LOOKING UP DATA: CHEMISTRY HANDBOOKS

When you need data on elements, compounds, chemical properties, or related data, the easiest place to find it is in a handbook. These are compilations of chemical data such as formulas, isotopes, molecular weights, density, solubility data, crystallographic information, thermodynamic data, spectroscopic data, and more that have been collected from many literature sources. Handbooks are not always easy to use, terms used may differ from those you are familiar with, and you will not find all the data you need, nor will it always be in the form you need it. In spite of those problems, handbooks are extremely useful since there is a great deal of information in a single source. Often, a handbook may list additional references where more information can be found. There are three popular handbooks.

1. **CRC Handbook of Chemistry and Physics**, CRC Press, Boca Raton, Florida.
   Once a true "handbook", the CRC Handbook has grown into a giant volume. The CRC Handbook is probably the most comprehensive handbook available containing mathematical tables, information on elements and inorganic compounds, organic compounds, nomenclature rules, general chemical data, general physical constants, definitions, and many miscellaneous tables. A new volume is published each year, but only a small amount of information changes. An edition is good for many years. There is also a student edition which contains less material than a standard CRC Handbook, but it sells at a reasonable price. Another way of obtaining a CRC Handbook at a reasonable price is to buy the previous year's version when offered as a closeout through schools. Usually, a quantity such as ten handbooks must be purchased.

2. **Lange's Handbook of Chemistry**, McGraw-Hill Book Company, New York.
   Lange's Handbook is similar to the CRC Handbook in that it contains many tables of data and information. It does not contain descriptive information such as the sources and uses of the elements, and definitions. In some instances, this is an easier handbook to use. Lange's Handbook complements the CRC Handbook, containing some different information.

3. **The Merck Index**, Merck & Company, Rahway, New Jersey.
   The Merck Index is mainly an encyclopedia of chemicals, drugs, and biologicals with a few miscellaneous tables of information. It contains an excellent formula index and a cross index of common and chemical names.

In addition to these, some chemical companies, such as Aldrich, Alfa, and others, list information such as physical constants, structures of compounds, Chemical Abstracts Service registry numbers, and other useful information in their catalogs. You may find data on compounds, not listed in handbooks, in these catalogs.

When using a handbook, you will encounter a number of symbols and abbreviations that are commonly used or may be unique to that handbook. Explanations of these are usually given in the beginning of the book, section, or immediately preceding the tables in which they are used.

Some samples of typical information found in handbooks is given on the following pages.

The Elements (CRC Handbook, 70th Edition, 1989-1990**).**

A typical entry contains information on the origin or the element's name, some physical properties, historical information, source, uses, and some important compounds. The listing for the element lithium follows:

Lithium — (Gr. *lithos*, stone), Li; at. wt. 6.941; at. no. 3; m.p. 180.54°C; b.p. 1342°C; sp. gr. 0.534 (20°C); valence 1. Discovered by Arfvedson in 1817. Lithium is the lightest of al metals, with a density only about half that of water. It does not occur free in nature; combined it is found in small amounts in nearly all igneous rocks and in the waters of many mineral springs. *Lepidolite, spodumene, petalite*, and *amblygonite* are the more important minerals containing it. Lithium is presently being recovered from brines of Searles Lake, in California, and from those in Nevada. Large deposits of spodumene are being recovered from brines of Searles Lake, in California, and from those in Nevada. Large deposits of spodumene are found in North Carolina. The metal is produced electrolytically from the fused chloride. Lithium is silvery in appearance, much like Na and K, other members of the alkali metal series. It reacts with water, but not as vigorously as sodium. Lithium imparts a beautiful crimson color to a flame, but when the metal burns strongly the flame is a dazzling white. Since World War II, the production of lithium metal and its compounds has increased greatly. Because the metal has the highest specific heat of any solid element, it has found use in heat transfer applications; however, it is corrosive and requires special handling. The metal has been used as an alloying agent, is of interest in synthesis of organic compounds, and has nuclear applications. It ranks as a leading contender as a battery anode material as it has a high electrochemical potential. Lithium is used in special glasses and ceramics. The glass for the 200-inch telescope at Mt. Palomar contains lithium as a minor ingredient. Lithium chloride is one of the most hygroscopic materials known, and it, as well as lithium bromide, is used in air conditioning and industrial drying systems. Lithium stearate is used as an all-purpose and high-temperature lubricant. Other lithium compounds are used in dry cells and storage batteries. The metal is priced at about $100/lb.

