703) (20°)
1,1-Difluoro-2 2-dichloroethyl ethyl ether	96 13	(537)	(723) (20°)
1,1-Difluoro-2,2-dichloroethyl methyl ether	80 68	(489)	(696) (20°)
1,1-Difluoro-2,2-dichloroethyl propyl ether	107 19	(555)	(701) (20°)
Difluoroethanol	(41 3)	503	
Di-n-heptylamine	171 5	(805)	
Di-n-hexylamine	148 9	(803)	
Dihydronaphthalene	(85 1)	654	(652) (12°)
o-Dimethoxybenzene	87 39	6329	(686) (25°)
m-Dimethoxybenzene	87 21	6316	(682) (0°)
p-Dimethoxybenzene	86 65	6275	(661) (55°)
o-(2,5-Dimethoxybenzoyl)-benzoic acid	161 0	(.562)	
Dimethoxymethane	(47 3)	621	(532)
Dimethylacetophenone	96 8	(653)	(645) (16°)
Dimethylallylacetophenone	122 4	(650)	(635) (16°)
Dimethylaniline	89 66	(740)	
2,2-Dimethylbutane	76 24	8848	5744 (20°)
2,3-Dimethylbutane	76 22	8845	5853 (20°)
2,3-Dimethyl-2-butene	65 9	(783)	(557)
Dimethylcyclohexanone	(84 8)	672	
1,2 and 1 3 Dimethylcyclopentanes	81 31	8281	6224 (20°)
2,5-Dimethyl-2,5 dibromo-3-hexine	(135 6)	506	
Dimethyl diethylketo tetrahydro-furfurane	(116 2)	753	
2,5-Dimethyl 1-ethylpyrrole	94 61	768 (20°)	
2,5-Dimethyl 3-ethylpyrrole	93 87	762 (20°)	
2,5-Dimethylfuran	66 37	687 (20°)	(620) (18°)
Dimethyl furazan	57 27	584	
2,5-Dimethyl-4-heptene	100 6	(797)	
2,4 Dimethyl-2,4-hexadiene	(78 7)	714	
2 3-Dimethylhexane	98 77	8648	6164 (20°)
2,5-Dimethylhexane	98 15	8593	5969 (20°)
3 4-Dimethylhexane	99 06	8673	6240 (20°)
2,6-Dimethyl-4 hexanol	116 9	812	
2,5-Dimethyl 3 hexine-2,5-diol	(103 0)	724	
Dimethyl isoxazole	59 7	(615)	
Dimethylketo tetrahydrofurfurane	(68 5)	600	
Dimethyl malonate	69 69	5277	(609) (20°)
1,6-Dimethylnaphthalene	113 3	(725)	
2,4-Dimethylnonane	134 68	(862)	(636) (20°)
3,4 Dimethylnonane	134 70	(862)	(647) (20°)
4,5-Dimethylnonane	134 52	(861)	(647) (20°)
2,6-Dimethyl-2,6,8-nonatriene	(108 8)	724	
Dimethyl-2,4-nonatriene	(148 8)	990	
2,6-Dimethyloctane	122 54	(861)	(627) (20°)
3,4-Dimethyloxadiazole	57 17	583	
Dimethyl oxalate	(55 7)	472	(542) (54°)
Dimethyl oxamide	(63 2)	544	
2,2-Dimethylpentane	86 97	8680	5849 (20°)
2,3-Dimethylpentane	87 51	8733	6070 (20°)
2,4-Dimethylpentane	87 48	8732	5876 (20°)
2,2-Dimethylpropane	63 1	(875)	(536) (0°)
2,5-Dimethyl-3-propyl-pyrrole	106 07	773 (20°)	
2,4-Dimethylpyrrole	69 64	732 (20°)	(679) (14°)
2,5-Dimethylpyrrole	71 92	756 (20°)	(707) (20°)
α ω-Dimethyl styrene	(90 7)	686	
Dimethyl succinate	81 50	5581	(625) (18°)
Dimethyl sulfate	(62 2)	493	(657) (20°)
Dimethyl sulfide	(44 9)	723	(612) (21°)
Dimethyltrichloromethylcarbinol	(105)	59	
N,N-Dimethyl urea	55 1	(625)	(784)
N N'-Dimethyl urea	56 3	(639)	(730)
o-Dinitrobenzene	65 98	3921	(614) (17°)
m-Dinitrobenzene	70 53	4197	(659) (0°)
p-Dinitrobenzene	68 30	4064	(660) (30°)
2,4-Dinitrophenol	(73 1)	397	(668) (24°)
Dinitroresorcinol	(62 4)	312	
1,4-Dioxane	52 16	592 (32°)	(606) (32°)
Diphenyl	103 25	6695	(664) (73°)
1,1-Diphenylallyl-3-chloride	146 1	(639)	
1,3-Diphenylallyl-3-chloride	140 7	(615)	
Diphenylamine	(109 7)	648	686 (55 5°)
Diphenyl-bis-diazo cyanide	85 03	(327)	
Diphenylbutadiene	129 6	(629)	
Diphenylchloroarsine	(145 5)	550	(871) (40°)
Diphenyldecapentaene	180 5	(635)	
Diphenyldiacetylene	(134 6)	640	
Diphenyldiazomethane	115	(592)	
Diphenyldihydrotetrazine	129 9	(545)	
1,1 Diphenylethylene	(118 0)	655	(680) (14°)
1,6-Diphenylhexane	171 81	7208	6877 (20°)
Diphenylhexatriene	146 9	(632)	
Diphenylmethane	(115 7)	688	684 (35 5°)
Diphenylmethanol	119 1	647	
1,1-Diphenylnonane	206 32	7357	6935 (20°)
Diphenyloctatetraene	164 3	(636)	
Diphenylphenoxyarsine	(225 2)	567	
N,N-Diphenyl urea	126 3	(595)	(759)
N,N -Diphenyl urea	127 5	(600)	(743) (20°)
Di-n propyl ketone	80 45	705_0	(576) (20°)
Di iso-propyl ketone	81 14	711_0	(573) (20°)
Dipropyl oxalate	105 27	6046	(628) (0°)
Di iso-propyl oxalate	106 02	6089	
Dodecyl alcohol	147 70	7849 (20 7°)	(652) (24°)
Dulcitol	112 40	617	(905) (15°)
Flaidic acid	204 8	(725)	(619) (79°)
Erythritol	73 80	604	(876) (20°)
Ethane	27 3	(910)	(511) (−100°)
4-Ethoxy-3-methoxybenzyl acetate	138 5	619	
4-Ethoxy 3-methoxybenzyl benzoate	177 3	620	
1-Ethoxynaphthalene	119 9	(696)	(738) (20°)
2-Ethoxynaphthalene	119 2	(692)	(734) (25°)
Ethyl acetate	54 10	614	554 (20°)
Ethyl acetoacetate	71 67	550_8	(565) (20°)
Ethylacetophenone	95 5	(644)	(639) (16°)
Ethyl alcohol	33 60	728	575 (20°)
Ethylally acetophenone	122 5	(651)	(634) (16°)
Ethyl amylpropiolate	(112 7)	670	
Ethylaniline	89 30	(737)	(709)
9-Ethyl anthracene	153 0	(741)	(771) (99°)
Ethylbenzene	77 20	7272	6341 (20°)
Ethyl benzoate	93 32	621_1	(648) (25°)
Ethyl benzoylacetate	(115 3)	600	(673) (20°)
Ethyl benzylidenecyanoacetate	(116 3)	578	
Ethyl benzylmalonate	(154 5)	6172	(663) (20°)
Ethyl bromide	54 70	502	719 (20°)
Ethyl bromoacetate	(82 8)	496	(747) (20°)
Ethyl-1-isobutylacetoacetate	(121 4)	652	
Ethyl butylmalonate	139 3	644_0	(629) (20°)
Ethyl n-butyrate	(77 7)	6693	(585) (25°)
Ethyl iso-butyrate	78 32	674_3	(583) (25°)
Ethyl chloroacetate	(72 3)	590	(684) (20°)
Ethyl cinnamate	(107 5)	610	(640) (20°)
Ethyl-iso-cyanate	(45 6)	642	(582) (16°)
Ethyl cyanoacetate	(67 3)	595	(632) (20°)
Ethylcyclohexane	91 09	8118	6324 (20°)
Ethyldiallylacetophenone	147 4	(646)	(636) (16°)
Ethyl dibromocinnamate	174 5	519	
Ethyl dichloroacetate	85 2	(543)	(696) (20°)
Ethyl diethylacetoacetate	(117 9)	6328	(615) (20°)
Ethyl diethylmalonate	(140 4)	6492	(641)(20°)
Ethyl dithioacetate	(71 0)	5904 (27 4°)	
Ethylene	12 0	(428)	(242) (−102°)
Ethylene	15 30	546 (32°)	(309) (−102°)
Ethylene bromide	78 80	419	915 (20°)
Ethylene chloride	59 62	602 (32°)	(757) (20°)
Ethylenediamine	46 26	771 (32°)	(686) (20°)
Ethylene iodide	104 7	371 (32°)	(791) (10°)
Ethylene oxide	30 7	(697)	(618) (7°)
Ethyl ether	55 10	743	534 (20°)
Ethyl etnylacetoacetate	93 9	5937	(582) (20°)
Ethyl ethylbutylmalonate	(163 3)	6683	(650) (20°)
Ethyl ethylpropylmalonate	(152 4)	6619	(648) (20°)
Ethyl formate	43 00	580	531 (20°)
Ethyl hexylpropiolate	129 9	713	
Ethyl hydroxylamine	(43 0)	704	
Ethylidene chloride	(57 4)	580	(681) (20°)
Ethyl iodide	(69 7)	4470 (17 5°)	(864) (20°)
Ethyl iodoacetate	(97 6)	456	(829) (13°)
Ethyl lactate	(72 6)	615	(633) (25°)

DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Ethyl methylacetoacetate	(81 9)	5684	(569) (20°)
Ethyl methyl ketoxime	57 3_2	658_0	(530) (20°)
Ethyl-1-methyl-2-oxocyclohexane-carboxylate	112 1	(608)	
Ethyl methylphenylmalonate	(153 2)	6121	(658) (20°)
Ethyl nitrophenylpropiolate	114 6	523	
Ethyl oxamate	62 0	(529)	(427) (19°)
Ethyl perfluor-n-butyrate	103 5	(427)	
Ethyl phenylacetate	104 27	(635)	(656) (20°)
Ethyl phenylmalonate	(142 2)	6017	(659) (20°)
Ethyl phenylpropiolate	(104 2)	598	(636) (13°)
Ethyl phosphate	(98 2)	539	(576) (25°)
Ethyl propionate	(66 5)	6514	(584) (15°)
Ethyl propylacetoacetate	(105 7)	6135	(593) (20°)
Ethyl-n-propyl ketone	69 03	689_1	(560) (22°)
Ethyl succinimide	(72 0)	566	
Ethyl sulfine	(67 0)	631	
Ethyl sulfite	(75 4)	546	(604) (0°)
Ethylsulfone ethyl ether	(81 8)	592	
Ethyl thiocyanate	(55 7)	6392 (27 4°)	(637) (25°)
Ethyl isothiocyanate	(59 0)	6772 (27 4°)	(680) (15°)
Ethyl thiolacetate	(62 7)	6019 (27 4°)	(586) (25°)
Ethyl thionacetate	(63 5)	6098 (27 4°)	
Ethyl tribromoacetate	(119 5)	368	(821) (20°)
Ethyl trichloroacetate	(99 6)	520	(719) (20°)
N-Ethyl urea	55 5	(630)	(764) (18°)
Ethyl iso valerate	(91 1)	700	(607) (20°)
Eucalyptol	(116 3)	754	(699) (20°)
Eugenol and iso-eugenol	(102 1)	622	(663) (20°)
Flavanthrone	241 0	590	
Fluorene	110 5	655	
Fluorenone	99 4	552	(623) (100°)
Fluorobenzene	(58 4)	608	(623) (20°)
Fluorobromoacetic acid	(59 5)	379	
Fluorodichloromethane	48 8	474	(676) (0°)
p-Fluorophenetole	(88 0)	628	
Fluoro trichloroethylene	72 5	485	(742) (25°)
Fluorotrichloromethane	58 7	427	(638) (17°)
Formaldehyde	(18 6)	62	(51) (−20°)
Formamide	(21 9)	486	(551) (20°)
Formic acid	19 90	432	527 (20°)
β-Formylpropionic acid	55 3	(542)	
Fructose	102 60	570	
Fulvene (Benzene χ_M measured to be 49)	42 9	(549)	(452) (20°)
Fulvene $\left(\chi \frac{54\ 8}{49}\right)$	48 0	(614)	(505) (20°)
Fumaric acid	49 11	(423)	(692) (20°)
Furan	43 09	633 (20°)	(598) (15°)
Furfural	47 1	(490)	(568) (20°)
Galactose	103 00	572	
Gallic acid	90 0	(529)	(896) (4°)
Geraniol formate	(119 9)	658	(610) (20°)
Glucose	102 60	570	
D-Glucose	101 5	(563)	(869) (25°)
Glutamic acid	78 5	(533)	
Glycerol	57 06	619	779 (20°)
Glycine	40 3	(537)	(846) (50°)
Glycol	38 80	624	698 (20°)
Guaiacol	(79 2)	638	(720) (21°)
Helianthrone	189 9	497	
1,2-Heptadiene	73 5	(764)	
2,3-Heptadiene	72 1	(749)	
Heptaldehyde	81 02	709_6	(603) (20°)
n-Heptane	85 24	8507	5817 (20°)
4-Heptanol	91 5	789	(647) (20°)
n-Heptanoic acid	88 60	680	626 (20°)
n-Heptyl amine	93 1	(808)	(628) (20°)
n-Heptyl benzene	134 41	7625	6528 (20°)
Heptyl cyclohexane	147 40	8084	6559 (20°)
n-Heptylic acid	89 74	6900	(630) (25°)
1-Heptyne	77 0	(801)	(584) (25°)
2 Heptyne	79 5	(826)	(615) (25°)
Hexabromoethane	(148 0)	294	(1 124) (20°)
Hexachlorobenzene	(147 5)	518	(1 059) (24°)
Hexachloroethane	(112 7)	476	(995) (20°)
Hexachlorohexatriene	(145 0)	433	
n-Hexadecane	187 63	8286	6421 (20°)
1,5-Hexadiene	(55 1)	671	(462) (20°)
2,3-Hexadiene	60 9	(741)	
n Hexaldehyde	69 40	693_0	
2,2,4,7,9,9-Hexamethyldecane	191 52	8458	6596 (20°)
Hexamethyl disiloxane	118 9	7324	
Hexamethylene glycol	84 30	713	
n-Hexane	(74 6)	8654 (27 4°)	(565)
Hexene	65 7	(781)	
Hexestrol	(165)	61 ± 02	
n-Hexyl alcohol	79 20	774	637 (20°)
n-Hexyl benzene	124 23 (20°)	(767)	(658) (20°)
n-Hexyl methyl ketone	91 4_7	713_1	(583)
n-Hexyl methyl ketoxime	102 5_8	716_2	(634) (20°)
Hexylpropiolamide	(103 7)	677	
Hydrindene	(78 5)	664	(639) (16°)
Hydroquinone	64 63	587	(797) (20°)
Hydroxyazobenzene	(99 7)	503	
p-Hydroxybenzaldehyde	66 8	(547)	(618) (130°)
4-Hydroxy-2-butanone	48 5	55	(573) (14°)
Indene (natural)	84 79	(730)	(723) 25°)
