SECTION 3
INORGANIC CHEMISTRY

3.1 NOMENCLATURE OF INORGANIC COMPOUNDS

The following synopsis of rules for naming inorganic compounds and the examples given in explanation are not intended to cover all the possible cases. For a more comprehensive and detailed description, see G. J. Leigh (ed.), *Nomenclature of Inorganic Chemistry*, 3d ed., Blackwell Scientific Publications, Oxford, 1990. This 289-page publication contains the Recommendations 1990 of the Commission on Nomenclature of Inorganic Chemistry and was prepared under the auspices of the International Union of Pure and Applied Chemistry (IUPAC). In particular, the latest report should be consulted for coordination compounds, boron compounds, and crystalline phases of variable composition.

3.1.1 Writing Formulas

3.1.1.1 Mass Number, Atomic Number, Number of Atoms, and Ionic Charge. The mass number, atomic number, number of atoms, and ionic charge of an element are indicated by means of four indices placed around the symbol:

$$\begin{matrix}\text{mass number}\\ \text{atomic number}\end{matrix}\ \mathbf{SYMBOL}\ \begin{matrix}\text{ionic charge}\\ \text{number of atoms}\end{matrix}\qquad {}^{15}_{7}\mathrm{N}_{2}^{3-}$$

Ionic charge should be indicated by an Arabic superscript numeral preceding the plus or minus sign: Mg^{2+}, PO_4^{3-}.

3.1.1.2 Placement of Atoms in a Formula. The electropositive constituent (cation) is placed first in a formula. If the compound contains more than one electropositive or more than one electronegative constituent, the sequence within each class should be in alphabetical order of their symbols.

The alphabetical order may be different in formulas and names; for example, $NaNH_4HPO_4$, ammonium sodium hydrogen phosphate.

Acids are treated as hydrogen salts. Hydrogen is cited last among the cations.

When there are several types of ligands, anionic ligands are cited before the neutral ligands.

3.1.1.3 Binary Compounds between Nonmetals. For binary compounds between nonmetals, that constituent should be placed first which appears earlier in the sequence:

Rn, Xe, Kr, Ar, Ne, He, B, Si, C, Sb, As, P, N, H, Te, Se, S, At, I, Br, Cl, O, F

Examples: $AsCl_3$, SbH_3, H_3Te, BrF_3, OF_2, and N_4S_4.

3.1.1.4 Chain Compounds. For chain compounds containing three or more elements, the sequence should be in accordance with the order in which the atoms are actually bound in the molecule or ion.

Examples: SCN^- (thiocyanate), HSCN (hydrogen thiocyanate or thiocyanic acid), HNCO (hydrogen isocyanate), HONC (hydrogen fulminate), and HPH_2O_2 (hydrogen phosphinate).

3.1.1.5 Use of Centered Period. A centered period is used to denote water of hydration, other solvates, and addition compounds; for example, $CuSO_4 \cdot 5H_2O$, copper(II) sulfate 5-water (or pentahydrate).

3.1.1.6 Free Radicals. In the formula of a polyatomic radical an unpaired electron(s) is(are) indicated by a dot placed as a right superscript to the parentheses (or square bracket for coordination compounds). In radical ions the dot precedes the charge. In structural formulas, the dot may be placed to indicate the location of the unpaired electron(s).

Examples: $(HO)^{\cdot}$ $(O_2)^{2\cdot}$ $(\dot{N}H_3^+)$

3.1.1.7 Enclosing Marks. Where it is necessary in an inorganic formula, enclosing marks (parentheses, braces, and brackets) are nested within square brackets as follows:

[( )], [{ ( ) }], [{ [( )] }], [{ { [( )] } }]

In an inorganic name the nesting order is different: { { { [( )] } } }, and so on.

3.1.1.8 Molecular Formula. For compounds consisting of discrete molecules, a formula in accordance with the correct molecular weight of the compound should be used.

Examples: S_2Cl_2, S_8, N_2O_4, and $H_4P_2O_6$; not SCl, S, NO_2, and H_2PO_3.

3.1.1.9 Structural Formula and Prefixes. In the structural formula the sequence and spatial arrangement of the atoms in a molecule are indicated.

Examples: NaO(O═C)H (sodium formate), Cl—S—S—Cl (disulfur dichloride).

Structural prefixes should be italicized and connected with the chemical formula by a hyphen: *cis-*, *trans-*, *anti-*, *syn-*, *cyclo-*, *catena-*, *o-* or *ortho-*, *m-* or *meta-*, *p-* or *para-*, *sec-* (secondary), *tert-* (tertiary), *v-* (vicinal), *meso-*, *as-* for asymmetrical, and *s-* for symmetrical.

The sign of optical rotation is placed in parentheses, (+) for dextrorotary, (−) for levorotary, and (±) for racemic, and placed before the formula. The wavelength (in nanometers is indicated by a right subscript; unless indicated otherwise, it refers to the sodium D-line.

The italicized symbols *d*- (for deuterium) and *t*- (for tritium) are placed after the formula and connected to it by a hyphen. The number of deuterium or tritium atoms is indicated by a subscript to the symbol.

Examples: *cis*-$[PtCl_2(NH_3)_2]$ methan-d_3-ol
di-*tert*-butyl sulfate $(+)_{589}[Co(en)_3]Cl_2$
methan-ol-*d*

3.1.2 Naming Compounds

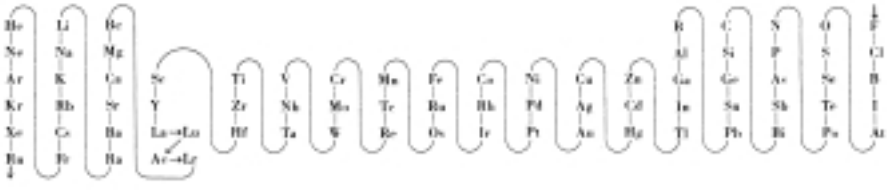
3.1.2.1 Names and Symbols for Elements. Names and symbols for the elements are given in Table 3.2. Wolfram is preferred to tungsten but the latter is used in the United States. In forming a complete name of a compound, the name of the electropositive constituent is left unmodified except when it is necessary to indicate the valency (see oxidation number and charge number, formerly the Stock and Ewens-Bassett systems). The order of citation follows the alphabetic listing of the names of the cations followed by the alphabetical listing of the anions and ligands. The alphabetical citation is maintained regardless of the number of each ligand.

Example: $K[AuS(S_2)]$ is potassium (disulfido)thioaurate(1−).

3.1.2.2 Electronegative Constituents. The name of a monatomic electronegative constituent is obtained from the element name with its ending (-en, -ese, -ic, -ine, -ium, -ogen, -on, -orus, -um, -ur, -y, or -ygen) replaced by -ide. The elements bismuth, cobalt, nickel, zinc, and the noble gases are used unchanged with the ending -ide. Homopolyatomic ligands will carry the appropriate prefix. A few Latin names are used with affixes: cupr- (copper), aur- (gold), ferr- (iron), plumb- (lead), argent- (silver), and stann- (tin).

For binary compounds the name of the element standing later in the sequence in Sec. 3.1.1.3 is modified to end in -ide. Elements other than those in the sequence of Sec. 3.1.1.3 are taken in the reverse order of the following sequence, and the name of the element occurring last is modified to end in -ide; e.g., calcium stannide.

ELEMENT SEQUENCE



3.1.2.3 Stoichiometric Proportions. The stoichiometric proportions of the constituents in a formula may be denoted by Greek numerical prefixes: mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nona- (Latin), deca-, undeca- (Latin), dodeca-, . . . , icosa- (20), henicosa- (21), . . . , triconta- (30), tetraconta- (40), . . . , hecta- (100), and so on, preceding without a hyphen the names of the elements to which they refer. The prefix mono can usually be omitted; occasionally hemi- (½) and sesqui- (3⁄2) are used. No elisions are made when using numerical prefixes except in the case of icosa- when the letter "i" is elided in docosa- and tricosa-. Beyond 10, prefixes may be replaced by Arabic numerals.

When it is required to indicate the number of entire groups of atoms, the multiplicative numerals bis-, tris-, tetrakis-, pentakis-, and so on, are used (i.e., -kis is added starting from tetra-). The entity to which they refer is placed in parentheses.

Examples: $Ca[PF_6]_2$, calcium bis(hexafluorophosphate); and $(C_{10}H_{21})_3PO_4$, tris(decyl) phosphate instead of tridecyl which is ($C_{13}H_{27}-$).

Composite numeral prefixes are built up by citing units first, then tens, then hundreds, and so on. For example, 43 is written tritetraconta- (or tritetracontakis-).

In indexing it may be convenient to italicize a numerical prefix at the beginning of the name and connect it to the rest of the name with a hyphen; e.g., *di*-nitrogen pentaoxide (indexed under the letter "n").

3.1.2.4 Oxidation and Charge Numbers. The *oxidation number* (Stock system) of an element is indicated by a Roman numeral placed in parentheses immediately following the name of the element. For zero, the cipher 0 is used. When used in conjunction with symbols the Roman numeral may be placed above and to the right. The *charge number* of an ion (Ewens-Bassett system) rather than the oxidation state is indicated by an Arabic numeral followed by the sign of the charge cited and is placed in parentheses immediately following the name of the ion.

Examples: P_2O_5, diphosphorus pentaoxide or phosphorus(V) oxide; Hg_2^{2+}, mercury(I) ion or dimercury(2+) ion; $K_2[Fe(CN)_6]$, potassium hexacyanoferrate(II) or potassium hexacyanoferrate(4−); $Pb^{II}_2Pb^{IV}O_4$, dilead(II) lead(IV) oxide or trilead tetraoxide.

Where it is not feasible to define an oxidation state for each individual member of a group, the overall oxidation level of the group is defined by a formal ionic charge to avoid the use of fractional oxidation states; for example, O_2^-.

3.1.2.5 Collective Names. Collective names include:

Halogens (F, Cl, Br, I, At)

Chalcogens (O, S, Se, Te, Po)

Alkali metals (Li, Na, K, Rb, Cs, Fr)

Alkaline-earth metals (Ca, Sr, Ba, Ra)

Lanthanoids or lanthanides (La to Lu)

Rare-earth metals (Sc, Y, and La to Lu inclusive)

Actinoids or actinides (Ac to Lr, those whose 5*f* shell is being filled)

Noble gases (He to Rn)

A transition element is an element whose atom has an incomplete *d* subshell, or which gives rise to a cation or cations with an incomplete *d* subshell.

3.1.2.6 Isotopically Labeled Compounds. The hydrogen isotopes are given special names: ^1H (protium), ^2H or D (deuterium), and ^3H or T (tritium). The superscript designation is preferred because D and T disturb the alphabetical ordering in formulas.

Other isotopes are designated by mass numbers: ^{10}B (boron-10).

Isotopically labeled compounds may be described by inserting the italic symbol of the isotope in brackets into the name of the compound; for example, $H^{36}Cl$ is hydrogen chloride[^{36}*Cl*] or hydrogen chloride-36, and $^2H^{38}Cl$ is hydrogen [^{2}*H*] chloride[^{38}*Cl*] or hydrogen-2 chloride-38.

3.1.2.7 Allotropes. Systematic names for gaseous and liquid modifications of elements are sometimes needed. Allotropic modifications of an element bear the name of the atom together with the descriptor to specify the modification. The following are a few common examples:

Symbol	Trivial name	Systematic name
H	Atomic hydrogen	Monohydrogen
O_2	(Common oxygen)	Dioxygen
O_3	Ozone	Trioxygen
P_4	White phosphorus	Tetraphosphorus
S_8	α-Sulfur, β-Sulfur	Octasulfur
S_n	μ-Sulfur (plastic sulfur)	Polysulfur

Trivial (customary) names are used for the amorphous modification of an element.

3.1.2.8 Heteroatomic and Other Anions. A few heteroatomic anions have names ending in -ide. These are

—OH, hydroxide ion (not hydroxyl)
—CN, cyanide ion
—HF_2^-, hydrogen difluoride ion
—NH_2, amide ion
—NH—, imide ion
—NH—NH_2, hydrazide ion
—NHOH, hydroxylamide ion
—HS^-, hydrogen sulfide ion

Added to these anions are

—I_3^-, triiodide ion
—N_3, azide ion
—O_3, ozonide ion
—O—O—, peroxide ion
—S—S—, disulfide ion

3.1.2.9 Binary Compounds of Hydrogen. Binary compounds of hydrogen with the more electropositive elements are designated hydrides (NaH, sodium hydride).

Volatile hydrides, except those of Periodic Group VII and of oxygen and nitrogen, are named by citing the root name of the element (penultimate consonant and Latin affixes, Sec. 3.1.2.2) followed by the suffix -ane. Exceptions are water, ammonia, hydrazine, phosphine, arsine, stibine, and bismuthine.

Examples: B_2H_6, diborane; $B_{10}H_{14}$, decaborane(14); $B_{10}H_{16}$, decaborane(16); P_2H_4, diphosphane; Sn_2H_6, distannane; H_2Se_2, diselane; H_2Te_2, ditellane; H_2S_5, pentasulfane; and PbH_4, plumbane.

3.1.2.10 Neutral Radicals. Certain neutral radicals have special names ending in -yl:

HO	hydroxyl	ClO_3	perchloryl*
CO	carbonyl	CrO_2	chromyl
ClO	chlorosyl*	NO	nitrosyl
ClO_2	chloryl*	NO_2	nitryl (nitroyl)

* Similarly for the other halogens.

PO	phosphoryl	SeO	seleninyl
SO	sulfinyl (thionyl)	SeO_2	selenonyl
SO_2	sulfonyl (sulfuryl)	UO_2	uranyl
S_2O_5	disulfuryl	NpO_2	neptunyl†

Radicals analogous to the above containing other chalcogens in place of oxygen are named by adding the prefixes thio-, seleno-, and so on; for example, PS, thiophosphoryl; CS, thiocarbonyl.

3.1.3 Cations

3.1.3.1 Monatomic Cations. Monatomic cations are named as the corresponding element; for example, Fe^{2+}, iron(II) ion; Fe^{3+}, iron(III) ion.

This principle also applies to polyatomic cations corresponding to radicals with special names ending in -yl (Sec. 3.1.2.10); for example, PO^+, phosphoryl cation; NO^+, nitrosyl cation; NO_2^{2+}, nitryl cation; O_2^{2+}, oxygenyl cation.

Use of the oxidation number and charge number extends the range for radicals; for example, UO_2^{2+} uranyl(VI) or uranyl(2+) cation; UO_2^+, uranyl(V) or uranyl(1+) cation.

3.1.3.2 Polyatomic Cations. Polyatomic cations derived by addition of more protons than required to give a neutral unit to polyatomic anions are named by adding the ending -onium to the root of the name of the anion element; for example, PH_4^+, phosphonium ion; H_2I^+, iodonium ion; H_3O^+, oxonium ion; $CH_3OH_2^+$, methyl oxonium ion.

Exception: The name ammonium is retained for the NH_4^+ ion; similarly for substituted ammonium ions; for example, NF_4^+, tetrafluoroammonium ion.

Substituted ammonium ions derived from nitrogen bases with names ending in -amine receive names formed by changing -amine into -ammonium. When known by a name not ending in -amine, the cation name is formed by adding the ending -ium to the name of the base (eliding the final vowel); e.g., anilinium, hydrazinium, imidazolium, acetonium, dioxanium.

Exceptions are the names uronium and thiouronium derived from urea and thiourea, respectively.

3.1.3.3 Multiple Ions from One Base. Where more than one ion is derived from one base, the ionic charges are indicated in their names: $N_2H_5^+$, hydrazinium(1+) ion; $N_2H_6^{2+}$, hydrazinium(2+) ion.