Physical Properties of Inorganic Compounds (CRC Handbook, 70th Edition, 1989-1990**).**

This table lists names, synonyms, formulas, molecular weights, crystalline forms, density, melting and boiling points, and solubility data for most of the known inorganic compounds. A sample portion of this table follows. Abbreviations used are given in the table immediately following this.

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (continued)

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
c433	**Cobalt**	Co	58.93320 ± 1	silv gray met, cub	8.9	1495	2870	i	i	s a
c434	(III) acetate	$Co(C_2H_3O_2)_3$	236.07	grn, oct		d 100		hydr		s a, glac ac a
c435	(II) acetate	$Co(C_2H_3O_2)_2{\cdot}4H_2O$	249.08	red-vlt, monocl, deliq, 1.542	1.705^{19}	$-4H_2O$, 140		s	s	s a, al
c436	aluminate	(approx) Thenard's blue. $CoAl_2O_4$	176.89	bl, cub				i	i	
c437	(II) *ortho*arsenate	$Co_3(AsO_4)_2{\cdot}8H_2O$	598.76	vlt-red, monocl, 1.626, 1.661, 1.669	3.178^{15}	d		i	i	s dil a, NH_4OH
c438	arsenic sulfide	Nat. cobaltite. CoAsS	165.91	gray-redsh	6.2—6.3	d				
c439	arsenide	Co_2As	192.79	cr powd	8.28	950		i	i	i CHl, H_2SO_4; s HNO_3, aq reg
c440	(II) benzoate	$Co(C_7H_5O_2)_2{\cdot}4H_2O$	373.23	gray red leaf		$-4H_2O$, 115		v s		
c441	boride, mono-	CoB	69.74	pr	7.25^{18}			d	d	s HNO_3, aq reg
c442	(II) bromate	$Co(BrO_3)_2{\cdot}6H_2O$	422.83	red, oct				45.5^{17}		s NH_4OH
c443	(II) bromide	$CoBr_2$	218.74	grn, hex. deliq	4.909_4^{25}	678 (in N_2)		66.7^{59}	68.1^{97}	77.1^{20} al; 58.6^{30} MeOH; s eth, acet
c444	(II) bromide hexahydrate	$CoBr_2{\cdot}6H_2O$	626.84	red-vlt pr, deliq	2.46	47—48, $-4H_2O$ 100	$-6H_2O$, 130	s red color	153.2^{97}	s blk color, al, a, eth
c445	bromoplatinate	$CoPtBr_6{\cdot}12H_2O$	949.62	trig	2.762					
c446	carbonate	Nat. spherocobaltite. $CoCO_3$	118.94	red, trig, 1.855, 1.60.	4.13	d		i	i	s a; i NH_3
c447	(II) carbonate, basic	$2CoCO_3{\cdot}3Co(OH)_2{\cdot}H_2O$	534.74	vlt-red pr				i	d	s a, $(NH_4)_2CO_3$
c448	carbonyl tetra-	Dicobalt octacarbonyl. $[Co(CO)_4]_2$ or $Co_2(CO)_8$	341.95	or cr or dk br, microcr.	1.73^{18}	51	d 52	i	i	sl s al; s CS_2, eth
c449	*carbonyl, tri-*	Tetracobalt dodecacarbonyl. $[Co(CO)_3]_4$ or $Co_4(CO)_{12}$	571.86	blk cr				sl s		s bz; d Br
c450	(II) chlorate	$Co(ClO_3)_2{\cdot}6H_2O$	333.93	red, cub, deliq, 1.55.	1.92	50	d 100	558.3^0	v s	s al
c451	(II) *per*chlorate	$Co(ClO_4)_2$	257.83	red need 1.510, 1.490	3.327			100^0	115^{45}	s al, acet
c452	(II) *per*chlorate	$Co(ClO_4)_2{\cdot}5H_2O$	347.91	red, hex		143		100.13^0	115.10^{65}	v s al, acet i $CHCl_3$
c453	*perchlorate*	$Co(ClO_4)_2{\cdot}6H_2O$	365.93	red pr		d 1534	d	259^{18}		s al, acet
c454	(II) *per*chlorate	$Co(ClO_4)_2{\cdot}6H_2O$	365.93	red, oct, deliq, 1.55.		d 182		255^{18}		s al, acet
c455	(II) chloride	$CoCl_2$	129.84	bl, hex, hygr	3.356_4^{36}	724 (in HCl gas)	1049	45^7	105^{96}	54.4 al; 8.6 acet; 38.5 MeOH; sl s eth
c456	(III) chloride	$CoCl_3$	165.29	red cr or yel cr.	2.94	subl		s		