Indene (synthetic)	80 89	(696)	(690) (25°)
Indole	85 0	(726)	
Iodobenzene	92 00	451	826 (20°)
Iodoform (in sol'n)	117 1	2974 (20°)	(1 192) (17°)
1 Iodo-2 phenylacetylene	(110 1)	483	
o Iodotoluene	(112 2)	5145 (30°)	(874) (20°)
m-Iodotoluene	(112 3)	5152 (30°)	(875) (20°)
p-Iodotoluene	101 31	(465)	(780) (40°)
Leucine	84 9	(647)	
iso-Leucine	84 9	(647)	
Maleic acid	49 71	(428)	(681) (20°)
Maleic anhydride	(35 8)	365	(341) (20°)
Malonic acid	(46 3)	4453	(726) (15°)
Mannitol	111 20	610	(908) (20°)
Mannose	102 90	571	(879)
Mesitylene	92 32	7632 (20°)	(665) (20°)
Methane	12 2_7	(765)	
Methione	91 0	(610)	
p-Methoxyazobenzene	(118 9)	560	
o-Methoxybenzaldehyde	76 0	(558)	(632) (20°)
p-Methoxybenzaldehyde	78 0	(572)	(642) (20°)
o-Methoxybenzyl alcohol	87 9	637	(664) (25°)
1-Methoxynaphthalene	107 0	(676)	(741) (14°)
2-Methoxynaphthalene	107 6	(680)	
1 (o-Methoxyphenylazo)-2-naphthol	163 6	(588)	
Methoxysaligenin acetate	110 3	613	
Methyl acetate	42 60	575	537 (20°)
Methyl acetoacetate	59 60	513_2	(553) (20°)
Methylacetylacetone	(65 0)	569	
Methyl alcohol	21 40	668	530 (20°)
Methylallylaketone	111 9	(1 330)	
Methylamine	(27 0)	870	(608) (−11°)
N Methylaniline	82 74	(773)	(762) 20°)
9-Methylanthracene	146 5	762)	(812) (99°)
Methyl benzoate	81 59	599_3	(651) (25°)
Methyl-o-benzoylbenzoate	139 4	(580)	(690) (19°)
Methylbenzylaniline	(132 2)	670	
Methyl bromide	42 8	451	(1 044) (0°)
2-Methylbutane	64 40	8925	5531 (20°)
2-Methyl-2-butene	54 14	(772)	(516) (18°)
Methyl butyl ketone	(69 1)	690	(563) (15°)
Methyl iso-butyl ketone	(69 3)	692	(554) (20°)
Methyl tert-butyl ketone	(70 4)	703	(562) (16°)
p-Methyl-o-tert butylphenol	120 3	(732)	
Methyl butyrate	(66 4)	6498	(588) (16°)
o-Methylcarbanilide	154 0	(681)	
Methyl chloride	(32 0)	633	
Methyl chloroacetate	58 1	(535)	(661) (20°)
Methylcholanthrene	(182)	68 ± 04	
3-Methylcholanthrene	194 0	(723)	
Methylcyclohexane	78 91	8038	6181 (20°)
2-Methylcyclohexanone	(74 0)	660	(610) (18°)
3-Methylcyclohexanone	(74 8)	667	(610) (20°)
4-Methylcyclohexanone	(63 5)	566	(516) (24°)
Methylcyclopentane	70 17	8338	6245 (20°)
4-Methyl-2,6-di tert-butylphenol	167 6	(761)	
Methyl dichloroacetate	73 1	(511)	
Methyldiphenoxyphosphine oxide	(152 9)	616	
Methyldiphenyltriazine	(155 1)	627	
Methylene bromide	65 10	375	935 (20°)
Methylene chloride	(46 6)	549	(733) (20°)
Methylene iodide	93 10	348	1 156 (20°)
Methylene succinic acid	57 57	(443)	(723)
Methyl ether	26 3	571	
Methylethylallylacetophenone	133 3	(659)	(643) (16°)
Methyl ethyl ketone	45 5_8	632_0	(509) (20°)
Methyl formate	(32 0)	5327	(519) (20°)
Methylfumaric acid	56 98	(438)	(642)
3-Methylheptane	97 99	8580	6056 (20°)
2-Methyl-4 heptene	88 0	(784)	
5-Methyl-1,2 hexadiene	73 6	(765)	(553) (19°)
2-Methylhexane	86 24	8607	5841 (20°)
Methyl hexyl ketone	(93 3)	728	(596) (20°)
Methyl-m-hydroxybenzoate	88 4	(581)	
Methyl p-hydroxybenzoate	88 7	(583)	
Methyl iodide	(57 2)	403	(918) (20°)
Methylmaleic acid	57 84	(446)	(721)
9-Methyl-10 methoxyanthracene	158 1	(711)	
Methyl-o-methoxybenzoate	95 6	(575)	(665) (19°)
Methyl-p-methoxybenzoate	98 6	(593)	
Methyl-α-methoxy isobutyrate	(81 9)	620	
1-Methylnaphthalene	102 8	(723)	(741) (14°)
2-Methylnaphthalene	102 6	(722)	(743) (20°)
4-Methylnonane	121 39	(853)	(625) (20°)
5-Methyl-5-nonene	111 6	(796)	
4-Methyloctane	109 63	(855)	(618) (20°)
Methylol urea	48 3	(493)	
2 Methylpentane	75 26	8734	5705 (20°)
3-Methylpentane	75 52	8764	5823 (20°)
4-Methyl 2-pentanol	80 4	788	(641) (20°)
Methyl perfluor-n-butyrate	92 5	(406)	
Methyl phenylacetate	92 73	(618)	(645) (16°)
Methyl phenylpropiolate	95 6	597	
2-Methylpropene	44 4	(791)	
Methyl propionate	(55 0)	6240	(571) (20°)