3.1.4 Anions

See Secs. 3.1.2.2 and 3.1.2.8 for naming monatomic and certain polyatomic anions. When an organic group occurs in an inorganic compound, organic nomenclature *(q.v.)* is followed to name the organic part.

3.1.4.1 Protonated Anions. Ions such as HSO_4^- are recommended to be named hydrogensulfate with the two words written as one following the usual practice for polyatomic anions. However, in the *Nomenclature of Organic Chemistry*, 1979 edition, hydrogen is used as a separate word; this practice is followed in this Handbook.

† Similarly for the other actinoid elements.

3.1.4.2 Other Polyatomic Anions. Names for other polyatomic anions consist of the root name of the central atom with the ending -ate and followed by the valence of the central atom expressed by its oxidation number. Atoms and groups attached to the central atom are treated as ligands in a complex.

Examples: $[Sb(OH)_6^-]$, hexahydroxoantimonate(V); $[Fe(CN_6]^{3-}$, hexacyanoferrate(III); $[Co(NO_2)_6]^{3-}$, hexanitritocobaltate(III); $[TiO(C_2O_4)_2(H_2O)_2]^{2-}$, oxobisoxalatodiaquatitanate(IV); $[PCl_6]^-$, hexachlorophosphate(V).

Exceptions to the use of the root name of the central atom are antimonate, bismuthate, carbonate, cobaltate, nickelate (or niccolate), nitrate, phosphate, tungstate (or wolframate), and zincate.

3.1.4.3 Anions of Oxygen. Oxygen is treated in the same manner as other ligands with the number of -oxo groups indicated by a suffix; for example, SO_3^{2-}, trioxosulfate.

The ending -ite, formerly used to denote a lower state of oxidation, may be retained in trivial names in these cases (note Sec. 3.1.5.3 also):

AsO_3^{3-}	arsenite	NOO_2^-	peroxonitrite
BrO^-	hypobromite	PO_3^{3-}	phosphite*
ClO^-	hypochlorite	SO_3^{2-}	sulfite
ClO_2^-	chlorite	$S_2O_5^{2-}$	disulfite
IO^-	hypoiodite	$S_2O_4^{2-}$	dithionite
NO_2^-	nitrite	$S_2O_2^{2-}$	thiosulfite
$N_2O_2^{2-}$	hyponitrite	SeO_3^{2-}	selenite

However, compounds known to be double oxides in the solid state are named as such; for example, Cr_2CuO_4 (actually $Cr_2O_3 \cdot CuO$) is chromium(III) copper(II) oxide (and not copper chromite).

3.1.4.4 Isopolyanions. Isopolyanions are named by indicating with numerical prefixes the number of atoms of the characteristic element. It is not necessary to give the number of oxygen atoms when the charge of the anion or the number of cations is indicated.

Examples: $Ca_3Mo_7O_{24}$, tricalcium 24-oxoheptamolybdate, may be shortened to tricalcium heptamolybdate; the anion, $Mo_7O_{24}^{6-}$, is heptamolybdate(6−); $S_2O_7^{2-}$, disulfate(2−); $P_2O_7^{4-}$, diphosphate(V)(4−).

When the characteristic element is partially or wholly present in a lower oxidation state than corresponds to its Periodic Group number, oxidation numbers are used; for example, $[O_2HP—O—PO_3H]^{2-}$, dihydrogendiphosphate(III,V)(2−).

A bridging group should be indicated by adding the Greek letter μ immediately before its names and separating this from the rest of the complex by a hyphen. The atom or atoms of the characteristic element to which the bridging atom is bonded, is indicated by numbers.

Examples: $[O_3P—S—PO_2—O—PO_3]^{5-}$, 1,2-$\mu$-thiotriphosphate(5−)
$[S_3P—O—PS_2—O—PS_3]^{5-}$, di-$\mu$-oxo-octathiotriphosphate(5−)

* Named for esters formed from the hypothetical acid $P(OH)_3$.

3.1.5 Acids

3.1.5.1 Acids and -ide Anions. Acids giving rise to the -ide anions (Sec. 3.1.2.2) should be named as hydrogen . . . -ide; for example, HCl, hydrogen chloride; HN_3, hydrogen azide.

Names such as hydrobromic acid refer to an aqueous solution, and percentages such as 48% HBr denote the weight/volume of hydrogen bromide in the solution.

3.1.5.2 Acids and -ate Anions. Acids giving rise to anions bearing names ending in -ate are treated as in Sec. 3.1.5.1; for example, H_2GeO_4, hydrogen germanate; $H_4[Fe(CN)_6]$, hydrogen hexacyanoferrate(II).

3.1.5.3 Trivial Names. Acids given in Table 3.1 retain their trivial names due to long-established usage. Anions may be formed from these trivial names by changing -ous acid to -ite, and -ic acid to -ate. The prefix hypo- is used to denote a lower oxidation state and the prefix per- designates a higher oxidation state. The prefixes ortho- and meta- distinguish acids of differing water content; for example, H_4SiO_4 is orthosilicic acid and H_2SiO_3 is metasilicic acid. The anions would be named silicate(4−) and silicate(2−), respectively.

3.1.5.4 Peroxo- Group. When used in conjunction with the trivial names of acids, the prefix peroxo- indicates substitution of —O— by —O—O—.

3.1.5.5 Replacement of Oxygen by Other Chalcogens. Acids derived from oxoacids by replacement of oxygen by sulfur are called thioacids, and the number of replacements are given by prefixes di-, tri-, and so on. The affixes seleno- and telluro- are used analogously.

Examples: HOO—C═S, thiocarbonic acid; HSS—C═S, trithiocarbonic acid.

3.1.5.6 Ligands Other than Oxygen and Sulfur. See Sec. 3.1.7, Coordination Compounds, for acids containing ligands other than oxygen and sulfur (selenium and tellurium).

3.1.5.7 Differences between Organic and Inorganic Nomenclature. Organic nomenclature is largely built upon the scheme of substitution, that is, the replacement of hydrogen atoms by other atoms or groups. Although rare in inorganic nomenclature: NH_2Cl is called chloramine and $NHCl_2$ dichloroamine. Other substitutive names are fluorosulfonic acid and chlorosulfonic acid derived from HSO_3H. These and the names aminosulfonic acid (sulfamic acid), iminodisulfonic acid, and nitrilotrisulfonic acid should be replaced by the following based on the concept that these names are formed by adding hydroxyl, amide, imide, and so on, groups together with oxygen atoms to a sulfur atom:

HSO_3F	fluorosulfuric acid	$NH(SO_3H)_2$	imidobis(sulfuric) acid
HSO_3Cl	chlorosulfuric acid	$N(SO_3H)_3$	nitridotris(sulfuric) acid
NH_2SO_3H	amidosulfuric acid		

3.1.6 Salts and Functional Derivatives of Acids

3.1.6.1 Acid Halogenides. For acid halogenides the name is formed from the corresponding acid radical if this has a special name (Sec. 3.1.2.10); for example, NOCl, nitrosyl chloride. In other cases these compounds are named as halogenide oxides with the ligands listed alphabetically; for example, BiClO, bismuth chloride oxide; VCl_2O, vanadium(IV) dichloride oxide.

3.1.6.2 Anhydrides. Anhydrides of inorganic acids are named as oxides; for example, N_2O_5, dinitrogen pentaoxide.

TABLE 3.1 Trivial Names Retained for Acids

Alphabetically by characteristic element.

H_3AsO_4	arsenic acid	$H_4P_2O_7$	diphosphoric acid (or pyrophosphoric acid)
H_3AsO_3	arsenious acid	$H_4P_2O_8$	peroxodiphosphoric acid
H_3BO_3	orthoboric acid (or boric acid)	$(HO)_2OP$ | $(HO)_2OP$	diphosphoric(IV) acid or hypophosphoric acid
HBO_2	metaboric acid		
$HBrO_3$	bromic acid		
$HBrO_2$	bromous acid		
HBrO	hypobromous acid	$(HO)_2P—O$ | $(HO)_2P—O$	diphosphoric(III,V) acid
H_2CO_3	carbonic acid		
HOCN	cyanic acid		
HNCO	isocyanic acid	H_2PHO_3	phosphonic acid
HONC	fulminic acid	$H_2P_2H_2O_5$	diphosphonic acid
$HClO_4$	perchloric acid	HPH_2O_2	phosphinic acid (formerly hypophosphorous acid)
$HClO_3$	chloric acid		
$HClO_2$	chlorous acid	$HReO_4$	perrhenic acid
HClO	hypochlorous acid	H_2ReO_4	rhenic acid
H_2CrO_4	chromic acid	H_2SO_4	sulfuric acid
$H_2Cr_2O_7$	dichromic acid	$H_2S_2O_7$	disulfuric acid
H_5IO_6	orthoperiodic acid	H_2SO_5	peroxomonosulfuric acid
HIO_4	periodic acid	$H_2S_2O_3$	thiosulfuric acid
HIO_3	iodic acid	$H_2S_2S_6$	dithionic acid
HIO	hypoiodous acid	H_2SO_3	sulfurous acid
$HMnO_4$	permanganic acid	$H_2S_2O_5$	disulfurous acid
H_2MnO_4	manganic acid	$H_2S_2O_2$	thiosulfurous acid
HNO_4	peroxonitric acid	$H_2S_2O_4$	dithionous acid
HNO_3	nitric acid	$H_2S_xO_6$ (x = 3, 4, . . .)	polythionic acid (tri-, tetra-, . . .)
HNO_2	nitrous acid		
H_2NO_2	nitroxylic acid	H_2SO_2	sulfoxylic acid
$H_2N_2O_2$	hyponitrous acid	$HSb(OH)_6$	hexahydrooxoantimonic acid
HOONO	peroxonitrous acid	H_2SeO_4	selenic acid
H_3PO_4	orthophosphoric acid (or phosphoric acid)	H_2SeO_3	selenious acid
		H_4SiO_4	orthosilicic acid
HPO_3	metaphosphoric acid	H_2SiO_3	metasilicic acid
H_3PO_5	peroxomonophosphoric acid	$HTcO_4$	pertechnetic acid
		H_2TeO_4	technetic acid
		H_6TeO_6	orthotelluric acid

3.1.6.3 Esters. Esters of inorganic acids are named as the salts; for example, $(CH_3)_2SO_4$, dimethyl sulfate. However, if it is desired to specify the constitution of the compound, the nomenclature for coordination compounds should be used.

3.1.6.4 Amides. Names for amides are derived from the names of the acid radicals (or from the names of acids by replacing acid by amide); for example, $SO_2(NH_2)_2$, sulfonyl diamide (or sulfuric diamide); NH_2SO_3H, sulfamidic acid (or amidosulfuric acid).

3.1.6.5 Salts. Salts containing acid hydrogen are named by adding the word hydrogen before the name of the anion (however, see Sec. 3.1.4.1), for example, KH_2PO_4, potassium dihydrogen phosphate; $NaHCO_3$, sodium hydrogen carbonate (not bicarbonate); $NaHPHO_3$, sodium hydrogen phosphonate (only one acid hydrogen remaining).

Salts containing O^{2-} and HO^- anions are named oxide and hydroxide, respectively. Anions are cited in alphabetical order which may be different in formulas and names.

Examples: FeO(OH), iron(III) hydroxide oxide; $VO(SO_4)$, vanadium(IV) oxide sulfate.

3.1.6.6 Multiplicative Prefixes. The multiplicative prefixes bis, tris, etc., are used with certain anions for indicating stoichiometric proportions when di, tri, etc., have been preempted to designate condensed anions; for example, $AlK(SO_4)_2 \cdot 12H_2O$, aluminum potassium bis(sulfate) 12-water (recall that disulfate refers to the anion $S_2O_7^{2-}$).

3.1.6.7 Crystal Structure. The structure type of crystals may be added in parentheses and in italics after the name; the latter should be in accordance with the structure. When the typename is also the mineral name of the substance itself, italics are not used.

Examples: $MgTiO_3$, magnesium titanium trioxide (*ilmenite* type); $FeTiO_3$, iron(II) titanium trioxide (ilmenite).

3.1.7 Coordination Compounds

3.1.7.1 Naming a Coordination Compound. To name a coordination compound, the names of the ligands are attached directly in front of the name of the central atom. The ligands are listed in alphabetical order regardless of the number of each and with the name of a ligand treated as a unit. Thus "diammine" is listed under "a" and "dimethylamine" under "d." The oxidation number of the central atom is stated last by either the oxidation number or charge number.

3.1.7.2 Anionic Ligands. Whether inorganic or organic, the names for anionic ligands end in -o (eliding the final -e, if present, in the anion name). Enclosing marks are required for inorganic anionic ligands containing numerical prefixes, and for thio, seleno, and telluro analogs of oxo anions containing more than one atom.

If the coordination entity is negatively charged, the cations paired with the complex anion (with -ate ending) are listed first. If the entity is positively charged, the anions paired with the complex cation are listed immediately afterward.

The following anions do not follow the nomenclature rules:

F^-	fluoro	HO_2^-	hydrogen peroxo
Cl^-	chloro	S^{2-}	thio (only for single sulfur)
Br^-	bromo	S_2^{2-}	disulfido
I^-	iodo	HS^-	mercapto
O^{2-}	oxo	CN^-	cyano
H^-	hydrido (or hydro)	CH_2O^-	methoxo or methanolato
OH^-	hydroxo	CH_2S^-	methylthio or methanethiolato
O_2^{2-}	peroxo		

3.1.7.3 Neutral and Cationic Ligands. Neutral and cationic ligands are used without change in name and are set off with enclosing marks. Water and ammonia, as neutral ligands, are called "aqua" and "ammine," respectively. The groups NO and CO, when linked directly to a metal atom, are called nitrosyl and carbonyl, respectively.

3.1.7.4 Attachment Points of Ligands. The different points of attachment of a ligand are denoted by adding italicized symbol(s) for the atom or atoms through which the attachment occurs at the end of the name of the ligand; e.g., glycine-*N* or glycinato-*O,N*. If the same element is involved in different possible coordination sites, the position in the chain or ring to which the element is attached is indicated by numerical superscripts: e.g., tartrato(3−)-O^1,O^2, or tartrato(4−)-O^2,O^3 or tartrato(2−)-O^1,O^4.

3.1.7.5 Abbreviations for Ligand Names. Except for certain hydrocarbon radicals, for ligand (L) and metal (M), and a few with H, all abbreviations are in lowercase letters and do not involve hyphens. In formulas, the ligand abbreviation is set off with parentheses. Some common abbreviations are

Ac	acetyl	en	ethylenediamine
acac	acetylacetonato	Him	imidazole
Hacac	acetylacetone	H_2ida	iminodiacetic acid
Hba	benzoylacetone	Me	methyl
Bzl	benzyl	H_3nta	nitrilotriacetic acid
Hbg	biguanide	nbd	norbornadiene
bpy	2,2′-bipyridine	ox	oxalato(2−) from parent H_2ox
Bu	butyl	phen	1,10-phenanthroline
Cy	cyclohexyl	Ph	phenyl
D_2dea	diethanolamine	pip	piperidine
dien	diethylenetriamine	Pr	propyl
dmf	dimethylformamide	pn	propylenediamine
H_2dmg	dimethylglyoxime	Hpz	pyrazole
dmg	dimethylglyoximato(2−)	py	pyridine
Hdmg	dimethylglyoximato(1−)	thf	tetrahydrofuran
dmso	dimethylsulfoxide	tu	thiourea
Et	ethyl	H_3tea	triethanolamine
H_4edta	ethylenediaminetetraacetic acid	tren	2,2′,2″-triaminotriethylamine
Hedta, edta	coordinated ions derived from H_4edta	trien	triethylenetetraamine
		tn	trimethylenediamine
Hea	ethanolamine	ur	urea

Examples: $Li[B(NH_2)_4]$, lithium tetraamidoborate(1−) or lithium tetraamidoborate(III); $[Co(NH_3)_5Cl]Cl_3$, pentaamminechlorocobalt(III) chloride or pentaamminechlorocobalt(2+) chloride; $K_3[Fe(CN)_5CO]$, potassium carbonylpentacyanoferrate(II) or potassium carbonylpentacyanoferrate(3−); $[Mn\{C_6H_4(O)(COO)\}_2(H_2O)_4]^-$, tetraaquabis[salicylato(2−)]manganate(III) ion; $[Ni(C_4H_7N_2O_2)_2]$ or [Ni(dmg)] which can be named bis-(2,3-butanedione dioximato)nickel(II) or bis[dimethylglyoximato(2−)]nickel(II).