ABBREVIATIONS USED IN TABLE OF PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS

a	acid	fus	fused	prop	properties
abs	absolute	fxd	fixed	purp	purple
ac. a	acetic acid	gel., gelat	gelatinous	pyr	pyridine
acet	acetone	gl	glass	quad	quadrilateral
act	active	glac	glacial	quest	questioned
al	alcohol	glit	glittering	rect	rectangular
alk	alkali	glob	globular	redsh	reddish
amm	ammonium	glyc	glycerin	reg	regular
amor	amorphous	gran	granular	rhbdr	rhombohedral
anh	anhydrous	greas	greasy	rhomb	rhombic, orthorhombic
appr	approximately	grn	green		
aq	aqua, water	h	hot	s	soluble
aq. reg	aqua regia	hex	hexagonal	satd	saturated
asym	asymmetrical	ht	heat	sld	solid
atm	atmospheres	hyd	hydrolyzed	sensit	sensitive
bipyr	bipyramidal	hydx	hydroxides	sc	scales
bl	blue	hyg	hygroscopic	sec	secondary
blk	black	i	insoluble	silv	silver
boil	boiling	ign	ignites	sl	slightly
br., brn	brown	ind	indigo	sly	slowly
brnsh	brownish	indef	indefinite	sm	small
bz	benzene	infl., inflam	inflammable	sod	sodium
c	cold	infus	infusible	soln	solution
calc	calculated	irid	iridescent	solv	solvents
carb	carbon	leaf	leaflets	spont	spontaneous
caust	caustic	lem	lemon	st	steel
chl	chloroform	lgr	ligroin	stab	stable
choc	chocolate	lng	long	subl	sublimes
cit. a	citric acid	lq., liq	liquid	suffoc	suffocating
col	colorless	lt	light	sulfd	sulfides
coll	colloidal	lum	luminous	sulf	sulfur
com'l	commercial	lust	lustrous	sym	symmetrical
comp	compounds	me., meth	methyl	tabl	tablets
compl	completely	met	metal or metallic	tart. a	tartaric acid
conc	concentrated			tetr	tetragonal
const	constant	micr	microscopic	tetrah	tetrahedral
cont	contains	min	mineral	tol	toluene
corros	corrosive	misc	miscible	trac	trace, traces
cr	crystalline	mixt	mixture	trans	transparent
cub	cubic	mod	modifications	translu	translucent
d., dec	decomposes	monbas	monobasic	tri., trig	trigonal
deliq	deliquescent	mon-H	monohydrogen	tribas	tribasic
deriv	derivative	monocl	monoclinic	tricl	triclinic
dibas	dibasic	near	nearly	trim	trimetric
di-H	dihydrogen	need	needles	tr	transition point
dil	dilute	nit	nitrate	turp	turpentine
dimorph	dimorphous	oct	octahedral	unpleas	unpleasant
disg	disagreeable	odorl	odorless	unst	unstable
dk	dark	offen	offensive	v	very
doubt	doubtful	olv	olive	vac	vacuum
duct	ductile	opt	optical or optically	var	various
effl	efflorescent			viol	violent, violence
em	emerald	or	orange		
eth	ether	ord	ordinary	visc	viscous
ev	evolves	org	organic	vitr	vitreous
evln	evolution	oxal	oxalate or oxalic	vlt	violet
ex	excess			volt., volat	volatizes
exist	existence	pa	pale	wh	white
exp	explodes	pet	petroleum	wh. lt	white light
extr	extreme(ly)	pl	plates	yel	yellow
f., fr	from	pois	poisonous	yelsh	yellowish
feath	feathery	polymorph	polymorphous	∞	soluble in all proportions
fl	flakes	powd	powder		
floc	flocculent	ppt	precipitate	>	above
fluo, fluores	fluorescent	pr	prisms	<	below
form	formic	press	pressure		
fum	fuming	prob	probably		