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Methyl n-propyl ketone	57 41	666$_1$	(541) (15°)
Methyl-iso-propyl ketone	58 45	679$_0$	(545) (20°)
1 Methylpyrrole	58 56	722 (20°)	(664) (10°)
2-Methylpyrrole	60 10	741 (20°)	(700)
Methyl salicylate	86 30	567	668 (20°)
Methyl silicone	(172 7)	730	
α-Methyl styrene	(80 1)	678	(620) (20°)
2 Methylthiazole	59 56	601 (20°)	
2-Methylthiophene	66 35	676 (20°)	(689) (20°)
Methyl trichloroacetate	84 2	(475)	(707) (19°)
N-Methyl urea	44 6	(602)	(725)
Morpholine	55 0	(631)	(631)
Myleran	169 7	69	(834) (4°)
Myristic acid	176 0	(771)	(661) (60°)
Naphthalaldehydic acid	117 6	(588)	
Naphthalene	(91 9)	717	(821) (20°)
Naphthalene picrate	185 9	(523)	
2-Naphthalenesulfonylamine	127 6	(616)	
2-Naphthalenesulfonyl chloride	121 91	(538)	
meso-Naphthodianthrene	214 6	612	
meso-Naphthodianthrone	221 8	583	
1-Naphthol	98 2	681	(834) (4°)
	97 0	673	(819) (4°)
2-Naphthol	98 25	(682)	(829) (4°)
α Naphthonitrile	103 3	(674)	(753) (5°)
β-Naphthonitrile	101 0	(659)	(721) (60°)
α-Naphthoquinone	73 5	(465)	(661)
β-Naphthoquinone	67 9	(429)	
N-1-Naphthylacetamide	117 8	(636)	
N-2-Naphthylacetamide	117 8	(636)	
1-Naphthylamine	98 8	690	757 (54°)
2-Naphthylamine	98 00	(684)	(726) (98°)
1-Naphthylamine hydrochloride	(127 6)	710	
Nicotine	113 328	(699)	(705) (20°)
o-Nitroaniline	66 47	(481)	(694) (15°)
m-Nitroaniline	70 09	(507)	(725) (20°)
p-Nitroaniline	66 43	(481)	(691) (14°)
o-Nitrobenzaldehyde	68 23	4517	
m-Nitrobenzaldehyde	68 55	4538	
p-Nitrobenzaldehyde	66 57	4407	(507) (0°)
Nitrobenzene	61 80	502	604 (20°)
Nitrobenzene diazo cyanide	59 22	(336)	
o-Nitrobenzoic acid	76 11	4556	(718) (4°)
m-Nitrobenzoic acid	80 22	4802	(717) (4°)
p-Nitrobenzoic acid	78 81	4718	(731) (32°)
o-Nitrobromobenzene	87 3	(432)	(700) (80°)
m-Nitrobromobenzene	89 5	(443)	(755) (20°)
p-Nitrobromobenzene	89 6	(444)	(859) (22°)
m-Nitro carbanilide	148 1	(576)	
Nitroethane	(35 4)	472	(497) (20°)
Nitromethane	21 1	3457	(391) (25°)
1-Nitronaphthalene	98 47	(569)	(696) (62°)
o-Nitrophenol	73 3	527 (24°)	(873) (20°)
m Nitrophenol	70 8	509 (25°)	(756)
p-Nitrophenol	69 5	500 (22°)	(740)
1-(m-Nitrophenylazo)-2-naphthol	142 0	(484)	
1-(p-Nitrophenylazo)-2-naphthol	141 7	(483)	
Nitrophenylfluoroform	(84 1)	440	
2-Nitropropane	45 73	5135	(509) (20°)
Nitrosobenzene	59 1	(552)	
N-Nitrosodiethylamine	59 3	(580)	(546) (20°)
p-Nitrosodiethylaniline	92 6	(520)	(644) (15°)
p-Nitrosodimethylaniline	73 3	(488)	
N-Nitrosodiphenylamine	110 7	(558)	
1-Nitroso-2-naphthol	83 9	(485)	
2-Nitroso-1-naphthol	82 7	(478)	
4-Nitroso-1-naphthol	91 8	(530)	
m-Nitrosonitrobenzene	66 0	(433)	
p-Nitrosonitrobenzene	65 8	(433)	
p-Nitrosophenol	50 7	(412)	
Nitrosopiperidine	(63 4)	555	(590) (20°)
p-Nitrosotoluene	70 4	(581)	
o-Nitrotoluene	72 28	5272	(613) (20°)
m-Nitrotoluene	72 71	5304	(614) (20°)
p-Nitrotoluene (in sol'n)	72 06	5257	(676) (20°)
n-Nonane	108 13	8431	6057 (20°)
1,2-Octadiene	83 6	(759)	
n-Octane	96 63	8460	5949 (20°)
Octanonoxime	(102 7)	717	
Octyl alcohol	102 65	7766 (20°)	(640) (20°)
Octyl chloride	(114 9)	773	(676) (20°)
Octylcyclohexane	158 09	8051	6578 (20°)
Octylene	(89 5)	798	(576) (17°)
Octylene bromide	(150 4)	553	
n-Octyl mercaptan	(115 1)	7866 (27 4°)	
Oenanthylidene chloride	(116 5)	689	
Oleic acid	208 5	(738)	(661) (18°)
Opianic acid	111 5	(530)	
Ovalene	353 8	888	
Oxalic acid (anh)	33 8	(375)	
Oxalic acid	60 05	(4763)	(787)
Oxamide	(39 0)	443	(738)
Palmitic acid	198 6	(775)	(661) (62°)
Paraldehyde	(86 2)	652	(648) (20°)
Pentabromophenol	(194 0)	397	
Pentacene	(205 4)	738	