3.1.8 Addition Compounds

The names of addition compounds are formed by connecting the names of individual compounds by a dash (—) and indicating the numbers of molecules in the name by Arabic numerals separated by the solidus (diagonal slash). All molecules are cited in order of increasing number; those having the same number are cited in alphabetic order. However, boron compounds and water are always cited last and in that order.

Examples: $3CdSO_4 \cdot 8H_2O$, cadmium sulfate—water (3/8); $Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$, aluminum sulfate—potassium sulfate—water (1/1/24); $AlCl_3 \cdot 4C_2H_5OH$, aluminum chloride—ethanol (1/4).

3.2 PHYSICAL PROPERTIES OF PURE SUBSTANCES

TABLE 3.2 Physical Constants of Inorganic Compounds

Names follow the IUPAC Nomenclature. Solvates are listed under the entry for the anhydrous salt. Acids are entered under Hydrogen and acid salts are entered as a subentry under hydrogen.
Formula weights are based upon the International Atomic Weights of 1993 and are computed to the nearest hundredth when justified. The actual significant figures are given in the atomic weights of the individual elements.

Each element that has neither a stable isotope nor a characteristic natural isotopic composition is represented in this table by one of that element's commonly known radioisotopes identified by mass number and relative atomic mass.
Density values are given at room temperature unless otherwise indicated by the superscript figure; for example, 2.487^{15} indicates a density of 2.487 g/cm^3 for the substance at 15°C. A superscript 20 over a subscript 4 indicates a density at 20°C relative to that of water at 4°C. For gases the values are given as grams per liter (g/L).
Melting point is recorded in a certain case as 250 d and in some other cases as d 250, the distinction being made in this manner to indicate that the former is a melting point with decomposition at 250°C while in the latter decomposition only occurs at 250°C and higher temperatures. Where a value such as $-6H_2O$, 150 is given it indicates a loss of 6 moles of water per formula weight of the compound at a temperature of 150°C. For hydrates the temperature stated represents the compound melting in its water of hydration.
Boiling point is given at atmospheric pressure (760 mm of mercury or 101 325 Pa) unless otherwise indicated; thus 82^{15mm} indicates that the boiling point is 82°C when the pressure is 15 mm of mercury. Also, subl 550 indicates that the compound sublimes at 550°C. Occasionally decomposition products are mentioned.
Solubility is given in parts by weight (of the formula weight) per 100 parts by weight of the solvent (i.e., percent by weight) and at room temperature. Another unit frequently used is grams per 100 mL of solvent (mL per 100 mL for liquids and gases). The symbols of the common mineral acids represent aqueous solutions of these acids.

Abbreviations Used in the Table

a, acid
abs, absolute
abs alc, anhydrous ethanol
acet, acetone
alk, alkali (aq NaOH or KOH)
anhyd, anhydrous
aq, aqueous
aq reg, aqua regia
atm, atmosphere
BuOH, butanol
bz, benzene
c, solid state
ca., approximately
chl, chloroform
conc, concentrated
cub, cubic
d, decomposes
dil, dilute
disprop, disproportionates
EtOAc, ethyl acetate
eth, diethyl ether
EtOH, 95% ethanol
expl, explodes
fcc, face-centered cubic
fctetr, face-centered tetragonal
FP, flash point
fum, fuming
fus, fusion, fuses
g, gas, gram
glyc, glycerol
h, hot
hex, hexagonal
HOAc, acetic acid
i, insoluble
ign, ignites
L, liter
lq, liquid
MeOH, methanol
min, mineral
mL, milliliter
org, organic
oxid, oxidizing
PE, petroleum ether
pyr, pyridine
s, soluble
satd, saturated
sl, slightly
soln, solution
solv, solvent(s)
subl, sublimes
sulf, sulfides
tart, tartrate
THF, tetrahyrofuran
v, very
vac, vacuum
viol, violently
volat, volatilizes
<, less than
>, greater than

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Actinium-227	Ac	227.0278	10.07	1050(50)	ca. 3200	d aq; s acids
bromide	$AcBr_3$	466.74	5.85	subl 800		s aq
Aluminum	Al	26.981539	2.70	660.323	2518	s HCl, H_2SO_4, alk
acetylacetonate	$Al(C_5H_7O_2)_3$	324.31	1.27	190–193	315	i aq; v s alc; s bz, eth
ammonium bis(sulfate) 12-water	$AlNH_4(SO_4)_2 \cdot 12H_2O$	453.33	1.65	anhyd >280		14.3 g/100 mL aq; s glyc; i alc
antimonide	AlSb	148.74	4.26	1060		
arsenide	AlAs	101.90	3.76	1740		
bis(acetylsalicylate)	$Al(OOCC_6H_4OCOCH_3)_2OH$	402.30				v sl s aq, alc, eth
borate (2/1)	$2Al_2O_3 \cdot B_2O_3$	273.54		ca. 1050		i aq
bromide	$AlBr_3$	266.69	3.205_0^{18}	97.5	subl 253	d (viol) aq; s alc, acet, bz, CS_2
butoxide, *sec-*	$Al(C_4H_9O)_3$	246.33	0.967		$200–206^{30mm}$	FP 27; v s org solv
butoxide, *tert-*	$Al(C_4H_9O)_3$	246.33	1.025_0^{20}		subl 180	v s org solv
carbide (4/3)	Al_4C_3	143.96	2.360	2100	$d > 2200^{400mm}$	d aq; fire hazard
chlorate	$Al(ClO_3)_3$	277.35				v s aq; s alc
chloride	$AlCl_3$	133.34	2.440^{25}	192.6	subl 181.1	g/100 mL: 70 aq (viol), 100^{12} abs alc; s CCl_4, eth; sl s bz
ethoxide	$Al(C_2H_5O)_3$	162.16	1.142_0^{20}	140	205^{14mm}	s hot aq d; v sl s alc, eth
fluoride	AlF_3	83.98	2.882_4^{25}	1090	subl 1272	0.56 aq; i a, alk, alc, acet
hydroxide	$Al(OH)_3$	78.01	2.42	to Al_2O_3, 300		i aq; s acids, alkalis
iodide	AlI_3	407.69	3.98^{17}	191.0	382	d aq; s alc, eth, CS_2
isopropoxide	$Al(C_3H_7O)_3$	204.25	1.0346_0^{20}	118.5	135^{10mm}	d aq; s alc, bz, chl, PE
methoxide	$Al(CH_3O)_3$	72.07		0	130	
nitrate 9-water	$Al(NO_3)_3 \cdot 9H_2O$	375.13	1.72	73	d 135	g/100 mL: 64 aq, 100 alc; s acet
nitride	AlN	40.99	3.05	d 2517		d aq, acid, alkali
oxide (alpha-)	AlO_3	101.96	3.97	2054(6)	2980	i aq; v sl s a, alk
perchlorate 6-water	$Al(ClO_4)_3 \cdot 6H_2O$	433.43	2.020	120.8	anhyd 178	133 g/100 mL^{20} aq
phenoxide	$Al(C_6H_5O)_3$	306.27	1.23	d 265		d aq; s alc, chl, eth
phosphate	$AlPO_4$	121.95	2.56	>1460		i aq; sl s a
phosphide	AlP	57.96	2.85_4^{15}	2550		d aq
phosphinate (hypophosphite)	$Al(H_2PO_2)_3$	221.94		d to PH_3, 220		i aq; s HCl, warm alkali

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Aluminum (*continued*)						
potassium bis(sulfate) 12-water	$AlK(SO_4)_2 \cdot 12H_2O$	474.39	1.757^{20}	$-9H_2O$, 92	anhyd, 200	11.4 g/100 mL aq; v s glyc; i alc
propoxide	$Al(C_3H_7O)_3$	204.25	1.0578_0^{20}	106	248^{14mm}	d aq; s alc
selenide	Al_2Se_3	290.84	3.437_4^{20}	947		d aq, acid
silicon oxide (1/1)	$Al_2O_3 \cdot SiO_2$	162.05	3.247			i aq; d HF; s fused alkali
sodium bis(sulfate) 12-water	$AlNa(SO_4)_2 \cdot 12H_2O$	458.28	1.675^{20}	61		110 g/100 mL^{15} aq; i alc
stearate	$Al(C_{18}H_{35}O_2)_3$	877.41	1.070	117–120		i aq, alc; s bz, alk
sulfate	$Al_2(SO_4)_3$	342.15	1.61	770 d		36.4 g/100 mL^{20} aq; sl s alc
sulfate 18-water	$Al_2(SO_4)_3 \cdot 18H_2O$	666.46	1.69^{17}	d 86.5		87 g/100 mL^0 aq; i alc
sulfide	Al_2S_3	150.16	2.20^{13}	1097	subl 1500	hyd aq; s acid
tetrahydridoborate	$Al(BH_4)_3$	71.53		−64.5	44.5	d aq; ign air; expl in O_2, 20
Americium	Am	243	12	1176	2011	s a
Ammonia	NH_3	17.03	lq: 0.6818 at bp g: $0.6175^{15,\ 7.2atm}$	−77.75	−33.35	g/100 mL: 34 aq; 13.2 alc; s eth, organic solvents
Ammonium acetate	$NH_4C_2H_3O_2$	77.08	1.17^{20}	114	d	g/100 mL: 148^4 aq, 7.9^{15} MeOH; s alc
amidosulfate	$NH_4SO_3NH_2$	114.13		131	d 160	v s aq; sl s alc
benzoate	$NH_4C_6H_5O_2$	139.15	1.260	198	subl 160	g/100 mL: 20^{15} aq, 2.8 alc; s glyc
bromide	NH_4Br	97.94	2.429	452 (subl under pressure)	d 397 vacuo	76 g/100 mL^{20} aq; v s acet, alc, eth
calcium arsenate 6-water	$NH_4CaAsO_4 \cdot 6H_2O$	305.13	1.905^{15}	d 140		0.02 aq; s NH_4Cl
carbamate	NH_4COONH_2	78.07		subl 60		v s aq; sl s alc; i eth
carbonate 1-water	$(NH_4)_2CO_3 \cdot H_2O$	114.10		volatilizes 60		v s aq; i alc
chloride	NH_4Cl	53.49	1.5274^{25}	237.8	520	g/100 mL: 26^{15} aq, 0.6^{19} abs alc; i acet, eth
chromate(VI)	$(NH_4)_2CrO_4$	152.07	1.91^{12}	d 185		34 g/100 mL^{20} aq; sl s MeOH
chromium(III) bissulfate 12-water	$NH_4Cr(SO_4)_2 \cdot 12H_2O$	478.34	1.72	94 d		7.2 g/100 mL^0 aq
copper(II) tetrachloride 2-water	$(NH_4)_2CuCl_4 \cdot 2H_2O$	277.46	1.993	anhyd, 110	d >120	40.3 g/100 mL^{20} aq; s alc

cyanide	NH_4CN	44.06	1.10	d 36		v s aq, alc
dichromate(VI)	$(NH_4)_2Cr_2O_7$	252.07	2.155	d 180 to Cr_2O_3		35.6 g/100 mL^{20} aq; s alc; flammable
dihydrogen arsenate	$NH_4H_2AsO_4$	158.97	2.311	d 300		v s aq
dihydrogen phosphate	$NH_4H_2PO_4$	115.03	1.803^{19}	d 190		37 g/100 mL^{20} aq; sl s alc; i acet
disulfatocobatate(II) 6-water	$(NH_4)_2[Co(SO_4)_2] \cdot 6H_2O$	395.23	1.902			18 g/100 mL^{20} aq; v sl s alc
disulfatoferrate(II) 6-water	$(NH_4)_2[Fe(SO_4)_2] \cdot 6H_2O$	392.14	1.864	d 100		36.4 g/100 mL^{20} aq; i alc
disulfatoferrate(III) 12-water	$NH_4[Fe(SO_4)_2] \cdot 12H_2O$	482.19	1.71	39–41	d 230	124 g/100 mL aq
disulfatonickelate(II) 6-water	$(NH_4)_2[Ni(SO_4)_2] \cdot 6H_2O$	395.00	1.923			8.95 g/100 mL^{20} aq
dithiocarbamate	$NH_4S(C{=}S)NH_2$	110.20	1.451_4^{20}	99 d		v s aq; s alc; sl s eth
diuranate(VI)	$(NH_4)_2U_2O_7$	624.22				v sl s aq, alk; s acids
fluoride	NH_4F	37.04	1.009^{25}	d to NH_3 + HF		100 g/100 mL^{0} aq; s alc
formate	NH_4OOCH	63.06	1.27	116	d 180	143 g/100 mL^{20} aq; s alc, eth
heptamolybdate(VI)(6−) 4-water	$(NH_4)_2Mo_7O_{24} \cdot 4H_2O$	1235.86	2.498	anhyd 90	d 190	43 g/100 mL aq; s acids; i alc
hexachloropalladate(IV)	$(NH_4)_2[PdCl_6]$	355.20	2.418	d		sl s aq
hexachloroplatinate(IV)	$(NH_4)_2[PtCl_6]$	443.87	3.065	d 380		0.5 aq
hexadecanoate	$NH_4OOC(CH_2)_{14}CH_3$	273.45		21–22		s aq; sl s bz; i alc, acet
hexafluoroaluminate(3−)	$(NH_4)_3[AlF_6]$	195.09	1.78	d >100		v s aq
hexafluorogallate	$(NH_4)_3GaF_6$	237.83	2.10	d 200		
hexafluorogermanate	$(NH_4)_2GeF_6$	222.68	2.564	380	subl	s aq; i eth
hexafluorophosphate	$NH_4[PF_6]$	163.00	2.180_4^{18}	d 68		74.8 g/100 mL^{20} aq; s alc, acet
hexafluorosilicate	$(NH_4)_2[SiF_6]$	178.15	2.011	d		18.6 g/100 mL^{20} aq; i alc, acet
hexanitratocerate(IV)	$(NH_4)_2[Ce(NO_3)_6]$	548.22				135 g/100 mL^{20} aq; s alc, HNO
hydrogen carbonate	NH_4HCO_3	79.06	1.586	107 (rapid heating)		g/100 mL: 17.4^{20} aq, 10 glyc
hydrogen citrate	$(NH_4)_2HC_6H_5O_7$	226.19	1.48			100 g/100 mL aq; sl s alc
hydrogen difluoride	NH_4HF_2	57.04	1.51	124.6	240 d	v s aq; sl s alc
hydrogen oxalate hydrate	$NH_4HC_2O_4 \cdot H_2O$	125.08	1.556	anhyd, 170		s aq, alc; i bz, eth
hydrogen phosphate	$(NH_4)_2HPO_4$	132.06	1.619	d 155		69 g/100 mL^{20} aq; i alc, acet
hydrogen sulfate	NH_4HSO_4	115.11	1.78	146.9	d 350	100 g/100 mL aq; i alc, acet
hydrogen sulfide	NH_4HS	51.11	1.17	d 25 to NH_3 + H_2S		128 g/100 mL^{0} aq; s glyc; i alc, acet
hydrogen sulfite	NH_4HSO_3	99.11	2.03	subl 150 in N_2		267 g/100 mL^{10} aq