Table of the Isotopes (CRC Handbook, 70th Edition, 1989-1990**):**

This table lists all known isotopes, both naturally occurring and artificially made, for each element. For each entry, the table includes the % natural abundance, the atomic mass, the half-life (lifetime), the observed modes of decay, the decay energy, the particle energies, the particle intensities, thermal neutron capture cross section, nuclear spin (I), and the nuclear magnetic moment (æ). A sample portion of this table follows:

TABLE OF THE ISOTOPES (Continued)

Isotope	A	Z	% Natural abundance	Atomic mass	Half-life	Decay mode	Decay energy (MeV)	Particle energy (MeV)	Particle intensity	Thermal neutron cross section	Spin (h/2π)	μ Nucl. mag. moment	Gamma-ray energy (MeV)	Gamma-ray intensity
C				12.0111						3.5 mb.				
$_6C^9$	9	6		9.031039	127 ms.	β+,p,2α	16.497						ann.rad.	
$_6C^{10}$	10	6		10.01686	19.3 s.	β+	3.650	1.865			0+		ann. rad.	100%
	10	6											0.71829 ± 0.0001	98.5%
	10	6											1.02178 ± 0.0002	1.5%
$_6C^{11}$	11	6		11.01143	20.3 m.	β+,E.C.	1.982	0.9608	99%		3/2-	-0.964	ann.rad.	99+%
$_6C^{12}$	12	6	98.90%	12.000000						3.5 mb.	0+			
$_6C^{13}$	13	6	1.10%	13.003355						1.4 mb.	1/2-	+0.70241		
$_6C^{14}$	14	6		14.003241	5730 y.	β-	0.15648	0.1565	100%		0+			
$_6C^{15}$	15	6		15.010599	2.45 s.	β-	9.772	4.51	68%		1/2+		5.29887 ± 0.0001	68%
	15	6						9.82	32%				7.3011 ± 0.0005	0.008%
	15	6											8.3129 ± 0.001	0.032%
	15	6											9.0500 ± 0.001	0.031%
$_6C^{16}$	16	6		16.014701	0.75 s.	β-,n	8.012							

Physical Constants of Organic Compounds (CRC Handbook, 70th Edition, 1989-1990**):**

This table lists names, synonyms, formulas, molecular weights, crystalline forms, specific rotations, maximum ultraviolet absorption peak, melting and boiling points, density, index of refraction, solubility data, and literature references for many of the known organic compounds. A sample portion of this table follows. The abbreviations used in this table are in the table that follows this.

PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS (Continued)