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Pentachloroethane	(99 1)	490	(819) (25°)
Pentachlorohexadiene	(129 5)	452	
2 3 Pentadiene	49 1	(721)	(501) (20°)
n-Pentane	63 05	8739	5472 (20°)
2 4 Pentanediol	70 4	677	
Perfluoroacetic acid	43 3	(380)	
Perfluoro n-butyric acid	81 0	(378)	
Perfluorobutyric anhydride	149 4	(387)	
Perfluorocyclooctane oxide	157 6	(379)	
Perfluoropropionic acid	61 0	(372)	
Perhydroanthracene	146 01	7592	7178 (20°)
Perylene	166 8	662	
Phenanthrene	(127 9)	718	(763) (100°)
Phenanthrenequinone	104 5	502	(698)
Phenanthrenonitrile	139 0	(685)	
o-Phenetidine	(101 7)	741 (25°)	
p-Phenetidine	(96 8)	706 (25°)	(749) (15°)
Phenetole	(84 5)	692	(689) (20°)
Phenol	60 21	(640)	(675) (45°)
Phenothiazine	114 8	(576)	
Phenylacetaldehyde	72 01	599$_4$	(614) (20°)
Phenyl acetate	82 04	(603)	(647) (25°)
Phenylacetic acid	82 72	(608)	(657) (80°)
Phenylacetylene	72 01	(705)	(655) (20°)
1-Phenylazo-2 naphthol	137 6	(554)	
2-Phenylbensofuran	130 5	(672)	
1 Phenyl 4-benzoyl 1,3 butadiene	(140 3)	599	
Phenylbutadiene	(85 7)	658	
4 Phenyl 1-butene	93 49	(7077)	(6239) (20°)
Phenylbutyl acetate	134 5	653	
Phenyl n-butyrate	105 46	(643)	
Phenyl iso-cyanate	(72 7)	610	(699) (20°)
o Phenylenediamine	71 98	6662	
m Phenylenediamine	70 53	6529	(723) (58°)
p Phenylenediamine	70 28	6503	
Phenyl ether	(108 1)	635	(681) (20°)
Phenylethyl sulfide	(94 4)	6826 (27 4°)	
Phenylfluoroform	(77 3)	529	
Phenylhydrazine	67 82	(627)	(688) (23°)
Phenylhydroxylamine	(68 2)	625	
Phenyl mercaptan	(70 8)	6425 (27 4°)	(693) (20°)
1-Phenyl 2 Methylbutane	113 53	(766)	(660) (20°)
Phenylmethyl sulfide	(83 2)	6695 (27 4°)	
Phenylpropiolamide	(83 3)	574	
Phenyl propionate	93 79	625)	(654) (25°)
Phenylsulfone	(129 0)	591	(740) (20°)
Phenyl thiocyanate	(81 5)	6027 (27 4°)	(677) (24°)
Phenyl isothiocyanate	(86 0)	6365 (27 4°)	(719) (24°)
1-Phenyl 4,6 6-trimethylheptane	173 90	(796)	(682) (20°)
N Phenyl urea	82 1	(603)	(785)
Phloroglucinol	(73 4)	582	
Phthalamide	(91 3)	556	
Phthalic acid	83 61	5035	(802) (20°)
iso Phthalic acid	84 64	5097	
tere-Phthalic acid	83 51	5029	(759)
Phthalic anhydride	67 31	(454)	(694) (4°)
Phthalimide	(78 4)	533	
Picric acid	84 38	(368)	(649)
Piperazine	56 8	(659)	
Piperidine	64 2	(754)	(650) (20°)
Propane	40 5	(919)	(538) (−45°)
Propene	31 5	(749)	(456) (−47°)
Propionaldehyde	34 32	591$_0$	(477) (20°)
Propionic acid	43 50	586	582 (20°)
Propionitrile	38 5	(699)	(547) (21°)
Propionylphenylacetylene	(95 1)	601	
Propiophenone	83 73	624$_0$	(631) (20°)
n-Propyl acetate	65 91	645$_3$ (25°)	(569) (25°)
iso Propyl acetate	67 04	656$_4$	(566) (25°)
n-Propyl alcohol	45 176 (20°)	(7518)	(6047) (20°)
iso-Propyl alcohol	45 794 (20°)	(7621)	(5985) (20°)
9-Propylanthracene	164 0	(744)	
n-Propylbenzene	89 24	(742)	(640) (20°)
n-Propyl benzoate	105 00	(640)	(646) (2$_0$°)
n-Propyl bromide	(65 6)	533	(721) (20°)
iso-Propyl bromide	(65 1)	529	(693) (20°)
Propyl butyrate	(89 4)	6867	(604) (15°)
prim-Propyl chloride	56 10	715	633 (20°)
iso-Propylcyclohexane	102 65	8131	6528 (20°)
Propylenediamine	(58 1)	784	(688) (15°)
Propylene oxide	42 5	(732)	(629) (0°)
Propyl formate	(55 0)	6248	(563) (20°)
Propyl hexylpropiolate	(136 8)	697	
Propyl iodide	(84 3)	4958 (30°)	(864) (20°)
Propyl propionate (extrap)	(77 95)	6711	(593) (20°)
Propyl sulfide	(92 1)	7787 (27 4°)	(634) (17°)
N-Propyl urea	67 4	(660)	
Pseudocumene	(101 6)	845 (20°)	(740) (20°)
Pyramidone	149 0	(645)	
Pyranthrene	266 9	709	
Pyranthrone	250 3	616	
Pyrazine	37 6	(469)	(484) (61°)
Pyrene	147 9	731	(933) (0°)
Pyridine	49 21	(622)	(611) (20°)
Pyrocatechol	68 76	6248	(857) (15°)
Pyrrole	47 6	(709)	(688) (20°)

DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Pyrrolidine	54 8	(771)	(657) (23°)	Trianilinophosphine oxide	(201 7)	624	
Quinoline	86 0	(666)	(729) (20°)	1,2,3-Tribromopropane	(117 9)	420	(1 023) (23°)
Quinone	38 4	(355)	(468) (20°)	Tri-iso-butylamine	(156 8)	846	(646) (25°)
Quinonoxime	(50 4)	409		Trichloroacetic acid (in sol n)	73 0	(44)	(723) (46°)
Resorcinol	67 26	6112	(785) (15°)	Trichlorobenzene	(106 5)	587	
Rhamnose	99 20	605	(890) (20°)	Trichloro-tert-butyl alcohol (in sol n)	98 01	552	
Safrol and iso-Safro	(97 5)	601	(66) (20°)	Trichloroethylene	65 8	501	(734) (20°)
Salicylaldehyde	64 4	(527)	(615) (20°)	Trichloronitromethane	(75 3)	458	(756) (20°)
Salicylic acid	72 23	523	(755) (20°)	Triethylamine	81 4	(804)	(586) (20°)
Saligenin	76 9	620	(720) (25°)	Triethyl citrate	(161 9)	586	(666) (20°)
Salol	(123 2)	575	678 (45°)	Triethyl phosphate	(125 3)	688	(735) (20°)
Salvarsan dihydrochloride	(246 1)	518		Triethylphosphine	(90 0)	762	(610) (15°)
Selenophene	66 82	510		Triethylphosphine oxide	(91 6)	683	
iso-Selenophene	110–111	84– 85		Triethyl phosphite	(104 8)	631	(611) (20°)
trans-Selenophene	70–77	53 59		Triethyl triazinetricarbonate	(164 1)	552	
Sorbitol	107 80	592		Trifluorocresol	(83 8)	517	
Stearic acid	220 8	(776)	(657) (69°)	Tri-n heptylamine	251 3	(806)	
Stilbene	(120 0)	666	(646) (125°)	Tri n hexylamine	221 7	(823)	
Stilbestrol	(130)	62 63		Trimethylacetophenone	108 2	(667)	(648) (16°)
Styrene	(68 2)	655	(594) (20°)	2,2 3-Trimethylbutane	88 36	8818	6086 (20°)
Succinic acid	(57 9)	4902	(767) (15°)	2,2 3 Trimethylpentane	99 86	8743	6261 (20°)
Succinic anhydride	(47 5)	475	(524)	2,2,4-Trimethylpentane	98 34	8610	5958 (20°)
Succinimide	(47 3)	477	(674) (16°)	2,3 5-Trimethylpyrrole	82 31	754 (20°)	
Sulfamide	44 4	(462)	(832)	1,3 5-Trinitrobenzene	74 55	(350)	(591) (20°)
p-Sulfanilamide	80 15	(465)		Triperfluorobutylamine	253 0	(377)	
Terpineol	111 9	(725)	(678) (room temp)	Triphenoxyarsine	(195 2)	551	
				Triphenylarsine	(177 0)	578	
Tetrabenzylmonosilane	266 2	(678)		Triphenylarsine dihydroxide	(270 5)	795	
1 1,2,2-Tetrabromoethane	(123 4)	357	(1 058) (20°)	Triphenylarsine oxide	(199 1)	618	
Tetrabromoethylene	(114 8)	334		Triphenylbismuthine	(196 8)	447	(708) (20°)
Tetracene	(168 0)	736		Triphenylbismuthine dinitrate	(254 5)	451	
1,1,2,2-Tetrachloroethane	(89 8)	535	(856) (20°)	Triphenylcarbinol	(175 7)	675	(802) (20°)
Tetrachloroethylene	81 6	492	(802) (15°)	Triphenylmethane	(165 6)	678	686 (100°)
Tetrahydroquinoline	(89 0)	668	(715) (4°)	Triphenylphosphine	(166 8)	636	(759)
Tetraiodoethylene	(164 3)	309	(922) (20°)	Triphenyl phosphite	(183 7)	592	(701) (18°)
Tetraiodopyrrole	(188 9)	331		Triphenylstibine	(182 2)	516	
Tetramethylketotetrahydrofurfurane	(104 7)	736		Triphenylstibine dihydroxide	(238 5)	616	
Tetranitromethane	43 02	2195	(360) (20°)	N,N',N Triphenyl urea	176 5	(613)	
Tetraphenylbutadiene	228 0	(636)		Triquinoyl	(133 0)	426	
Tetraphenyldecapentaene	280 8	(643)		Tropolone	61	50	
Tetraphenylhexatriene	246 4	(641)		Tryptophan	132 0	(646)	
Tetraphenyloctatetraene	264 1	(643)		Tyrosine	105 3	(581)	
Tetraphenylrubene	344 0	(646)		Undecane	131 84	(8435)	(6247) (20°)
Tetra-p-tolylmonosilane	276 4	(704)		Urea	33 4	(556)	(742) (20°)
Tetrolic acetal	(97 8)	688		Urethan	(57)	64	(63) (21°)
Tetronic acid	(52 5)	525		iso-Valeraldehyde	(57 5)	668	(536) (17°)
Thiacoumerin	93 6	577		n Valeric acid	66 85	6548	(617) (20°)
Thiazole	50 55	595 (20°)	(714) (17°)	iso-Valeric acid	(67 7)	663	(621) (15°)
Thiobarbituric acid	72 9	(506)		Valerylphenylacetylene	(119 0)	639	
Thiophene	57 38	682 (20°)	(726) (20°)	Valine	74 3	(634)	
Tolane	(118 9)	667	(644) (100°)	Violanthrene	273 5	641	
Toluene	66 11	7176	6179 (20°)	Violanthrone	204 8	449	
o-Toluidine	76 0	710 (24°)	(709) (20°)	iso-Violanthrone	215 9	473	
m-Toluidine	74 6	697 (25°)	(689) (20°)	Water	(13 00)	7218 (20°)	(7205) (20°)
p-Toluidine	72 1	673 (25°)	(704) (20°)	Water (value usually used as standard)	(12 97)	720 (20°)	(719) (20°)
α-Tolunitrile	76 87	(656)	(666) (18°)	Xanthone	(108 1)	551	
1-(o-Tolylazo) 2-naphthol	148 7	(567)		o-Xylene	77 78	7327	6440 (20°)
1-(p-Tolylazo)-2 naphthol	157 6	(601)		m-Xylene	76 56	7212	6235 (20°)
Triallylacetophenone	152 5	(634)		p-Xylene	76 78	7232	6226 (20°)
Tri iso-amylamine	192	845	(647) (25°)	Xylose	84 80	565	(862) (20°)