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Ammonium acetate (*continued*)						
hydrogen (±)tartrate	$NH_4HC_4H_4O_6$	167.12	1.68	d 200		2.2^{15} aq; i alc
hydroxide	NH_4OH	35.05		−77		49% dissolved NH_3
hypophosphite	$NH_4H_2PO_2$	83.03		d		v s aq; sl s alc; i acet
iodate	NH_4IO_3	192.94	3.309	d 150		2.6^{15} aq
iodide	NH_4I	144.94	2.514^{25}	subl 551	220 vacuo	167 g/100 mL^{20} aq; v s alc, acet
lactate	$NH_4C_3H_5O_3$	107.11	1.2^{15}	92		v s aq, alc, glyc; i acet, eth
magnesium arsenate 6-water	$NH_4MgAsO_4 \cdot 6H_2O$	289.36	1.923	d		0.038^{20} aq
molybdate(VI)(2−)	$(NH_4)_2MoO_4$	196.04	2.276_4^{25}	d		s acids
nitrate	NH_4NO_3	80.04	1.725^{25}	169.6	d 210	g/100 mL: 192^{20} aq; 3.8^{20} alc; 17^{20} MeOH; s acet
octadecanoate	$NH_4OOC(CH_2)_{16}CH_3$	301.50		21–22		sl s aq; s alc; i acet
octanoate	$NH_4OOC(CH_2)_6CH_3$	161.24		d on standing		v s aq, alc, acet; sl s eth
oxalate hydrate	$(NH_4)_2C_2O_4 \cdot H_2O$	142.11	1.50	d 70		5.1^{20} aq; s alc
oxodioxalatotitanate(IV)	$(NH_4)_2TiO(C_2O_4)_2$	276.02				v s aq
perchlorate	NH_4ClO_4	117.49	1.95	d 240		g/100 mL^{25}: 21.9 aq, 1.49 EtOH, 0.014 BuOH, 0.029 EtOAc
permanganate	NH_4MnO_4	136.97	2.208^{10}	explodes, 110		0.8^{15} aq
peroxodisulfate	$(NH_4)_2S_2O_8$	228.20	1.982	d 120	expl 180	58 g/100 mL^0 aq
phosphinate	$NH_4PH_2O_2$	83.04	1.634	200	d 240	g/100 mL: 100 aq, 5 alc; i acet
phosphomolybdate hydrate	$(NH_4)_3PO_4 \cdot 12MoO_3 \cdot H_2O$	1894.36		d		sl s aq
picrate	$NH_4C_6H_2N_3O_7$	246.14	1.719	d	expl 423	1.1^{20} aq; sl s alc
selenate(VI)	$(NH_4)_2SeO_4$	179.04	2.193_4^{20}	d		117 g/100 mL^7 aq; s HOAC; i alc
stearate	$NH_4C_{18}H_{35}O_2$	301.51	0.89	22		sl s aq, bz; s alc; i acet
sulfamate	$NH_4NH_2SO_3$	114.13		131	d 160	v s aq; sl s alc
sulfate	$(NH_4)_2SO_4$	132.14	1.769^{20}	d >280		43.5 g/100 mL^{20} aq; i alc, acet
sulfide	$(NH_4)_2S$	68.14		d ≈0		v s aq; s alc, alk
sulfite hydrate	$(NH_4)_2SO_3 \cdot H_2O$	134.16	1.41	d 60		75 g/100 mL^{20} aq; i alc, acet
(±)tartrate	$(NH_4)_2C_4H_4O_6$	184.15	1.601	d		58 g/100 mL^{15} aq; sl s alc
tetraborate 4-water	$(NH_4)_2B_4O_7 \cdot 4H_2O$	263.44				s aq; i alc

tetrachloroaluminate	$NH_4[AlCl_4]$	186.83		304		s aq, eth
tetrachloropalladate(II)	$(NH_4)_2[PdCl_4]$	284.29	2.170	d		v s aq; i abs alc
tetrachloroplatinate(II)	$(NH_4)_2[PtCl_4]$	372.97	2.936	140 d		s aq; i alc
tetrachlorozincate	$(NH_4)_2[ZnCl_4]$	243.28	1.879	150 d	subl 341	v s aq
tetrafluoroborate	$NH_4[BF_4]$	104.84	1.871	subl		25 g/100 mL^{16} aq
thiocyanate	NH_4SCN	76.12	1.305	149.6	d 170	128 g/100 mL^{0} aq; v s alc; s acet
thiosulfate	$(NH_4)_2S_2O_3$	148.21	1.679	d 150		2.15^{15} aq; i alc, eth
vanadate(V)(1−)	NH_4VO_3	116.98	2.326	d 200		0.48^{20} aq
Antimony	Sb	121.760(1)	6.697^{25}	630.7	1587	s hot conc H_2SO_4, aqua regia
arsenide	SbAs	196.68	6.0	≈680		
(III) bromide	$SbBr_3$	361.47	4.35	96.6	280	s acet, bz, chl
(III) chloride	$SbCl_3$	228.12	3.14_4^{20}	73.4	220.3	10 g/100 mL^{20} aq; s alc, bz, chl
(V) chloride	SCl_5	299.02	2.336_4^{20}	3.5	79^{22mm}	d aq; s HCl, chl, CCl_4
(III) fluoride	SbF_3	178.75	4.379_{20}^{20}	292	376	444 g/100 mL^{20} aq
(V) fluoride	SbF_3	216.75	2.99^{23}	8.3	141	d viol aq; s HOAc; forms solids with alc, bz, CS_2, eth
hydride (stibine)	SbH_3	124.78	5.475 g/L	−91.5	−18.4	20 mL/100 mL^{20} aq; s CS_2, alc
(III) iodide	SbI_3	502.47	4.92	168	401	g/100 g^{25}: 1.16 bz, 1.24 tol, 0.16 chl
(III) oxide (valentinite)	Sb_2O_3	291.52	5.7	655	1425	v sl s aq; s HCl, KOH
(V) oxide	Sb_2O_3	323.52	3.78	$-O_2$, >300		v sl s aq; sl s warm KOH, eth
(III) selenide	Sb_2Se_3	480.40	5.81	612		v sl s aq; s conc HCl
(III) sulfate	$SB_2(SO_4)_3$	531.71	3.62	d		sl s aq
(III) sulfide	Sb_2S_3	339.72	4.56	546		0.002^{20} aq (d); s H_2SO_4
(V) sulfide	Sb_2S_5	403.85	4.120	75 d		i aq; s HCl (d), NaOH
(III) telluride	Sb_2Te_3	626.32	6.52	620		i aq; s HNO_3
triethyl	$Sb(C_2H_5)_3$	209.0	1.324^{14}	−29	159.5	i aq
trimethyl	$Sb(CH_3)_3$	166.9	1.523^{15}		80.6	sl s aq
Argon	Ar	39.948(1)	1.7824 g/L^{0}	−189.38	−185.87	3.36 mL/100 mL^{20} aq
Arsenic	As	74.92159(2)	5.727_4^{25}	817	subl 615	i aq; s HNO_3
(III) bromide	$AsBr_3$	314.63	3.3972_4^{25}	31.1	220.0	hyd aq; s HCl, CS_2, PE
(III) chloride	$AsCl_3$	181.28	2.1497_4^{25}	−16.2	130.2	misc chl, CCl_4, eth; s HCl
(*di*-) disulfide	As_2S_2	213.97	3.254^{19}	320	565	s alkali; v sl s bz
(III) fluoride	AsF_3	131.92	2.73_{15}^{15}	−5.95	57.8	s alc, bz, eth, HF
(V) fluoride	AsF_5	169.91	7.46 g/L	−79.8	−52.8	hyd aq; s alc, bz, eth
(III) hydride (arsine)	AsH_3	77.95	3.420 g/L	−116.9	−62.5	28 mL/100 mL^{20} aq; s bz, chl
(III) iodide	AsI_3	455.63	4.73	140.9	424	s bz, tol; sl s aq, alc, eth
(III) oxide (arsenolite)	As_2O_3	197.84	3.86	274	460	1.8^{20} aq; s alc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Arsenic (*continued*)						
(III) oxide (claudetite)	As_2O_3	197.84	3.74	313	460	sl s aq; s dil acid, alk
(V) oxide	As_2O_5	229.84	4.32	315	d 800	66 g/100 mL^{20} aq; s alc
(III) selenide	As_2Se_3	386.72	4.75	260		s alkali, HNO_3
(III) sulfide	As_2S_3	246.04	3.460	310	707	i aq; s alk, slowly s hot HCl
(V) sulfide	As_2S_5	310.17		subl 500		0.0003 aq; s alkali, HNO_3
(III) telluride	As_2Te_3	532.64	6.50	621		
Astatine	At	210		302		
Barium	Ba	137.33	3.51^{20}	726.9	1845	d aq to Ba(OH)
acetate hydrate	$Ba(C_2H_3O_2)_2 \cdot H_2O$	273.43	2.19	anhyd 110	d 150	58.8 g/100 mL^{0} aq; 0.014 alc
benzenesulfonate	$Ba(O_3SC_6H_5)_2$	451.70				s aq; sl s alc
bromate hydrate	$Ba(BrO_3)_2 \cdot H_2O$	411.14	3.99^{18}	d 260		0.96^{30} aq; s acet; i alc
bromide	$BaBr_2$	297.14	4.781	856	1835	92 g/100 mL^{0} aq; s MeOH, acet
carbonate	$BaCO_3$	197.34	4.2865	d 1300 to BaO + CO_2		0.0024 aq; s acids
chlorate hydrate	$Ba(ClO_3)_2 \cdot H_2O$	322.24	3.179	anhyd 120	$-O_2$, 250	34 g/100 mL^{20} aq; sl s alc, acet
chloride	$BaCl_2$	208.24	3.856^{24}	962	1560	36 g/100 mL^{20} aq; s MeOH; i acet, EtAc
chloride dihydrate	$BaCl_2 \cdot 2H_2O$	244.26	3.097	anhyd 113		31.7 g/100 mL^{0} aq
chromate(VI)	$BaCrO_4$	253.33	4.498^{20}	d		0.001^{20} aq; s mineral acids
cyanide	$Ba(CN)_2$	189.36				80 g/100 mL^{14} aq; s alc
fluoride	BaF_2	175.32	4.89	1368	2260	0.161^{20} aq; s acids
hexafluorosilicate	$Ba[SiF_6]$	279.40	4.29_4^{21}	d 300		0.0235^{25} aq; s NH_4Cl soln; i alc
hydrogen phosphate	$BaHPO_4$	233.31	4.165^{15}	d 410		0.01 aq; s HCl, HNO_3
hydroxide 8-water	$Ba(OH)_2 \cdot 8H_2O$	315.48	2.18^{16}	78		3.9^{20} aq
iodate	$Ba(IO_3)_2$	487.13	5.23^{20}	d 476		0.033^{20} aq; s HCl
iodide	BaI_2	391.14	5.15	711	2027	169 g/100 mL^{20} aq; s alc, acet
manganate(VI)(2−)	$BaMnO_4$	256.26	4.85			disprop to $Ba(MnO_4)_2 + MnO_2$
molybdate	$BaMoO_4$	297.27	4.975	1450		0.0058^{25} aq
niobate	$Ba(NbO_3)_2$	419.14	5.44	1455		i aq
nitrate	$Ba(NO_3)_2$	261.34	3.24^{23}	592	d	5.0 aq; v sl s alc, acet
nitrite hydrate	$Ba(NO_2)_2 \cdot H_2O$	247.35	3.173^{30}	d 115		54.8 g/100 mL^{0} aq; i alc

oxalate	BaC_2O_4	225.35	2.658	400 d		i aq
oxide	BaO	153.33	5.72	1973	3088	3.5^{20} aq; s acids, EtOH
perchlorate	$Ba(ClO_4)_2$	336.23	3.20	505		g/100 mL^{25}: 129 aq, 78 EtOH, 42 BuOH, 81 EtOAc; i eth
perchlorate 3-water	$Ba(ClO_4)_2 \cdot 3H_2O$	390.27	2.74	d 400		198 g/100 mL^{25} aq; s MeOH; sl s acet
permanganate	$Ba(MnO_4)_2$	375.20	3.77	d 200		v s aq
peroxide	BaO_2	169.33	4.96	450 d	$-O_2$, 800	1.5^{0} aq
selenide	BaSe	216.29	5.02	1780		d aq
stearate	$Ba(C_{18}H_{35}O_2)_2$	704.28	1.145	160		i aq
sulfate	$BaSO_4$	233.39	4.50^{15}	1580	d >1600	0.00285 aq
sulfide	BaS	169.39	4.25^{15}	2230		7.9^{20} aq; dec in acids
sulfite	$BaSO_3$	217.39	4.44	d		0.02^{0} aq; i alc
tetracyanoplatinate(II)-4-water	$Ba[Pt(CN)_4] \cdot 4H_2O$	508.54	2.076			2.86 aq; i alc
thiocyanate 2-water	$Ba(SCN)_2 \cdot 2H_2O$	289.53	2.286^{18}	d 160		170 g/100 mL^{20} aq; s alc, acet
thiosulfate hydrate	$BaS_2O_3 \cdot H_2O$	267.47	3.5^{18}	d 220		0.21^{20} aq; i alc, acet, eth, CS
titanate(IV)(2−)	$BaTiO_3$	233.19	6.02	1625		i aq
vanadate	$Ba_3(VO_4)_2$	641.86	5.14	707		
zirconate	$BaZrO_3$	276.55	5.52	2500		i aq, alk; sl s acids
Berkelium (α form)	Bk	247	14.78	1050		
(β form)	Bk	247	13.25	986		
Beryllium	Be	9.012	1.8477^{20}	1287	2467	i aq; s acid, alk
bromide	$BeBr_2$	168.82	3.465^{25}	508	521	v s aq; s alc; 18.6 pyr
carbide	Be_2C	30.04	1.90^{15}	d >2127		d aq; s acids, alkali giving CH_4
chloride	$BeCl_2$	79.92	1.899^{25}	415 (alpha)	482.3	42 g/100 mL aq; s alc, eth, pyr, CS_2
fluoride	BeF_2	47.01	1.986	555	subl 1036^{1mm}	v s aq (slowly)
hydride	BeH_2	11.03	0.65	$-H_2$, 220		d aq (slowly), acids (rapidly)
hydroxide	$Be(OH)_2$	43.03	1.909	93		s hot conc acids and alkali (viol)
iodide	BeI_2	262.82	4.32	480	487	hyd aq violently; s alc, eth, CS_2
nitrate 3-water	$Be(NO_3)_2 \cdot 3H_2O$	187.07	1.557	60.5	d 125	166 g/100 mL^{20} aq
nitride	Be_3N_2	55.05	2.71	2200		d hot aq, alkali
oxide	BeO	25.01	3.025	2578 (alpha)	3787	s conc H_2SO_4
selenate 4-water	$BeSeO_4 \cdot 4H_2O$	224.03	2.03	anhyd 300	d 560	49 g/100 mL^{25} aq
silicate	Be_2SiO_4	110.11	3.0	1560		i aq
sulfate 4-water	$BeSO_4 \cdot 4H_2O$	177.14	1.713	anhyd 270	d 580	39 g/100 mL^{20} aq; i alc
sulfide	BeS	41.08	2.36	d		i aq; s HNO_3