No.	Name, Synonyms, and Formula	Mol. wt.	Color, crystalline form, specific rotation and λ_{max} (log ε)	b.p. °C	m.p. °C	Density	n_D	Solubility	Ref.
7757	Hexamethylene diamine or 1,6-Diamino hexane $H_2N(CH_2)_6NH_2$	116.21	rh bi pym pl	204-5, 100^{20}	41-2	.....	.....	w, al, bz	B4[4], 1320
7758	Hexamethylene tetramine or Hexamin. Urotropine $C_6H_{12}N_4$	140.19	rh (al)	sub	285-95 sub	1.331^{-5}	.....	w, al, ace, chl	B26[2], 200
7759	Hexanal or Caproaldehyde $CH_3(CH_2)_4CHO$	100.16	.....	128, 28^{12}	−56	$0.8139^{20/4}$	1.4039^{20}	al, eth, ace, bz	B1[4], 3296
7760	Hexane C_6H_{14}	86.18	.....	69	−95	$0.6603^{20/4}$	1.3751^{20}	al, eth, chl	B1[4], 338
7761	Hexane, 1-amino or *n*-Hexyl amine $CH_3(CH_2)_4CH_2NH_2$	101.19	.....	130	−19	0.7660^{20}	1.4180^{20}	**al, eth**	B4[4], 709
7762	Hexane, 2-amino (d) $CH_3(CH_2)_3CHNH_2CH_3$	101.19	.....	114-5, 64^{90}	.....	$0.755^{27/4}$	.....	al, eth	B4[1], 361
7763	Hexane, 2-amino (dl) $CH_3(CH_2)_3CHNH_2CH_3$	101.19	.....	117-8	−19	$0.7534^{20/0}$	1.4080^{25}	al, eth	B4[4], 721
7764	Hexane, 2-amino-4-methyl $CH_3CH_2CH(CH_3)CH_2CH(NH_2)CH_3$	115.22	.....	130-5	.....	0.7655^{20}	1.4150^{25}	al, eth, chl	B4[4], 747
7765	Hexane, 1-bromo or *n*-Hexyl bromide $CH_3(CH_2)_4CH_2Br$	165.07	.....	155.3, 41^{10}	−84.7	$1.1744^{20/4}$	1.4478^{20}	**al, eth**, ace, chl	B1[4], 352
7766	Hexane, 1-bromo-6-fluoro $F(CH_2)_6Br$	183.06	.....	$67\text{-}8^{11}$	.....	$1.293^{20/4}$	1.4435^{25}	al, eth, ace, chl	B1[4], 353
7767	Hexane, 2-bromo or *sec*-Hexyl bromide $CH_3(CH_2)_3CHBrCH_3$	165.07	.....	144^{749}, 78^{90}	.....	$1.1658^{20/4}$	1.4832^{25}	al, eth, ace, chl	B1[4], 353
7768	Hexane, 3-bromo $C_3H_7CHBrC_2H_5$	165.07	.....	141-3	.....	$1.1799^{20/4}$	1.4472^{20}	al, eth, ace, chl	B1[4], 353
7769	Hexane, 1-chloro or *n*-Hexyl chloride $CH_3(CH_2)_4CH_2Cl$	120.62	.....	134.5	−94	$0.8785^{20/4}$	1.4199^{20}	al, eth, ace, bz, chl	B1[4], 349