FOUR-PLACE LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	*4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	*3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

* Interpolation in this section of the table is inaccurate.

FOUR-PLACE LOGARITHMS (Continued)

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

1a	2a	3b	4b	5b	6b	7b	8	1b	2b	3a	4a	5a	6a	7a	0	Orbit
1 +1 −1 **H** 1.00797 1					Atomic Number → **50** +2 +4 Symbol → **Sn** Atomic Weight → 118.69 −18−18−4 ← Electron Configuration ← Oxidation States KEY TO CHART										**2** 0 **He** 4.0026 2	K
3 +1 **Li** 6.939 2-1	**4** +2 **Be** 9.0122 2-2									**5** +3 **B** 10.811 2-3	**6** +2 +4 −4 **C** 12.01115 2-4	**7** +1 +2 +3 +4 +5 −1 **N** 14.0067 −2 −3 2-5	**8** −2 **O** 15.9994 2-6	**9** −1 **F** 18.9984 2-7	**10** 0 **Ne** 20.183 2-8	K-L
11 +1 **Na** 22.9898 2-8-1	**12** +2 **Mg** 24.312 2-8-2	Transition Elements						Transition Elements		**13** +3 **Al** 26.9815 2-8-3	**14** +2 +4 −4 **Si** 28.086 2-8-4	**15** +3 +5 −3 **P** 30.9738 2-8-5	**16** +4 +6 −2 **S** 32.064 2-8-6	**17** +1 +5 +7 −1 **Cl** 35.453 2-8-7	**18** 0 **Ar** 39.948 2-8-8	K-L-M
19 +1 **K** 39.102 -8-8-1	**20** +2 **Ca** 40.08 -8-8-2	**21** +3 **Sc** 44.956 -8-9-2	**22** +2 +3 +4 **Ti** 47.90 -8-10-2	**23** +2 +3 +4 +5 **V** 50.942 -8-11-2	**24** +2 +3 +6 **Cr** 51.996 -8-13-1	**25** +2 +3 +4 +7 **Mn** 54.9380 -8-13-2	**26** +2 +3 **Fe** 55.847 -8-14-2	**27** +2 +3 **Co** 58.9332 -8-15-2	**28** +2 +3 **Ni** 58.71 -8-16-2	**29** +1 +2 **Cu** 63.54 -8-18-1	**30** +2 **Zn** 65.37 -8-18-2	**31** +3 **Ga** 69.72 -8-18-3	**32** +2 +4 **Ge** 72.59 -8-18-4	**33** +3 +5 −3 **As** 74.9216 -8-18-5	**34** +4 +6 −2 **Se** 78.96 -8-18-6	**35** +1 +5 −1 **Br** 79.909 -8-18-7	**36** 0 **Kr** 83.80 -8-18-8	-L-M-N
37 +1 **Rb** 85.47 -18-8-1	**38** +2 **Sr** 87.62 -18-8-2	**39** +3 **Y** 88.905 -18-9-2	**40** +4 **Zr** 91.22 -18-10-2	**41** +3 +5 **Nb** 92.906 -18-12-1	**42** +6 **Mo** 95.94 -18-13-1	**43** +4 +6 +7 **Tc** (99) -18-13-2	**44** +3 **Ru** 101.07 -18-15-1	**45** +3 **Rh** 102.905 -18-16-1	**46** +2 +4 **Pd** 106.4 -18-18-0	**47** +1 **Ag** 107.870 -18-18-1	**48** +2 **Cd** 112.40 -18-18-2	**49** +3 **In** 114.82 -18-18-3	**50** +2 +4 **Sn** 118.69 -18-18-4	**51** +3 +5 −3 **Sb** 121.75 -18-18-5	**52** +4 +6 −2 **Te** 127.60 -18-18-6	**53** +1 +5 +7 −1 **I** 126.9044 -18-18-7	**54** 0 **Xe** 131.30 -18-18-8	-M-N-O
55 +1 **Cs** 132.905 -18-8-1	**56** +2 **Ba** 137.34 -18-8-2	**57*** +3 **La** 138.91 -18-9-2	**72** +4 **Hf** 178.49 -32-10-2	**73** +5 **Ta** 180.948 -32-11-2	**74** +6 **W** 183.85 -32-12-2	**75** +4 +6 +7 **Re** 186.2 -32-13-2	**76** +3 +4 **Os** 190.2 -32-14-2	**77** +3 +4 **Ir** 192.2 -32-15-2	**78** +2 +4 **Pt** 195.09 -32-16-2	**79** +1 +3 **Au** 196.967 -32-18-1	**80** +1 +2 **Hg** 200.59 -32-18-2	**81** +1 +3 **Tl** 204.37 -32-18-3	**82** +2 +4 **Pb** 207.19 -32-18-4	**83** +3 +5 **Bi** 208.980 -32-18-5	**84** +2 +4 **Po** (210) -32-18-6	**85** **At** (210) -32-18-7	**86** 0 **Rn** (222) -32-18-8	-N-O-P
87 +1 **Fr** (223) -18-8-1	**88** +2 **Ra** (226) -18-8-2	**89**** +3 **Ac** (227) -18-9-2														-O-P-Q

*Lanthanides	**58** +3 +4 **Ce** 140.12 -19-9-2	**59** +3 **Pr** 140.907 -20-9-2	**60** +3 **Nd** 144.24 -22-8-2	**61** +3 **Pm** (145) -23-8-2	**62** +2 +3 **Sm** 150.35 -24-8-2	**63** +2 +3 **Eu** 151.96 -25-8-2	**64** +3 **Gd** 157.25 -25-9-2	**65** +3 **Tb** 158.924 -26-9-2	**66** +3 **Dy** 162.50 -28-8-2	**67** +3 **Ho** 164.930 -29-8-2	**68** +3 **Er** 167.26 -30-8-2	**69** +3 **Tm** 168.934 -31-8-2	**70** +2 +3 **Yb** 173.04 -32-8-2	**71** +3 **Lu** 174.97 -32-9-2	-N-O-P
**Actinides	**90** +4 **Th** 232.038 -19-9-2	**91** +5 +4 **Pa** (231) -20-9-2	**92** +3 +4 +5 +6 **U** 238.03 -21-9-2	**93** +3 +4 +5 +6 **Np** (237) -22-9-2	**94** +3 +4 +5 +6 **Pu** (242) -23-9-2	**95** +3 +4 +5 +6 **Am** (243) -24-9-2	**96** +3 **Cm** (247) -25-9-2	**97** +3 +4 **Bk** (249) -26-9-2	**98** +3 **Cf** (251) -28-8-2	**99** **Es** (254) -29-8-2	**100** **Fm** (252) -30-8-2	**101** **Md** (256) -31-8-2	**102** (254) -32-8-2	**103** **Lw**	-O-P-Q

Numbers in parentheses are mass numbers of most stable isotope of that element.