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Bismuth	Bi	208.9804	9.78	271.5	1564	i aq; s hot H_2SO_4
(III) bromide	$BiBr_3$	448.69	5.72	218	453	d aq; s dil acids, acet
bromide oxide	BiBrO	304.88	8.082^{15}	d		i aq; s acids
(III) chloride	$BiCl_3$	315.34	4.75	233.5	447	d aq; s HCl, alc, eth, acet
chloride oxide	BiClO	260.43	7.72^{15}	d		i aq; s HCl
(III) fluoride	BiF_3	265.98	8.32	727	900	i aq; s HF
(V) fluoride	BiF_5	303.97	5.55^{25}	154.4	subl 550	d (viol) aq giving O_3 + BiF_3
hydride	BiH_3	212.00	9.303 g/L	−67	16.8	very unstable liquid
(III) hydroxide	$Bi(OH)_3$	260.00	4.962^{15}	−water, 100		d aq; s HCl
(III) iodide	BiI_3	589.69	5.778^{20}_4	408.6	subl 439	i aq; s HCl, alc
iodide oxide	BiIO	351.88	7.922	d red heat		i aq; s HCl
(III) nitrate 5-water	$Bi(NO_3)_3 \cdot 5H_2O$	485.07	2.83	anhyd 80		d aq; s HNO_3, acet, glyc
(III) oxide	Bi_2O_3	465.96	8.76	817	1890	i aq; s HCl, HNO_3
(V) oxide	Bi_2O_5	497.96	5.10	d 150		i aq; s KOH
(III) phosphate	$BiPO_4$	303.95	6.323^{15}	d		s conc HCl, HNO_3
(III) selenide	Bi_2Se_3	654.84	7.70^{20}_4	710 d	d	i aq; d aq reg
(III) sulfate	$Bi_2(SO_4)_3$	706.14	5.08	d 405		d aq, alc; s HCl
(III) sulfide	Bi_2S_3	514.16	6.78	850		i aq, EtAc; s HNO_3, HCl
(III) telluride	Bi_2Te_3	800.76	7.74	588.5		i aq; s alc
Boranes						
diborane(6)	B_2H_6	27.67	1.214 g/L	−165.5	−92.5	FP −68; s NH_4OH, conc H_2SO_4
tetraborane(10)	B_4H_{10}	53.32	2.340 g/L	−120	18	sl s aq; s bz
pentaborane(9)	B_5H_9	63.13	0.60	−46.81	60.0	hyd aq
pentaborane(11)	B_5H_{11}	65.14	0.745	−123	63	d aq
hexaborane(10)	B_6H_{10}	74.95	0.67	−62.3	108 d	d hot aq
decaborane(14)	$B_{10}H_{14}$	122.22	0.948	99.5	213	sl s aq; s bz, CS_2, eth
Borazine	$B_3H_6N_3$	80.50	lq: 0.81^{bp}	−58	55	sl s aq (d)
Boric acids, *see* under Hydrogen						
Boron	B	10.811	2.34	2076	3864	i aq
carbide	B_4C	55.25	2.510^{25}_4	2350	>3500	s fused alkalis
tribromide	BBr_3	250.52	2.6	−46.0	91.3	d aq, alc

trichloride	BCl_3	117.17	5.141 g/L	−107	12.7	d aq, alc
trifluoride	BF_3	67.81	3.077 g/L^{STP}	−127.1	−100.4	332 g/100 mL^{0} aq; s bz, chl, CCl_4
trifluoride 1-diethyl ether	$BF_3 \cdot O(C_2H_5)_2$	141.94	1.125	−60.4	125.7	d aq
trifluoride 1-methanol	$BF_3 \cdot HOCH_3$	131.89	1.203		59^{4mm}	
nitride	BN	24.82	2.18	2967		sl s hot acids
oxide	B_2O_3	69.62	2.55	450.0	2065	3.3 aq (slowly); s alc, glyc
Bromine	Br_2	159.808	3.1023_4^{25}	−7.25	58.8	3.4 g/100 mL^{20} aq; v s alc, chl, eth
pentafluoride	BF_5	174.90	2.460	−60.5	40.76	explodes with water; s HF
trifluoride	BF_3	136.90	2.803^{25}	8.77	125.74	d viol aq; d alk; smokes in air
Cadmium	Cd	112.411	8.65^{25}	321	765	i aq, alk; s HNO_3, hot HCl
acetate	$Cd(C_2H_3O_2)_2$	230.50	2.341	255	d	v s aq; s alc
bromide	$CdBr_2$	272.22	5.192	566	963	99 g/100 mL^{20} aq; s acet; sl s eth
carbonate	$CdCO_3$	172.42	4.258^{4}	d 500		s acids, NH_4OH
chloride	$CdCl_2$	183.32	4.05^{25}	568	960	120 g/100 mL^{25} aq
cyanide	$Cd(CN)_2$	164.44	2.226	d 200		1.71 g/100 mL^{15} aq; sl s alc
fluoride	CdF_2	150.41	6.33	1110	1748	4.3 g/100 mL^{25} aq
hydroxide	$Cd(OH)_2$	146.43	4.79	$-H_2O$, 130	CaO, 200	0.00026^{20} aq; s acids
iodide	CdI_2	366.22	5.670	388	742	84.7 g/100 mL^{20} aq; s alc, acet, eth
nitrate 4-water	$Cd(NO_3)_2 \cdot 4H_2O$	308.48	2.455	59.4		167 g/100 mL^{25} aq; s alc, acet
oxide	CdO	128.41	8.15 cubic	1540		i aq; s acids
phosphide	Cd_3P_2	399.18	5.96	700		s dil acid
selenide	CdSe	191.37	5.81^{15}	1350		i aq; d acids
sulfate-water (3/8)	$3CdSO_4 \cdot 8H_2O$	769.56	3.08	monohydrate, 80		94.4 g/100 mL^{25} aq; i alc, EtAc
sulfide	CdS	144.48	4.83	1750		0.13^{18} aq; s acids
telluride	CdTe	240.01	6.20_4^{15}	1041		i aq; d HNO_3
tungstate(VI)	$CdWO_4$	360.25	8.0			i aq, dil acids; s alkali CN's
Calcium	Ca	40.078(4)	1.55	842	1484	d aq; s acids
acetate	$Ca(C_2H_3O_2)_2$	158.17	1.50	d >160		37.4 g/100 mL^{0} aq; i alc, bz, acet
arsenate	$Ca_3(AsO_4)_2$	398.07	3.620			0.013^{25} aq
bromide	$CaBr_2$	199.89	3.38	742	1815	143 g/100 mL^{20} aq; v s alc, acet
carbide	CaC_2	64.10	2.222	2300		reacts with aq giving C_2H_2
carbonate (aragonite)	$CaCO_3$	100.09	2.83	d 825 to CaO		s dil acids
carbonate (calcite)	$CaCO_3$	100.09	2.711	d 825 to CaO		0.0013 g/100 mL^{20}; s acids
chlorate 2-water	$Ca(ClO_3)_2 \cdot 2H_2O$	243.01	2.711	anhyd 100		167 g/100 mL^{20} aq; s alc
chloride	$CaCl_2$	110.98	2.16_4^{25}	775	ca. 1940	42 g/100 mL^{20} aq; s alc, acet
chloride 6-water	$CaCl_2 \cdot 6H_2O$	219.07	1.71	anhyd 200		74.5 g/100 mL20 aq; v s alc
chlorite	$Ca(ClO_2)_2$	174.99	2.71^{25}	100		167 g/100 mL aq; s alc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Calcium (*continued*)						
chromate(VI) 2-water	$CaCrO_4 \cdot 2H_2O$	192.10	2.50	anhyd 200		sl s aq; s dil acids
citrate 4-water	$CaC_6H_6O_7 \cdot 4H_2O$	570.51		anhyd 120		0.10 aq; i alc
cyanamide	$CaCN_2$	80.10	2.29	ca. 1340	subl	no known solv without dec
cyanide	$Ca(CN)_2$	92.11		s >350		s aq
dichromate(VI)	$CaCr_2O_7$	256.10	2.370_4^{30}	d >100		v s aq; i eth; d alc
dihydrogen phosphate hydrate	$Ca(H_2PO_4)_2 \cdot H_2O$	252.07	2.220_4^{18}	anhyd 100	d 200	1.8^{30} aq
diphosphate (pyrophosphate)	$Ca_2P_2O_7$	254.10	3.09	1353		i aq; s HCl, HNO_3
fluoride	CaF_2	78.08	3.180	1418	2533	0.0015^{20} aq; s conc mineral acids
formate	$Ca(CHO_2)_2$	130.11	2.015	300 d		16.6 g/100 mL^{20} aq; i alc
(+)gluconate	$Ca[OOC(CHOH)_2CH_4OH]_2$	430.38				3.72^{20} aq
glycerophosphate	$Ca[C_3H_5(OH)_3]PO_4$	210.16		d >170		1.66^{20} aq; i alc
hexafluorosilicate	$Ca[SiF_6]$	182.17	2.662			i aq, acet
hydride	CaH_2	42.09	1.70	1000		d aq, alc
hydroxide	$Ca(OH)_2$	74.09	2.343	$-H_2O$, 580		0.17^{10} aq; s acids
hypochlorite	$Ca(OCl)_2$	142.99	2.35	100 d		d aq evolving Cl_2; i alc
iodate	$Ca(IO_3)_2$	389.88	4.519_4^{15}	d >540		0.10^{0} aq; i alc
iodide	CaI_2	293.89	3.956	783	1755	68 g/100 mL^{20} aq; v s alc, acet; i eth
lactate 5-water	$Ca(C_3H_5O_3)_2 \cdot 5H_2O$	308.30		$-3H_2O$, 100	anhyd 120	5.4^{15} aq; v sl s alc
magnesium carbonate	$Ca[Mg(CO_3)_2]$	184.41	2.872	d 730		0.032^{18} aq; s HCl
molybdate(VI)(2−)	$CaMoO_4$	200.02	4.35			s conc mineral acids
nitrate	$Ca(NO_3)_2$	164.09	2.504	56l		152 g/100 mL^{30} aq
nitride	Ca_3N_2	148.25	2.67	1195		d aq; s dilute acids (d)
nitrite 4-water	$Ca(NO_2)_2 \cdot 4H_2O$	204.15	1.674	d		84.5 g/100 mL^{18} aq; sl s alc
oleate	$Ca(C_{18}H_{33}O_2)_2$	603.01		83–84	d >400	0.04 aq; s chl, bz; v sl s alc, eth
oxalate hydrate	$CaC_2O_4 \cdot H_2O$	146.11	2.2	anhyd 200		0.0006 aq; s acids
oxide	CaO	56.08	3.34	2900	3500	0.13^{25} aq; s acids
palmitate	$Ca(C_{16}H_{31}O_2)_2$	550.93		d >155		0.003 aq; sl s bz, chl, HOAc
(+)panthothenate (vitamin B_3)	$Ca[O_2CH_2CH_2NHO\text{-}CH(OH)C(CH_3)_2CH_2OH]_2$	476.55		d 195–196		36 g/100 mL aq; sl s alc, acet

perchlorate	$Ca(ClO_4)_2$	238.98	2.65	d 270		g/100 mL[25]: 112 aq, 89.5 EtOH, 68 BuOH, 57 EtOAc, 43 acet
permanganate 5-water	$Ca(MnO_4)_2 \cdot 5H_2O$	368.03	2.4	d		338 g/100 mL aq
peroxide	CaO_2	72.08	2.92	explodes 275		sl s aq; s acids
phenoxide	$Ca(OC_6H_5)_2$	226.28	d in air			sl s aq, alc
phosphate	$Ca_3(PO_4)_2$	310.18	3.14	1670		0.03[25] aq; s HCl, HNO_3; i alc
phosphide	Ca_3P_2	182.18	2.51	ca. 1600		d aq; s acids; i alc, eth
phosphinate	$Ca(PH_2O_2)_2$	170.06		d >300		15.4 g/100 mL aq; sl s glyc
propanoate	$Ca(OOCC_3H_5)_2$	186.22				s aq; sl s alc; i acet, bz
salicylate 2-water	$Ca(C_7H_5O_3)_2 \cdot 2H_2O$	350.34		anhyd 200	d 240	2.8[15] aq; 0.015[16] EtOH
selenate 2-water	$CaSeO_4 \cdot 2H_2O$	219.07	2.75	anhyd 200	d 698	9.2 g/100 mL[25] aq
selenide	CaSe	119.04	3.82			
silicate	Ca_2SiO_4	172.24	3.27	2130		i aq
stearate	$Ca(C_{18}H_{35}O_2)_2$	607.04		179–180		0.004[15] aq; s hot pyr; i acet, chl
succinate 3-water	$CaC_4H_6O_4 \cdot 3H_2O$	212.22				1.28[20] aq; s acids; i alc
sulfate	$CaSO_4$	136.14	2.960	1460		0.20 aq; s acids
sulfate hemihydrate	$CaSO_4 \cdot 0.5H_2O$	145.15		anhyd 163		0.3[20] aq; s acids, glyc
sulfate 2-water	$CaSO_4 \cdot 2H_2O$	172.17	2.32	−1.5 H_2O, 128	anhyd 163	0.26[20] aq; s acid, glyc
sulfide	CaS	72.14	2.59	2525		0.02 (d) aq; d acids
sulfite 2-water	$CaSO_3 \cdot 2H_2O$	156.17		anhyd 100		0.004 aq; s acids d; sl s alc
(±)tartrate 4-water	$CaC_4H_4O_6 \cdot 4H_2O$	260.21		anhyd 200		0.0045[25] aq; s acids; sl s alc
telluride	CaTe	167.68	4.873			
tetraborate	CaB_4O_7	195.36				s dil acids
tetrahydridoaluminate	$Ca[AlH_4]_2$	102.10		ign moist air		d viol aq, alc; i bz, eth
thiocyanate 3-water	$Ca(SCN)_2 \cdot 3H_2O$	210.29		d >160		150 g/100 mL aq; v s alc
thioglycollate 3-water	$Ca(\text{-}OOCCH_2S\text{-}) \cdot 3H_2O$	184.24		−H_2O, >95	d >220	s aq; v sl s alc, chl; i bz, eth
thiosulfate 6-water	$CaS_2O_3 \cdot 6H_2O$	260.30	1.872	d >45		92 g/100 mL[25] aq; i alc
titanate	$CaTiO_3$	135.84	3.98	1980		
tungstate(VI)(2−)	$CaWO_4$	287.93	6.062[20]			0.0032 aq; d hot acids
Californium-252	Cf	252.1		900		
chloride	$CfCl_3$	358.5	5.88			
Carbon (diamond)	C	12.011	3.513	3500[63.5atm]	3930	i aq, alc
(graphite)	C		2.267	subl 3915–4020		
dioxide	CO_2	44.01	c: 1.56[−79] g: 1.975 g/L[0]	−78.44 subl		88 mL/100 mL[20] aq
diselenide	CSe_2	169.93	2.6626_4^{25}	−45.5	125.1	i aq; s acet, eth; misc CCl_4; d alc
disulfide	CS_2	76.14	1.2555	−111.6	46.56	FP −30; 0.29[20] aq; s alc, eth