SYMBOLS AND ABBREVIATIONS

[α]	specific rotation
>	above, more than
<	below, less than
?	unkown
aa	acetic acid
abs	absolute
ac	acid
Ac	acetyl
ace	acetone
AFCL	Aliphatic Fluorine Compounds
al	alcohol[1]
ALD	Aldrich Handbook of Organic Chemicals and Biochemicals
alk	alkali
Am	J. Am. Chem. Soc.
Am	amyl (pentyl)
amor	amorphous
anh	anhydrous
aqu	aqueous
as	asymmetric
Atlas	Atlas of Spectral Data and Physical Constants for Organic Compounds
atm	atmospheres
b	boiling
B	Beilstein
Ber	Chem. Ber.
bipym	bipyramidal
bk	black[2]
bl	blue[2]
BOSC	Bayant, et al., Organosilicon Compounds
br	brown[2]
bt	bright
Bu	butyl
bz	Benzene
CAS	Chemical Abstracts
c	percentage concentration
ca	about (circa)
chl	chloroform
co	columns
col	colorless
con	concentrated
cor	corrected
cr	crystals
cy	cyclohexane
d	decomposes
D	line in the spectrum of sodium (subscript)
D, d	dextro[3]
́d	slight decomposition
dil	diluted
diox	dioxane
distb	distillable
dk	dark
Dl, dl	racemic[3]
dlq	deliquescent
DMF	dimethyl formamide
E	Elsevier's
eff	efforescent
Et	ethyl
eth	ether[4]
exp	explodes
extrap	extrapolated
fl	flakes
flam	flammable
flr	fluorescent
fr	freezes
fr. p.	freezing point
fum	fuming
gel	gelatinous
gl	glacial
gold	golden
gr	green[2]
gran	granular
gy	gray[2]
h	hot
H	Helv. Chim. Acta
hex	hexagonal
HDOC	Helibron Dictionary of Organic Compounds
hp	heptane
htng	heating
hx	hexane
hyd	hydrate
hyg	hygroscopic
i	insoluble
i-	iso-
ign	ignites
in	inactive
inflam	inflammable
infus	infusible
irid	iridescent
iso	isooctaine
J	J. Chem. Soc.
JOC	J. Org. Chem.
KHOC	Kaufman Handbook of Organometallic Compounds
L, l	levo[3]
la	large
lf	leaf
liq	ligroin
liq	liquid
lo	long
lt	light
m	melting
m-	meta-
M	molar (concentration)
M	Merck Index, 7th Edition
mcl	monoclinic
Me	methyl
met	metallic
micr	microsopic
min	mineral
mod	modification
mut	mutarotatory
n	normal chain, refractive index
N	normal (concentration)
N	nitrogen[5]
nd	needles
o-	ortho-
oct	octahedral
og	orange[2]
ord	ordinary
org	organic
orh	orthorhombic
p-	para-
pa	pale
par	partial
PCHE	Egloff Physical Constants of Hydrocarbons
peth	petroleum ether
pk	pink[2]
Ph	phenyl
pl	plates
pr	prisms
Pr	propyl
Prak	J. Prak. Chem.
purp	purple[2]
pw	powder
Py	pyrimidine
pym	pyramids
rac	racemic
rect	rectangular
red	red
res	resinous
rh	rhombic
rhd	rhombodohedral
s	soluble
sc	scales
sec	secondary
sf	softens
sh	shoulder
silv	silvery
sl	slightly
so	solid
sol	solution
solv	solvent
Solvents	Entries in this column in medium type means soluble; entries in boldface means very soluble
sph	sphenoidal
st	stable
sub	sublimes
suc	supercooled
sulf	sulfuric acid
sym	symmetrical
syr	syrup
ta	tablets
tcl	triclinic
tert	tertiary
Tet	Tetrahedron
tetr	tetragonal
THF	tetrahydrofuran
to	toluene
tr	transparent
trg	trigonal
undil	undiluted
uns	unsymmetrical
unst	unstable
v	very
vac	vacuum
var	variable
vap	vapor
vic	vicinal
visc	viscous
volat	volatile or volatilises
vt	violet[2]
w	water
wh	white[1]
wr	warm
wx	waxy
ye	yellow[2]
xyl	xylene

[1] Generally means ethyl alcohol.

[2] The abbreviation of a color ending in "sh" is to be read as ending with the suffix "-ish," e.g., grsh means greenish.

[3] *D, L* generally means configuration and *d, l* generally mean optical rotation, but there are many examples in the chemical literature for which the meaning of these symbols is ambiguous and/or interchangeable.

[4] Generally means diethyl ether.

[5] *N* indicates a position in the molecule.

Thermodynamic Properties of Elements and Inorganic Compounds (Lange's Handbook):

This table is compilation of enthalpies and Gibbs (free) energies of formation, entropies, ad heat capacities of elements and compounds in kilojoules per mole (the units are kilocalories per mole in older editions). A sample portion of this table follows:

Table 9-1 (*Continued*)
ELEMENTS AND INORGANIC COMPOUNDS

Formula and Description	State	$\Delta Hf°$	$\Delta Gf°$	$S°$	$C_p°$
Silicon					
Si	c	*0*	*0*	4.50	4.78
	amorp	1.0			
	g	108.9	98.3	40.12	5.318
Si_2	g	142	128	54.92	8.22
SiBr	g	50			9.23
$SiBr_4$	liq	−109.3	−106.1	66.4	
	g	−99.3	−103.2	90.29	23.21
SiC β, cubic	c	−17.5	−16.9	3.97	6.42
α, hexagonal	c	−17.1	−16.5	3.94	6.38
	g	147	132	56.55	10.90
SiCl	g	45.39		56.82	8.81
$SiCl_2$	g	−39.59	−42.35	67.0	12.16
$SiCl_4$	liq	−164.2	148.16	57.3	34.73
	g	−158.4	−148.8	79.02	21.57
SiH_3Cl	g	−48	−43	59.88	12.20
SiH_2Cl_2	g			68.26	14.45
$SiHCl_3$	liq	−128.9	−115.34	54.4	
SiF	g	1.7	−5.8	53.94	7.80
SiF_2	g	−140.5	−143.0	61.38	10.49
SiF_4	g	−385.98	−375.88	67.49	17.60