PERIODIC TABLE OF THE ELEMENTS

ATOMIC WEIGHTS

For the sake of completeness all known elements are included in the list. Several of those more recently discovered are represented only by the unstable isotopes. The value in parenthesis in the atomic weight column is, in each case, the mass number of the most stable isotope.**

Name	Symbol	At. No.	International atomic weight		Valence
			1961	1959	
Actinium	Ac	89	.....	(227)	.....
Aluminum	Al	13	26.9815	26.98	3
Americium	Am	95	.....	(243)	3, 4, 5, 6
Antimony, stibium	Sb	51	121.75	121.76	3, 5
Argon	Ar	18	39.948	39.944	0
Arsenic	As	33	74.9216	74.92	3, 5
Astatine	At	85	.....	(210)	1, 3, 5, 7
Barium	Ba	56	137.34	137.36	2
Berkelium	Bk	97	.....	(217)	3, 4
Beryllium	Be	4	9.0122	9.013	2
Bismuth	Bi	83	208.980	208.99	3, 5
Boron	B	5	10.811	10.82	3
Bromine	Br	35	79.909	79.916	1, 3, 5, 7
Cadmium	Cd	48	112.40	112.41	2
Calcium	Ca	20	40.08	40.08	2
Californium	Cf	98	.....	(251)	.....
Carbon	C	6	12.01115	12.011	2, 4
Cerium	Ce	58	140.12	140.13	3, 4
Cesium	Cs	55	132.905	132.91	1
Chlorine	Cl	17	35.453	35.457	1, 3, 5, 7
Chromium	Cr	24	51.996	52.01	2, 3, 6
Cobalt	Co	27	58.9332	58.94	2, 3
Columbium, see *Niobium*					
Copper	Cu	29	63.54	63.54	1, 2
Curium	Cm	96	.....	(247)	3
Dysprosium	Dy	66	162.50	162.51	3
Einsteinium	Es	99	.....	(254)	.....
Erbium	Er	68	167.26	167.27	3
Europium	Eu	63	151.96	152.0	2, 3
Fermium	Fm	100	.....	(257)	.....
Fluorine	F	9	18.9984	19.00	1
Francium	Fr	87	.....	(223)	1
Gadolinium	Gd	64	157.25	157.26	3
Gallium	Ga	31	69.72	69.72	2, 3
Germanium	Ge	32	72.59	72.60	4
Gold, aurum	Au	79	196.967	197.0	1, 3
Hafnium	Hf	72	178.49	178.50	4
Helium	He	2	4.0026	4.003	0
Holmium	Ho	67	164.930	164.94	3
Hydrogen	H	1	1.00797	1.0080	1
Indium	In	49	114.82	114.82	3
Iodine	I	53	126.9044	126.91	1, 3, 5, 7
Iridium	Ir	77	192.2	192.2	3, 4
Iron, ferrum	Fe	26	55.847	55.85	2, 3
Krypton	Kr	36	83.80	83.80	0
Lanthanum	La	57	138.91	138.92	3
Lead, plumbum	Pb	82	207.19	207.21	2, 4
Lithium	Li	3	6.939	6.940	1
Lutetium	Lu	71	174.97	174.99	3
Magnesium	Mg	12	24.312	24.32	2
Manganese	Mn	25	54.9380	54.94	2, 3, 4, 6, 7
Mendelevium	Md	101	.....	(256)	.....
Mercury, hydrargyrum	Hg	80	200.59	200.61	1, 2
Molybdenum	Mo	42	95.94	95.95	3, 4, 6
Neodymium	Nd	60	144.24	144.27	3
Neon	Ne	10	20.183	20.183	0
Neptunium	Np	93	.....	(237)	4, 5, 6
Nickel	Ni	28	58.71	58.71	2, 3
Niobium (columbium)	Nb	41	92.906	92.91	3, 5
Nitrogen	N	7	14.0067	14.008	3, 5
Nobelium	No	102	.....	(254)	.....
Osmium	Os	76	190.2	190.2	2, 3, 4, 8
Oxygen	O	8	15.9994	16.000	2
Palladium	Pd	46	106.4	106.4	2, 4, 6
Phosphorus	P	15	30.9738	30.975	3, 5
Platinum	Pt	78	195.09	195.09	2, 4
Plutonium	Pu	94	.....	(244)	3, 4, 5, 6
Polonium	Po	84	.....	(209)	.....
Potassium, kalium	K	19	39.102	39.100	1
Praseodymium	Pr	59	140.907	140.92	3
Promethium	Pm	61	.....	(145)	3
Protactinium	Pa	91	.....	(231)	.....
Radium	Ra	88	.....	(226)	2
Radon	Rn	86	.....	(222)	0
Rhenium	Re	75	186.2	186.22	.....
Rhodium	Rh	45	102.905	102.91	3
Rubidium	Rb	37	85.47	85.48	1
Ruthenium	Ru	44	101.07	101.1	3, 4, 6, 8
Samarium	Sm	62	150.35	150.35	2, 3
Scandium	Sc	21	44.956	44.96	3
Selenium	Se	34	78.96	78.96	2, 4, 6
Silicon	Si	14	28.086	28.09	4
Silver, argentum	Ag	47	107.870	107.873	1
Sodium, natrium	Na	11	22.9898	22.991	1
Strontium	Sr	38	87.62	87.63	2
Sulfur	S	16	32.064	32.066*	2, 4, 6
Tantalum	Ta	73	180.948	180.95	5
Technetium	Tc	43	.....	(97)	6, 7
Tellurium	Te	52	127.60	127.61	2, 4, 6
Terbium	Tb	65	158.924	158.93	3
Thallium	Tl	81	204.37	204.39	1, 3
Thorium	Th	90	232.038	(232)	4
Thulium	Tm	69	168.934	168.94	3
Tin, stannum	Sn	50	118.69	118.70	2, 4
Titanium	Ti	22	47.90	47.90	3, 4
Tungsten (wolfram)	W	74	183.85	183.86	6
Uranium	U	92	238.03	238.07	4, 6
Vanadium	V	23	50.942	50.95	3, 5
Xenon	Xe	54	131.30	131.30	0
Ytterbium	Yb	70	173.04	173.04	2, 3
Yttrium	Y	39	88.905	88.91	3
Zinc	Zn	30	65.37	65.38	2
Zirconium	Zr	40	91.22	91.22	4

* Because of natural variations in the relative abundances of the isotopes of sulfur the atomic weight of this element has a range of ± 0.003.

** The 1959 atomic weights are based on O = 16.000 whereas those of 1961 are based on the isotope C^{12}.

ORGANIC COMPOUND INDEX

B

C

D

E

F

M

N

O

P

Y

Index

This Index lists the names of all tables and major subjects contained in this book in alphabetical order. The Index listing the individual compounds for which derivatives are cited begins on page 479.

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