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Carbon (*continued*)						
hydride (methane)	CH_4	16.04	0.415^{-164}	−182.48	−161.49	s bz
monoxide	CO	28.01	lq: 0.814^{-195} g: 1.250 g/L^{0}	−205.05	−191.49	2.3 mL/100 mL^{20} aq; 16 mL/100 ml alc; s HOAc, EtAc
suboxide	C_3O_2	68.03	1.114_4^0 2.985 g/L	−111.3	6.8	d aq to malonic acid; sl s CS_2
tetrabromide	CBr_4	331.65	3.42	90.1	190	i aq; s alc, chl, eth
tetrachloride	CCl_4	153.82	1.589_{25}^{25}	−22.9	76.7	0.05 mL/100 mL aq; s alc, chl, eth
tetrafluoride	CF_4	88.00	1.96^{-184}	−183.6	−127.8	sl s aq
tetraiodide	CI_4	519.63	4.34_4^{20}	171	subl 130	slowly hyd aq; s bz, chl, eth
Carbonyl bromide	$COBr_2$	187.82	2.5		64.5	hyd aq
chloride	$COCl_2$	98.92	4.340 g/L	−127.9	8.2	hyd aq; s bz, HOAc
fluoride	COF_2	66.01	lq: 1.139 g: 2.896 g/L	−114.0	−83.1	hyd aq
sulfide	COS	60.07	2.636 g/L	−138.81	−50.23	54 mL/100 mL^{20} aq; s alc, CS_2
Cerium	Ce	140.11	6.773	795	3440	i aq; s acids
(III) bromide	$CeBr_3$	379.83	5.18	733	1460	s aq, alc
(III) chloride	$CeCl_3$	246.47	3.97^{25}	817	1730	s aq, alc
(III) fluoride	CeF_3	197.11	6.157	1430	2327	i but slowly hyd aq; s H_2SO_4
(IV) fluoride	CeF_4	216.11	4.77	d >550		i aq
(III) iodide	CeI_3	520.83		766	1400	s aq
(III) nitrate 3-water	$Ce(NO_3)_3$ $3H_2O$	380.17		anhyd 150	d 200	234 g/100 mL^{20} aq
(IV) oxide	CeO_2	172.11	7.65	2400		i aq; s acids
(III) sulfate	$Ce_2(SO_4)_3$	568.42	3.912	d 1000		9.72 g/100 mL^{21} aq
(IV) sulfate	$Ce(SO_4)_2$	332.24	3.91	d 195		hyd aq; s dil H_2SO_4
Cesium	Cs	132.9054	1.8785^{15}	28.44	668.2	d aq; s acids
bromide	CsBr	212.81	4.44	636	≈1300	107 g/100 mL^{18} aq; s alc; i acet
carbonate	Cs_2CO_3	325.82	4.24	792		v s aq; 11 g/100 mL^{20} alc; s eth
chloride	CsCl	168.36	3.99	646	1300	g/100 mL: 187^{20} aq; 34^{25} MeOH; v s alc
fluoride	CsF	151.90	4.115	703	1231	322 g/100 mL^{18} aq
hydroxide	CsOH	149.91	3.68	272	990	386 g/100 mL^{15} aq; s alc

iodate	$CsIO_3$	307.81	4.934[20]	565		2.6[25] aq
iodide	CsI	259.81	4.510	621	≈1280	76.5 g/100 mL[20] aq; s EtOH; i acet
nitrate	$CsNO_3$	194.91	3.66	414	d 849	23 g/100 mL[20] aq; s acet; v sl s alc
oxide	Cs_2O	281.81	4.65	490		v s aq
perchlorate	$CsClO_4$	232.36	3.327	250		g/100 mL[25]: 1.96, 0.0086 EtOH, 0.118 acet, 0.0048 BuOH; i EtOAc, eth
selenate	Cs_2SeO_4	408.77	4.453			244 g/100 mL[12] aq
sulfate	Cs_2SO_4	361.87	4.243	1005		179 g/100 mL[20] aq; i alc, acet, pyr
Chlorine	Cl_2	70.905	g: 2.98[20] g/L lq: 1.5649[−35]	−101.5	−34.04	199 mL/100 mL[25] aq
dioxide	ClO_2	67.45	2.960 g/L	−59.6	10.9	11.2 g/100 mL[10] aq
fluoride	ClF	54.45	4.057 g/L	−155.6	−100.1	d viol aq; organics burst into flame
heptoxide	Cl_2O_7	182.90	1.805[25]	−91.5	82	hyd aq slowly; explodes on concussion or on contact with flame or I_2
monoxide	Cl_2O	86.90	3.813 g/L	−120.6	2.2	v s aq (forms HClO); s CCl_4
pentafluoride	ClF_5	130.44	5.724 g/L	−103	−13.1	
trifluoride	ClF_3	92.45	g: 4.057 g/L lq: 1.825[bp 20]	−76.3	11.75	hyd viol aq; organic matter and glass wool burst into flame
trioxide (dimer)	$(ClO_3)_2$	166.90	1.92[20]	3.5	≈200	reacts with aq
Chromium	Cr	51.996	7.15	1907	2679	s dil HCl
(II) acetate	$Cr(C_2H_3O_2)_2$	170.09	1.79			sl s aq, alc; s a; i eth
(III) acetate	$Cr(C_2H_3O_2)_3$	229.13				s aq
(II) bromide	$CrBr_2$	211.80	4.236	842		s aq, alc
(III) bromide	$CrBr_3$	291.71	4.68			s hot aq; v s alc
(II) chloride	$CrCl_2$	122.90	2.88[25]	814	subl 1300	v s aq
(III) chloride	$CrCl_3$	158.35	2.87	1152	d >1300	s aq, alc (slow); i acet
(II) fluoride	CrF_2	89.99	3.79	894		sl s aq; s hot HCl
(III) fluoride	CrF_3	108.99	3.8	1400		aq, alc; s HF, HCl
(III) formate 6-water	$Cr(CHO_2)_3 \cdot 6H_2O$	295.15		d >300		s aq
hexacarbonyl	$Cr(CO)_6$	220.06	1.77	d 130	explodes 210	i aq, alc; s eth, chl
(III) hydroxide	$Cr(OH)_3$	101.02		d		i aq; s acids
(III) nitrate 9-water	$Cr(NO_3)_3 \cdot 9H_2O$	400.15	1.80	66	d >100	208 g/100 mL[15] aq; s alc
(III) oxide	Cr_2O_3	151.99	5.21	2330	≈3000	i aq, alc; sl s acids, alkalis
(IV) oxide	CrO_2	84.00	4.89	197	$-O_2$, 250	i aq; s HNO_3
(VI) oxide	CrO_3	99.99	2.70[25]	198	d 250	61.7 g/100 mL aq; may ign organics

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Chromium (*continued*)						
(III) phosphate	$CrPO_4$	146.97	4.6	>1800		i aq, acids, aq reg
potassium bissulfate 12-water	$CrK(SO_4)_2 \cdot 12H_2O$	499.41	1.826^{25}	89	anhyd 400	22 g/100 mL^{25} aq; i alc
(II) sulfate 7-water	$CrSO_4 \cdot 7H_2O$	274.17				22.9 g/100 mL^{0} aq; sl s alc
(III) sulfate 18-water	$Cr_2(SO_4)_3 \cdot 18H_2O$	716.45	1.7	d 100		220 g/100 mL^{20} aq
Chromyl chloride	CrO_2Cl_2	154.90	1.9145_4^{25}	−96.5	117	d aq; s bz, chl, eth, CCl_4
fluoride	CrO_2F_2	121.99		31.6^{885mm}	subl 29.6	
Cobalt	Co	58.9332	8.90	1494	2927	i aq; s dil HNO_3
(II) acetate 4-water	$Co(C_2H_3O_2)_2 \cdot 4H_2O$	249.08	1.705^{19}	anhyd 140		s aq; 2.1 g/100 mL^{15} MeOH
(III) acetate	$Co(C_2H_3O_2)_3$	236.07		d >100		s aq, HOAc, alc
(II) bromide	$CoBr_2$	218.74	4.909_4^{25}	678 (in N_2)		112 g/100 mL^{20} aq; s alc, acet
(II) carbonate	$CoCO_3$	118.94	4.13	d		0.18^{15} aq; s hot acids
(II) chloride	$CoCl_2$	129.84	3.367_4^{25}	735	1049	53 g/100 mL^{20} aq; s alc, acet, eth, glyc, pyr
(II) chloride 6-water	$CoCl_2 \cdot 6H_2O$	237.93	1.924	anhyd 110		97 g/100 mL^{20} aq
(II) chromate	$CoCrO_4$	174.93	≈4.0	d		i aq; s acids
(II) cyanide	$Co(CN)_2$	110.97	1.872_4^{25}	d 300		0.0042^{18} aq; s KCN
(II) fluoride	CoF_3	96.93	4.46	1127	≈1400	1.36^{20} aq; s warm mineral acids
(III) fluoride	CoF_3	115.93	3.88	926		d aq
(II) formate 2-water	$Co(CHO_2)_2 \cdot 2H_2O$	185.00	2.129_4^{22}	anhyd 140	d 175	5.03 g/100 mL^{30} aq; i alc
(II) hydroxide	$Co(OH)_2$	92.95	3.37	168 (vacuo)		0.00018 aq; v s acids
(III) hydroxide	$Co(OH)_3$	109.96	4.46	$-H_2O$, 100	d	0.00032 aq; s acids
(II) iodide (alpha, black)	CoI_2	312.74	5.584_4^{25}	515 (vacuo)	570 (vacuo)	203 aq
(II) nitrate 6-water	$Co(NO_3)_3 \cdot 6H_2O$	291.03	1.88	55	d >74	155 g/100 mL^{30} aq; v s alc
(II) oxalate	CoC_2O_4	146.95	3.021	d 250		0.002^{18} aq
(II) oxide	CoO	74.93	6.44	−s1935		i aq; s acids, alkalis
(II,III) oxide	Co_3O_4	240.80	6.07	d >900		i aq; s acids, alkalis
(II) phosphate 8-water	$Co_3(PO_4)_2 \cdot 8H_2O$	510.87	2.769	anhyd 200		v sl s aq; s mineral acids
(II) sulfate 7-water	$CoSO_4 \cdot 7H_2O$	281.10	2.03	anhyd 420	d 1140	65 g/100 mL^{20} aq; sl s alc
(II) sulfide	CoS	91.00	5.45^{18}	1180		i aq; s acids
(II) thiocyanate 3-water	$Co(SCN)_2 \cdot 3H_2O$	229.14		anhyd 105		7.8^{18} aq; s alc, eth

Copper	Cu	63.546	8.96^{20}	1084.62	2561.5	i; s HNO_3, hot H_2SO_4
(II) acetate 1-water	$Cu(C_2H_3O_2) \cdot H_2O$	199.65	1.882	115	d 240	8 g/100 mL aq; 0.48 MeOH; sl s eth
acetate *meta*-arsenate (1/3)	$Cu(C_2H_3O_2)_2 \cdot 3Cu(AsO_2)_2$	1013.80				unstable in acids, bases; s NH_4OH
(II) borate(1−)	$Cu(BO_2)_2$	149.17	3.859			s a; i aq
(I) bromide	CuBr	143.45	4.98	497	1345	v sl s aq; s HCl, HBr, NH_4OH
(II) bromide	$CuBr_2$	223.35	4.71	498	900	126 g/100 mL aq; s alc, acet, pyr; i bz
(II) carbonate hydroxide (1/1) (malachite)	$CuCO_3 \cdot Cu(OH)_2$	221.12	4.0	d 200		i aq; s acids
(II) chlorate 6-water	$Cu(ClO_3)_2 \cdot 6H_2O$	338.54		65	d 100	242 g/100 mL^{18} aq; v s alc; s acet
(I) chloride	CuCl	99.00	4.14	430	≈1400	0.024 aq; s conc HCl, conc NH_4OH
(II) chloride	$CuCl_2$	134.45	3.386	300 d		73 g/100 mL^{20} aq; s alc, acet
(II) chloride 2-water	$CuCl_2 \cdot 2H_2O$	170.48	2.51	anhyd 200	d >300	76.4 g/100 mL^{25} aq; v s alc; s acet
(I) chromium(III) oxide (1/1)	$Cr_2O_3 \cdot Cu_2O$	295.07	5.24^{20}	d >900		i aq; s HNO_3
(II) citrate 2.5-water	$Cu_2C_6H_4O_7 \cdot 2.5H_2O$	360.22		anhyd 100		0.17 aq; s acids
(I) cyanide	CuCN	89.56	2.92	473 (in N_2)	d	i aq; s NH_4OH, KCN; d hot dil HCl
(II) fluoride	CuF_2	101.54	4.23	836	1676	4.75 g/100 mL^{20} aq; s acids
(II) formate	$Cu(CHO_2)_2$	153.58	1.831			12.5 aq
(II) hexafluorosilicate 4-water	$Cu[SiF_6] \cdot 4H_2O$	277.60	2.56	d		124 g/100 mL^{20} aq
(II) hydroxide	$Cu(OH)_2$	97.56	3.368	d 160		i aq; s acids
(I) iodide	CuI	190.45	5.67	606	≈1290	i aq; s KCN, NH_4OH, KI
(II) nitrate 3-water	$Cu(NO_3)_2 \cdot 3H_2O$	241.60	2.32	114.5	170 d	138 g/100 mL^0 aq; v s alc
(II) oleate	$Cu(OOCC_{17}H_{33})_2$	626.46				i aq; sl s alc; s eth
(II) oxalate hemihydrate	$CuC_2O_4 \cdot 0.5H_2O$	160.57		anhydr >200	d 310	0.002 aq; s NH_4OH
(I) oxide	Cu_2O	143.09	6.0_4^{25}	1235	$-O_2$, 1800	i aq; s HCl
(II) oxide	CuO	79.54	6.315_4^{14}	1450		i aq, alc; s acids, KCN
(II) perchlorate	$Cu(ClO_4)_2$	262.45	2.225^{23}	d >130		146 g/100 mL^{30} aq; s eth, EtAc; i bz
(II) phosphate 3-water	$Cu_3(PO_4)_2 \cdot 3H_2O$	434.63		d		i aq; s acids
(II) salicylate 4-water	$Cu(C_7H_5O_3)_2 \cdot 4H_2O$	409.83		dehyd in air		v s aq; s alc
(II) selenate 5-water	$CuSeO_4 \cdot 5H_2O$	296.58	2.559	anhyd 265	d ca. 480	25 g/100 mL^{20} aq; v sl s acet
(I) selenide	Cu_2Se	206.05	6.84_4^{21}	1113		d HCl
(II) selenide	CuSe	142.51	6.0	d 550		s acids
(II) stearate	$Cu(OOCC_{17}H_{35})_2$	630.50		≈250		i aq, alc, eth; s hot bz, pyr
(II) sulfate	$CuSO_4$	159.61	3.603	d >560		14.3 g/100 mL^0 aq; i alc
(II) sulfate 5-water	$CuSO_4 \cdot 5H_2O$	249.69	2.284_4^{16}	anhyd 200		32 g/100 mL^{20} aq; s MeOH, glyc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Copper (*continued*)						
(I) sulfide	Cu_2S	159.16	5.6_4^{20}	1130		i aq; d HNO_3, s KCN
(II) sulfide	CuS	95.61	4.76			i aq; s hot HNO_3, KCN
(I) sulfite hydrate	$Cu_2SO_3 \cdot H_2O$	225.16	3.83^{15}	d		sl s aq; s HCl
(II) tartrate 3-water	$CuC_4H_4O_6 \cdot 3H_2O$	265.66				0.42*20* aq; s acids, alkalis
(I) thiocyanate	CuSCN	121.62	2.85	1084		0.00044 aq; s NH_4OH, eth, alkali SCN
(II) tungstate(VI)(2-)	$CuWO_4 \cdot 2H_2O$	347.41				0.1^{15} aq; d acids; s NH_4OH
Curium-244	Cm	244.063	13.51	1340	≈3110	s acids
Cyanogen	NC—CN	52.03	2.335 g/L	−27.84	−21.15	mL/100 mL: 450^{20} aq, 230 alc; s acetonitrile; pure azide detonates upon shock. Handle only in solvents.
azide	$NC—N_3$	68.04				
bromide	NCBr	105.92	2.005	52	61.5	v s aq, alc, eth
chloride	NCCl	61.47	2.697 g/L	−6.5	13.8	s aq, alc, eth
fluoride	NCF	45.02	1.975 g/L	−82	−46	
Deuterium	D_2 or $^2H_2$	4.03	0.169^{mp} lq	−252.89	−249.49	sl s aq
oxide	D_2O	20.03	1.1056^{20}	3.82	101.43	misc aq
Dysprosium	Dy	162.50	8.540^{25}	1412	2567	s acids
bromide	$DyBr_3$	402.21	4.78	880	1480	s aq
chloride	$DyCl_3$	268.86	3.67	680	1530	s aq
fluoride	DyF_3	219.50	7.465	1154	2230	i aq
oxide	Dy_2O_3	373.00	7.81^{27}	2408		s aq
Einsteinium	Es	252.083	8.84	860		
Erbium	Er	167.26	9.066	1529	2868	s acid
chloride	$ErCl_3$	273.62	4.1	776	1500	s aq; sl s alc
oxide	Er_2O_3	382.52	8.640	2418		0.0005^{25} aq; s acids
sulfate 8-water	$Er_2(SO_4)_3 \cdot 8H_2O$	766.83	3.205	anhyd 110	d 630	16.0 g/100 mL^{20} aq
Europium	Eu	151.965	5.244	822	1527	s acids
(III) chloride	$EuCl_3$	258.32	4.89	623 d		s aq
(III) oxide	Eu_2O_3	351.93	7.42	2350		i aq; s acids
(III) sulfate 8-water	$Eu_2(SO_4)_3 \cdot 8H_2O$	736.24	$-8H_2O$, 375			2.56^{20} aq