Solubilities of Inorganic Compounds and Metal Salts of Organic Acids in Water at Various Temperatures (Lange's Handbook):

This table lists the solubility data many compounds in terms grams of substance that will dissolve in 100 g of water at various temperatures. A sample portion of this table follows:

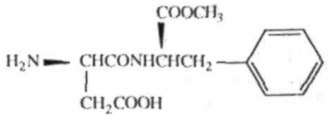
Table 10-2 (*Continued*)
SOLUBILITIES OF INORGANIC COMPOUNDS AND METAL SALTS OF ORGANIC ACIDS IN WATER AT VARIOUS TEMPERATURES

Substance	Formula	0°	10°	20°	30°	40°	60°	80°	90°	100°
Sodium acetate	$NaC_2H_3O_2$	36.2	40.8	46.4	54.6	65.6	139	153	161	170
aluminum sulfate	$Na_2Al_2(SO_4)_4$	37.4	39.3	39.7	41.7	43.8				
azide	NaN_3	38.9	39.9	40.8						55.3
benzoate	$NaC_7H_5O_2$	62.6	62.8	62.8	62.9	63.1	64.5	68.6	70.6	73.3
borate (penta-)	$Na_2B_{10}O_{16}$	6.4	8.6	12.0	16.4	22.0	37.9	63.4	83.5	108
borate (tetra-)	$Na_2B_4O_7$	1.11	1.60	2.56	3.86	6.67	19.0	31.4	41.0	52.5
bromate	$NaBrO_3$	24.2	30.3	36.4	42.6	48.8	62.6	75.7		90.8
bromide	NaBr	80.2	85.2	90.8	98.4	107	118	120	121	121
carbonate	Na_2CO_3	7.00	12.5	21.5	39.7	49.0	46.0	43.9	43.9	
chlorate	$NaClO_3$	79.6	87.6	95.9	105	115	137	167	184	204
chloride	NaCl	35.7	35.8	35.9	36.1	36.4	37.1	38.0	38.5	39.2
chloroaurate(III)	$NaAuCl_4$		139	151	178	227	900			
chloroiridate(IV)	Na_2IrCl_6		31.6	39.3	56.2	96.1	192	279		
chromate	Na_2CrO_4	31.7	50.1	84.0	88.0	96.0	115	125		126
cyanide	NaCN	40.8	48.1	58.7	71.2					
dichromate	$Na_2Cr_2O_7$	163	172	183	198	215	269	376	405	415

Aspartame (Merck Index).

A typical entry in the Merck Index contains information in paragraph form. Each lists a monograph number (for indexing), the generic name of the compound, the Chemical Abstracts name (in ***boldface italic***), alternate names, the molecular formula, the molecular weight, the % composition, literature references (often with a brief description), structure, physical data, (such as color, melting or boiling points in °C, solubility, and optical rotations in water), toxicity data (e.g., LD_{50}, LC_{50}, etc.), and the use and/or therapeutic category. The listing for aspartame follows:

861. Aspartame. ***N*-L-α-*Aspartyl*-L-*phenylalanine 1-methyl ester; 3-amino-N-*(α-*carboxyphenethyl)succinamic acid N-methyl ester;*** APM; SC 18862; Canderel; Equal; NutraSweet; Sanecta; Tri-Sweet. $C_{14}H_{18}N_2O_5$; mol wt 294.30. C 57.14%, H 6.16%, N 9.52%, O 27.18%. Dipeptide ester about 160 times sweeter than sucrose in aqueous solution. Prepn: Davey *et al., J. Chem. Soc. (C)* **1966,** 555; Schlatter, **S. Afr.** pat. **67 02,190** corresp to **U.S.** pat. **3,492,131** (1968, 1970 to Searle); H. Pietsch, *Tetrahedron Letters* **1976,** 4053; K. J. Vinick, S. Jung, *ibid.* **23,** 1315 (1982); utilizing immobilized enzyme technology: C. Fuganti, P. Grasselli, *ibid.* **27,** 3191 (1986). Structure-taste relationship: Mazur *et al., J. Am. Chem. Soc.* **91,** 2684 (1969). Potential as a low-calorie sweetener: Cloninger, Baldwin, *Science* **170,** 81 (1970). Metabolism: Oppermann *et al., J. Nutr.* **103,** 1454, 1460 (1973).