Fermium-257	Fm	257.0951		1527		
Fluorine	F_2	38.00	1.513^{bp} lq 1.667 g/L	−219.61	−188.13	d aq viol; ignites organics and silicates
nitrate	$FONO_2$	81.00	1.507^{bp} lq	−175	−45.9	hyd aq; s acet; ignites alc, eth; liquid explodes on slight concussion
perchlorate	$FOClO_3$	118.45	5.20 g/L	−167.3	−15.9	explodes on slightest provocation
Francium-223	Fr	223.02				
Gadolinium	Gd	157.25	7.90	1312	3273	s acids
chloride	$GdCl_3$	263.61	4.52^{0}	∼609	1580	s aq
fluoride	GdF_3	214.25	7.047	1231	2277	i aq
nitrate 6-water	$Gd(NO_3)_3 \cdot 6H_2O$	451.36	2.332	91		s aq, alc
oxide	Gd_2O_3	362.50	7.407^{15}	2340		s acids
sulfate 8-water	$Gd_2(SO_4)_2 \cdot 8H_2O$	746.81	3.010^{18}	anhyd 400	d 500	4.08 aq
Gallium	Ga	69.723	$5.904^{29.6}$ (c) $6.095^{29.8}$ (lq)	29.7646	2203	s conc HCl, halogens, alkalis
antimonide	GaSb	191.48	5.614	712		s HCl
arsenide	GaAs	144.65	5.318_4^{25}	1238		s HCl
chloride	$GaCl_3$	176.08	2.47	77.9	201.2	d aq; s bz, CCl_4, CS_2
fluoride	GaF_3	126.72	4.47	>1000	subl 950	0.004^{25} aq; s HF
nitrate	$Ga(NO_3)_3$	255.74		d 110	→ Ga_2O_3, 200	v s aq
phosphide	GaP	100.70		1465		
selenide	GaSe	148.68	5.03^{25}	960	d	
triethyl	$Ga(C_2H_5)_3$	146.90	1.058^{30}	−82.3	142.8	
trimethyl	$Ga(CH_3)_3$	114.84	1.151^{15}	−15.7	55.8	
Germanium	Ge	72.61	5.323	937.3	2830	i aq; s hot H_2SO_4
(IV) bromide	$GeBr_4$	392.23	3.132	26.1	186.4	hyd aq; s bz, eth
IV) chloride	$GeCl_4$	214.42	1.879	−49.5	86.5	hyd aq; s bz, eth; sl s dil HCl
(IV) fluoride	GeF_4	148.60	6.521 g/L	−15	d >1000	hyd aq; s dil HCl
hydride (germane)	GeH_4	76.64	3.363 g/L	−164.8	−88.1	sl s hot HCl
(IV) oxide	GeO_2	104.61	4.25	1115	1200	0.43^{20} aq; s acids, alkalis
sulfide	GeS_2	136.74	3.01	530		
Gold	Au	196.967	19.3	1064.18	2856	s aq reg, KCN, hot H_2SO_4
(I) chloride	AuCl	232.42	7.57	289		s HCl, HBr, KCN
(III) chloride	$AuCl_3$	303.33	4.7	d >160	subl 180	68 g/100 mL^{20} aq; s EtOH
(I) cyanide	AuCN	222.99	7.14_4^{20}	d		s aq reg, KCN, NH_4OH
(III) cyanide 3-water	$Au(CN)_3 \cdot 3H_2O$	329.07		d 50		v s aq; sl s alc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Gold (*continued*)						
diantimonide	$AuSb_2$	440.47		460		
(III) fluoride	AuF_3	253.96	6.75	subl 300	d 500	
(III) oxide	Au_2O_3	441.93		d 150		s HCl, KCN
(I) sodium thiosulfate 2-water	$AuNa_3(S_2O_3)_2 \cdot 2H_2O$	526.24	3.09	anhyd 160		50 g/100 mL aq; i alc
stannide	AuSn	315.66		418		
(III) sulfide	Au_2S_3	490.13	8.754	d 197		i aq; s Na_2S
Hafnium	Hf	178.49	13.31	2227	4450	s HF
chloride	$HfCl_4$	320.30		432	subl 317	hyd aq; s acet, MeOH
oxide	HfO_2	210.49	9.68^{20}	2774		i aq
Helium	He	4.00260	0.176 g/L 0.1249 (lq)	-272.15^{25atm}	−268.935	0.861 mL/100 mL^{20} aq
Holmium	Ho	164.9304	8.79	1474	2720	s acids; oxidizes in moist air
bromide	$HoBr_3$	404.64	4.86	914	1470	s aq
chloride	$HoCl_3$	271.29	3.7	718	1510	s aq
Hydrazine	$H_2N—NH_2$	32.05	1.0036_4^{25}	2.0	113.5	FP 52; misc aq, alc
hydrate	$H_2N—NH_2 \cdot H_2O$	50.06	1.030	−51.7 & −65	118–119	misc aq, alc; i chl, eth
Hydrazinium(1+) chloride	$H_2N—NH_3Cl$	68.51	1.5	89	d 240	v s aq; i org solv
(2+) chloride	$ClH_3N—NH_3Cl$	104.97	1.423	198	d 200	v s aq; sl s alc
(1+) iodide	$H_2N—NH_3I$	159.96		125		s aq
(+1) perchlorate	$H_2N—NH_3ClO_4$	132.51	1.939^{15}	137	d 145	d aq; s alc
(2+) sulfate	$(H_3NNH_3)SO_4$	130.13	1.378	254	d	3.4^{20} aq; i alc
(1+) tartrate	$(H_2N—NH_3)_2C_4H_4O_6$	182.13		183		6.0 g/100 mL^0 aq
Hydrogen	H_2	2.0159 0.07099[bp] (lq)	0.088 g/L	−259.35	−252.88	1.9 mL aq
amidosulfate (sulfamate)	H_2NSO_3H	97.09	2.126	205	d	14.7 g/100 mL aq; sl s alc, acet
azide	HN_3	43.03	1.126^0	−80	37	v s aq; (very explosive)
borate(1−) (cubic)	HBO_2	43.83	2.486	236		v sl s aq
borate(3−) (ortho)	H_3BO_3	61.83	1.435^{15}	171.0	d 357	5.56 g/100 mL^{30} aq
bromide	HBr	80.91	3.388 g/L^{20}	−86.87	−66.71	193 g/100 mL^{25} aq; misc alc

bromide (constant boiling)	48% HBr + H_2O		1.49	−11	126	v s aq
bromide-*d*	^{2}HBr	81.91	3.39 g/L^{20}	−87.46	−66.5	v s aq
bromosulfate	$HOSO_2Br$	240.90		−6 to −8	d	hyd aq
chlorate (40% solution)	$HClO_3$	84.46	1.282_4^{20}			
chloride	HCl	36.46	1.526 g/L^{20}	−114.18	−85.05	72 g/100 mL^{20} aq
chloride (constant boiling)	20.24% HCl + H_2O		1.097		110	v s aq
chloride-*d*	^{2}HCl	37.47	1.49 g/L^{25}	−114.64	−84.72	v s aq
chlorosulfate	HSO_3Cl	116.52	1.753	−80	152	hyd viol → HCl + H_2SO_4
cyanate	HOCN	43.03	1.140_4^{-20}	−86	23.5	s aq d; s bz, eth
cyanide	HCN	27.03	0.687	−13.4	25.6	misc aq
deuteride	$^1H^2H$ or HD	3.02		−256.56	−251.03	
diphosphate(IV)	$(HO)_2OP—PO(OH)_2$	162.01	70	d 100	d	aq
diphosphate(V)	$H_4P_2O_7$	177.98		61		709 g/100 mL^{23} aq
fluoride	HF	20.01	0.922 g/L^0	−83.57	19.52	v s aq, alc; 2.54 g/100 g^5 bz
fluoride (constant boiling)	35.35% HF + H_2O				120	v s aq
fluoride-*d*	^{2}HF	21.02		−83.6	18.65	s aq
fluoroborate	$H[BF_4]$	87.81		d 130		v s aq
fluorophosphate	H_2PO_3F	99.99	1.818	−80		
fluorosulfate	$HOSO_2F$	100.07	1.726_4^{25}	−87.3	165.5	s aq
hexafluorosilicate 2-water	$H_2[SiF_6] \cdot 2H_2O$	180.11	1.463	19		60−70% aq solution
iodate	HIO_3	175.91	4.629_4^0	110 →H_5IO_6	220 →I_2O_5	269 g/100 mL^{20} aq; s alc; i eth
iodide	HI	127.91	5.37 g/L^{20}	−50.8	−35.1	234 g/100 mL^{10} aq; misc alc
iodide (constant boiling)	57% HI + H_2O		1.70		127	v s aq
iodide-*d*	HI	128.91		−51.87	−35.7	v s aq
molybdate hydrate	$H_2MoO_4 \cdot H_2O$	179.97	3.124^{15}	−H O, 70		0.133^{18} aq; s alk
nitrate	HNO_3	63.02	1.5492^0 lq	−41.59	83	v s
nitrate (constant boiling)	69% HNO_3 + H_2O		1.41^{20}		120.5	misc aq
oxide (water)	H_2O	18.02	1.000	0.00	100.00	
oxide-d_2	D_2O or ^2H_2O	20.03	1.1044^{25}	3.81	101.42	misc aq
perchlorate 2-water	$HClO_4 \cdot 2H_2O$	136.49	1.67^{20}	−17.8	203	v s aq (commercial 72% acid)
periodate(1−) (meta)	HIO_4	191.91		subl 110	d 138	440 g/100 mL^{25} aq
periodate(5−)	H_5IO_6	227.94		122	d 130−140	misc aq; s alc
peroxide	H_2O_2	34.01	1.463^0	−0.43	152	misc aq; s alc, eth
peroxodisulfate	$HO_3S—O—OSO_3H$	194.14		d 60		v s aq
phosphate(V)(1−) (meta)	HPO_3	79.98	2.2−2.5	subl	red heat	slowly s aq → H_3PO_4; s alc
phosphate(V)(3−) (ortho)	H_3PO_4	98.00	1.868^{25}	42.35	d 213	v s aq
commercial 85% acid			1.685	anhyd 150	$H_4P_2O_7$, 200	→ HPO_3, >300

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Hydrogen (*continued*)						
phosphate(V)(3−)-d_3	$^2H_3PO_4$	101.03	1.908^{25}	46.0		v s aq
phosphide, *see* Phosphine						
phosphinate	HPH_2O_2	66.0	1.493^{19}	26.5	d 50	s aq
phosphonate (phosphorous acid)	H_2PHO_3	82.00	1.651_4^{25}	≈73	d >180	v s aq, alc
selenate	H_2SeO_4	144.98	2.9508_4^{15}	58	260	vs aq (viol)
selenide	H_2Se	80.98	2.12_4^{-bp}	−65.73	−41.4	9.5 mL/100 mL^{20} aq; s CS_2
sulfate	H_2SO_4	98.08	1.8318^{20}	10.38	335.5	misc aq
sulfate-d_2	$^2H_2SO_4$ or D_2SO_4	100.09	1.8620	14.35		misc aq
sulfide	H_2S	34.08	1.5392 g/L^0	−85.49	−60.33	0.334 mL^{25} aq
tellurate(IV)	H_2TeO_3	177.63	3.0	d to TeO_2		0.0007 aq; s acid, alkali
tellurate(VI) (monoclinic)	H_6TeO_6	229.66	3.068	$-2H_2O$, 120	320 → TeO	30 g/100 mL^{18} aq
telluride	H_2Te	129.62	5.687 g/L	−49	−2	s aq d
trithiocarbonate	$(HS)_2CS$	110.21	1.483_4^{20}	−26.9	57.8	d aq, alc
tungstate(VI)(2−)	H_2WO_4	249.86	5.5	anhyd 100		i aq; s HF, alkalis
Hydroxylamine	$HONH_2$	33.03	1.204_4^{40}	33	58^{22mm}	v s aq, MeOH; sl s bz, eth
Hydroxylammonium chloride	$HONH_3Cl$	69.49	1.680^{20}	150.5	d	g/100 mL: 83^{17} aq, 12.5^{20} MeOH, 5.1^{20} EtOH; s glyc
sulfate	$(HONH_3)_2SO_4$	164.14		170		69 g/100 mL^{20} aq
Indium	In	114.82	7.31	156.60	2072	s acids
antimonide	InSb	236.58	5.77	525		i aq
arsenide	InAs	189.74	5.67	942		
chloride	$InCl_3$	221.18	4.0	583	subl 500	212 g/100 mL^{25} aq
fluoride	InF_3	171.82	4.39	1170		0.040^{25} aq; s dilute acids
oxide	In_2O_3	277.63	7.179		850	s hot mineral acids
phosphide	InP	145.79	4.81	1062		v sl s acids
telluride	In_2Te_3	612.44	5.75	667		
trimethyl	$In(CH_3)_3$	159.93	1.568	88.4	135.8	d aq; s acet, bz
Iodine	I_2	253.809	4.63^{25}	113.60	185.24	g/100 mL^{25}: 0.029 aq, 14.1 bz, 16.5 CS_2, 21.4 EtOH, 25.2 eth, 2.6 CCl_4; s chl, HOAc