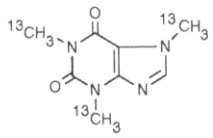
Colorless needles from water, mp 246-247°. $[\alpha]_D^{22}$ — 2.3° (1*N* HCl).

USE: Sweetener.

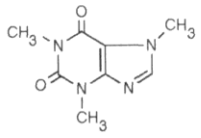
Caffeine (Sigma-Aldrich catalog)

Some catalogs, such as the Sigma-Aldrich catalog, not only list sizes and prices of chemical compounds, but they may include properties of the compounds such as melting points and boiling points, structural formulas, and references for additional information. A sample page from the Sigma-Aldrich catalog is shown below with the section for caffeine.

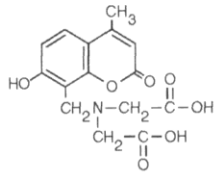
48,536-5	**Caffeine-*trimethyl*-$^{13}C_3$,** 99 atom % ^{13}C [*78072-66-9*] FW 197.17 mp 234-236.5°..... *TOXIC* Manufactured by *ISOTEC INC.*	**1g**	428.70
C5-3 ★	**Caffeine,** 99% [*58-08-2*] FW 194.19 mp 234-236.5° *Beil.* **26**,461 *Merck Index* **12**,1674 *FT-IR* **1**(2),710B *Safety* **2**,664C *R&S* **1**(2),2467A *RTECS#* EV6475000 *TOXIC*	**5g** **100g** **500g**	8.70 15.00 49.70
	Calcein, see 11,985-7, Fluorexon page 817		
22,909-1	**Calcein Blue,** indicator grade [*54375-47-2*] (4-methylumbelliferone-8-methylene-iminodiacetic acid) FW 321.29 λ*max* 360nm *Safety* **2**,664D *R&S* **1**(2),2833G *IRRITANT* A metallofluorochromic indicator for EDTA titration of Ca at high pH, and Cu, Ni, and Co at low pH. Used as a fluorescent label in bone. Dye content ~90%	**1g** **5g**	17.50 57.90
	Calcichrome, see 23,237-8, Calcion page 328		
23,237-8 ★	**Calcion** [*3810-39-7*] (Calcichrome) FW 1,112.78 λ*max* 547nm *FT-IR* **1**(2),993A ..... *R&S* **1**(2),2765M *IRRITANT*	**1g**	14.60
44,187-2 ★	**Calcium,** distilled, dendritic pieces, 99.99% [*7440-70-2*] Ca FW 40.08 mp 850°..... d 1.540 *Merck Index* **12**,1682 *RTECS#* EV8040000 *FLAMMABLE SOLID CORROSIVE* (*Packaged under argon in ampules*)	**5g** **25g**	70.30 266.40
46,589-5 ★	**Calcium,** distilled, dendritic pieces, 99.5% [*7440-70-2*] Ca FW 40.08 mp 850°..... *Merck Index* **12**,1682 *RTECS#* EV8040000 *FLAMMABLE SOLID CORROSIVE* (*Packaged under argon in ampules*)	**5g** **25g**	54.90 208.50



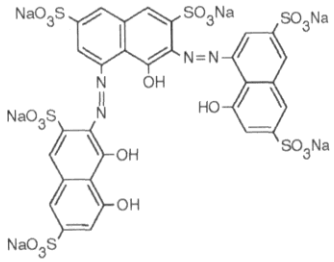
48,536-5



C5-3



22,909-1



23,237-8