heptafluoride	IF_7	259.89	lq: 2.8^{6}	6.45	4.77 subl	s aq (d), s NaOH
monobromide	IBr	206.81	4.416	40	116 d	s aq, alc, eth, CS_2
monochloride	ICl	162.36	3.10^{29}_{4}	27.2 α-form	97 d	d aq; s alc, eth, HOAc
pentafluoride	IF_5	221.90	3.19^{25}	9.43	100.5	d aq viol
pentoxide	I_2O_5	333.81	4.98	d 275		187 g/100 mL^{13} aq
trichloride	ICl_3	233.26	3.202^{-4}	~33	64 subl	d aq; s alc, bz, HCl
Iridium	Ir	192.217	22.65^{20}_{4}	2447	~2550	s K_2SO_4 fusion, KOH + KNO_3 fusion
hexafluoride	IrF_6	306.21	4.82	44.4	53.6	d aq
(III) oxide	Ir_2O_3	432.43		d ~ 1000 to Ir + O_2		s boiling HCl
(IV) oxide	IrO_2	224.22	11.7	d 1100		0.0002^{20} aq; s HCl
trichloride	$IrCl_3$	298.58	5.30	d 763		i acids, alkalis
Iron	Fe	55.845	7.86	1535	2861	i aq; s acids
(III) arsenate 2-water	$FeAsO_4 \cdot 2H_2O$	230.79	3.18	1020		v sl s aq; s acids
(II) bromide	$FeBr_2$	126.75	3.16	677	1023	117 g/100 mL^{20} aq; v s alc
(III) bromide	$FeBr_3$	295.67	4.5	d		s aq, alc, eth, HOAc
(*tri*-) carbide	Fe_3C	179.55	7.694	1227		s acids
(II) carbonate	$FeCO_3$	115.85	3.9	d		0.072^{18} aq; s acids
(II) chloride	$FeCl_2$	126.75	3.16	677	1024	62.5 g/100 mL^{20} aq; v s alc, acet
(III) chloride	$FeCl_3$	162.20	2.898	304	≈316	74 g/100 mL^{0} aq; s alc, acet, eth
disulfide (pyrite)	FeS_2	119.98	5.02	d 602		s acids d
(II) fluoride	FeF_2	93.84	4.09	1100	1837	sl s aq; s dil HF; i alc, bz, eth
(III) fluoride	FeF_3	112.84	3.87	subl 1000		0.091^{25} aq; s HF
(III) hexacyanoferrate(II)	$Fe_4[Fe(CN)_6]_3$	859.23	1.80	250 d		i aq; s HCl
(II) hydroxide	$Fe(OH)_2$	89.86	3.4			0.006 aq; s acids
(III) hydroxide oxide	FeO(OH)	88.85	4.26	anhyd 136		i aq, alc; s HCl
(II) iodide	FeI_2	309.65	5.315	587	1093	s aq
(III) nitrate 9-water	$Fe(NO_3)_3 \cdot 9H_2O$	404.00	1.684	47	d 100	138 g/100 mL^{20} aq
(*di*-) nitride	Fe_2N	125.70	6.35	d 200		s HCl
(II) oxalate 2-water	$FeC_2O_4 \cdot 2H_2O$	179.89	2.28	d 150		0.044^{18} aq; s mineral acids
(II) oxide	FeO	71.84	6.0	1377	d 3414	i aq; s acids
(II,III) oxide	Fe_3O_4	231.53	5.17	1597		i aq; s acids
(III) oxide	Fe_2O_3	159.69	5.25	1565		i aq; s HCl
pentacarbonyl	$Fe(CO)_5$	195.90	1.49	−20.0	103.9	FP −20; i aq; s alc, bz, eth
(II) phosphate 8-water	$Fe_3(PO_4)_2 \cdot 8H_2O$	501.60	2.58			i aq; s acids
phosphide	Fe_2P	142.66	6.85	1370		s hot mineral acids

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Iron (*continued*)						
(II) selenide	FeSe	134.81	6.78	d		s HCl
(II) silicate(2−)	$FeSiO_3$	131.93	3.5	1140		
(II) silicate(4−)	Fe_2SiO_4	203.77	4.30	1220		d HCl
(II) sulfate 7-water	$FeSO_4 \cdot 7H_2O$	278.01	1.89	anhyd 300	d 671	48 g/100 mL^{20} aq
(III) sulfate	$Fe_2(SO_4)_3$	399.88	3.097^{18}	d 1178		slowly s aq (hyd); sl s alc
(II) sulfide	FeS	87.92	4.7	1190	d	0.0006^{18} aq; s acid
(III) thiocyanate	$Fe(SCN)_3$	230.09				v s aq
Krypton	Kr	83.80	3.7493 g/L	−157.36	−153.22	5.94 mL/100 mL^{20} aq
difluoride	KrF_2	121.80	3.24	subl−60		s anhyd HF
Lanthanum	La	138.9055	6.162	920	3464	i aq; s HCl
chloride	$LaCl_3$	245.26	3.84	852	1812	v s aq
chloride 7-water	$LaCl_3 \cdot 7H_2O$	371.37		anhyd 852 (in HCl atm)		v s aq; s alc
fluoride	LaF_3	195.90	5.9	1493	2327	
nitrate 6-water	$La(NO_3)_3 \cdot 6H_2O$	433.01		40	d 126	181 g/100 mL^{20} aq; v s alc
oxide	La_2O_3	325.81	6.51	2305	4200	s acids
sulfate	$La_2(SO_4)_3$	566.00	3.60	d white heat		2.33 g/100 mL^{20} aq; i alc
sulfate 9-water	$La_2(SO_4)_3 \cdot 9H_2O$	728.14	2.821	anhyd 400		2.92 g/100 mL^{20} aq; i alc
Lawrencium	Lr	262		1627		
Lead	Pb	207.2	11.34_4^{20} (fcc)	327.43	1749	s hot conc HNO_3, HCl, H_2SO_4
(II) acetate 3-water	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	427.3	2.55	75	d >200	g/100 mL: 63^{15} aq, 3.3 alc
(IV) acetate	$Pb(C_2H_3O_2)_4$	443.4	2.228	≈75–180		s hot HOAc, bz, chl, conc HX acids
(II) azide	$Pb(N_3)_2$	291.2	4.7	expl 350 or when shocked		0.023^{18} aq; v s HOAc
(II) borate(1−) hydrate	$Pb(BO_2)_2 \cdot H_2O$	310.8	5.598 anhyd	anhyd 160	mp 500	s acids
(II) bromide	$PbBr_2$	367.0	6.69	371	912	0.450^0 aq; s acids; i alc
(II) carbonate	$PbCO_3$	267.2	6.61	d 340 → PbO		i aq; s acids, alkalis
(II) chlorate	$Pb(ClO_3)_2$	374.1	3.89	d 230		140 g/100 mL^{18} aq; v s alc
(II) chloride	$PbCl_2$	278.1	5.98	501	950	0.99^{20} aq
(II) chloride fluoride	PbClF	261.7	7.05			

(II) chromate(VI)(2−)	$PbCrO_4$	323.2	6.12	844	d	i aq; s dil HNO_3, alkalis
(II) fluoride	PbF_2	245.2	8.445	830	1297	0.064^{20} aq
(IV) fluoride	PbF_4	283.2	6.7	≈ 600		hyd aq
(II) formate	$Pb(CHO_2)_2$	297.2	4.63	d 190		1.6 g/100 mL^{20} aq
(II) hydrogen arsenate	$PbHAsO_4$	347.1	5.94	d 280 to $Pb_2As_2O_7$		s HNO_3, alkalis
(II) hydroxide	$Pb(OH)_2$	241.2	7.59	d 145		0.016^{20} aq; s acids, alkalis
(II) iodide	PbI_2	461.0	6.16	410	872	0.063^{20} aq; s KI, $Na_2S_2O_3$, alkalis
(II) molybdate(VI)(2−)	PbMoO	367.1	6.7	1065		s acids, alkalis
(II) nitrate	$Pb(NO_3)_2$	331.2	4.53	470		g/100 mL: 56^{20} aq, 1.3 MeOH
(II) oleate	$Pb(C_{18}H_{33}O_2)_2$	770.1				s alc, bz, eth
(II) oxalate	PbC_2O_4	295.2	5.28	d 300		s acids, alkalis
(II) oxide (litharge)	PbO	223.2	9.35 (red)	886	1472 d	0.0017^{20} aq; s HNO_3
(IV) oxide	PbO_2	239.2	9.64	d 290, Pb_3O_4	d 595, PbO	s HCl, dil HNO_3 + H_2O_2[3], $H_2C_2O_4$
(II,IV) oxide (red lead)	Pb_3O_4	685.6	8.92	d 595 → PbO		s HNO_3, hot HCl
(II) phosphate	$Pb_3(PO_4)_2$	811.5	7.0	1014		s HNO_3, alkalis
(II) selenide	PbSe	286.2	8.15	1078		s HNO_3
(II) silicate(2−)	$PbSiO_3$	283.3	6.5	764		s acids
(II) silicate(4−)	Pb_2SiO_4	506.5	7.60	743		
(II) stearate	$Pb(C_{18}H_{35}O_2)_2$	774.2	1.4	≈125		0.05^{35} aq; s hot alc
(II) sulfate	$PbSO_4$	303.3	6.29	1170		0.00425 aq; s NaOH
(II) sulfide	PbS	239.3	7.60	1118	1300 subl	0.0006^{18} aq; s HNO_3, hot dil HCl
(II) telluride	PbTe	334.8	8.16	924		i acids and alkalis
tetraethyl	$Pb(C_2H_5)_4$	323.45	1.653	−137	≈200	i aq; s bz, hydrocarbons
tetramethyl	$Pb(CH_3)_4$	267.35	1.995	−30.2	110	s hydrocarbons
(II) thiocyanate	$Pb(SCN)_2$	323.4	3.82	d 190		0.44^{18} aq, s HNO_3, NaOH
Lithium	Li	6.941	0.534^{20}	180.54	1341	d aq to LiOH
acetate 2-water	$LiC_2H_3O_2 \cdot 2H_2O$	102.02	1.3	58	d	63 g/100 mL^{20} aq; v s alc
aluminate(1−)	$LiAlO_2$	65.92	2.554	1700		
amide	$LiNH_2$	22.96	1.178	380	d 450 vacuo	d aq (→ LiOH + NH_3); i bz, eth
benzoate	$LiC_7H_5O_2$	128.06		>300		g/100 mL: 33 aq; 7.7 alc
borate(1−)	$LiBO_2$	49.75	2.18	849	1719	2.7 g/100 mL^{20} aq; i alc
borohydride	$Li[BH_4]$	21.78	0.66	268	d 380	s aq, eth, THF, aliphatic amines
bromate	$LiBrO_3$	134.85	3.62			179 g/100 mL^{20} aq
bromide	LiBr	86.84	3.464	552	1289	164 g/100 mL aq; s alc, eth
carbonate	Li_2CO_3	73.89	2.11	720	d 1300	1.3 g/100 mL^{20} aq; i alc; s acids

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Lithium (*continued*)						
chloride	LiCl	42.39	2.07	613	1360	77 g/100 mL^{20} aq; s alc, acet
chromate(VI)(2−) 2-water	$Li_2CrO_4 \cdot 2H_2O$	165.91	2.15	anhyd 75		142 g/100 mL^{18} aq; s EtOH
citrate 4-water	$Li_3C_6H_5O_7 \cdot 4H_2O$	281.98		anhyd 105		61 g/100 mL^{15} aq; sl s alc
fluoride	LiF	25.94	2.640	848	1681	0.13^{25} aq; s acids
hexafluoroaluminate(3−)	$Li_3[AlF_6]$	161.79		1012		
hydride	LiH	7.95	0.76–0.77	680	d 950	no solvent known; flammable
hydride-*d*	Li^2H or LiD	8.96	0.881	686		
hydroxide	LiOH	23.95	1.45	471.2	1626	12.4 g/100 mL^{20} aq; sl s alc
iodate	$LiIO_3$	181.84	4.502	450		66 g/100 mL aq; in alc
iodide	LiI	133.84	4.061	469	1174	165 g/100 mL^{20} aq & alc; v s acet
nitrate	$LiNO_3$	68.95	2.38	∼255		50 g/100 mL^{20} aq; s alc
nitride	Li_3N	34.83	1.27	813		d aq
oxide	Li_2O	29.88	2.013	1570	2563	forms LiOH in aq
perchlorate	$LiClO_4$	106.39	2.43	236	d ∼ 400 LiCl + O_2	47.4 g/100 mL^{25} aq; v s organic solv
peroxide	Li_2O_2	45.88	2.31	d >195 to Li_2O		
silicate(2−)	Li_2SiO_3	89.97	2.52_4^{25}	1201		d dil HCl
sulfate	Li_2SO_4	109.95	2.22	859		34.5 g/100 mL^{20} aq; i alc
tetraborate(2−)	$Li_2B_4O_7$	169.12		917		sl s aq
tetrahydridoaluminate	$Li[AlH_4]$	37.95	0.917	d 137		d aq, alc; g/100 mL: 30 eth, 13 THF; flammable
tetrahydridoborate	$LiBH_4$	21.79	0.666	268	d 380	s aq pH >7; s eth, THF
Lutetium	Lu	174.967	9.841	1663	3402	s acids
chloride	$LuCl_3$	281.33	3.98	892	subl >750	s aq
sulfate 8-water	$Lu_2(SO_4)_3 \cdot 8H_2O$	782.25				42.3 g/100 mL^{20} aq
Magnesium	Mg	24.305	1.738^{20}	651	1100	i aq; s dilute acids
acetate	$Mg(C_2H_3O_2)_2$	142.00	1.42	323 d		53.4 g/100 mL^{20} aq; v s alc
aluminate(2−)	$MgAl_2O_4$	142.25	3.6	2135		v sl s HCl
amide	$Mg(NH_2)_2$	56.35	1.39_4^{25}	ign in air		d viol water giving NH_3
borate(1−) 8-water	$Mg(BO_2)_2 \cdot 8H_2O$	254.04	2.30			sl s aq; s acids
bromide	$MgBr_2$	184.11	3.722	711 d	1158	101 g/100 mL^{20} aq

carbonate	$MgCO_3$	84.31	3.05	990		0.01 aq; s acids
chloride	$MgCl_2$	95.21	2.33	714	1412	54.6 g/100 mL^{20} aq
fluoride	MgF_2	62.30	3.148	1263	2270	0.013^{25} aq; s HNO_3
(*di*-) germanide	Mg_2Ge	121.22	3.09	1115		
hexafluorosilicate 6-water	$Mg[SiF_6] \cdot 6H_2O$	274.47	1.788	$-SiF_4$, 120		51 g/100 mL^{20} aq; i alc
hydride	MgH_2	26.32	1.45	d 200 vacuo	ign in air	d aq and alc violently
hydrogen phosphate 3-water	$MgHPO_4 \cdot 3H_2O$	174.33	2.13^{15}	anhyd 205	d 550	sl s aq; s acids
hydroxide	$Mg(OH)_2$	58.32	2.36	350 d		0.00125 aq; s acids
iodide	MgI_2	278.12	4.43	634	0	140 g/100 mL^{20} aq; s alc
lactate 3-water	$MgC_6H_{10}O_6 \cdot 3H_2O$	256.51				4 g/100 mL aq; sl s alc
mandelate	$MgC_{16}H_{14}O_6$	326.59				0.004^{100} aq; i alc
nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	256.41	1.464	95	d 129	120 g/100 mL^{20} aq; v s alc
nitride	Mg_3N_2	100.93	2.712	d 270		d aq; s acids
oleate	$Mg(C_{18}H_{33}O_2)_2$	587.22				sl s alc, eth, PE
oxide	MgO	40.30	3.65–3.75	2800	3600	i aq, alc; s acids
perchlorate	$Mg(ClO_4)_2$	223.21	2.21	d >251		g/100 mL^{25}: 73 aq, 18 EtOH, 44.6 BuOH, 54 EtOAc, 32 acet
permanganate	$Mg(MnO_4)_2$	262.19				v s aq
peroxide	MgO_2	56.30	≈3.0	d 100		s acids
peroxoborate 7-water	$Mg(BO_3)_2 \cdot 7H_2O$	268.09				sl s aq d; s dilute acids
phosphate 5-water	$Mg_3(PO_4)_2 \cdot 5H_2O$	352.96	1.64^{15}	anhyd ~400		0.02 aq; s acids
silicate(2−)	$MgSiO_3$	100.39	3.192_4^{25}	d 1557		i aq; v sl s HF
silicate(4−)	Mg_2SiO_4	140.69	3.21	1898		i aq; d hot HCl
(*di*-) silicide	Mg_2Si	76.70	2.0	1100		d aq, HCl
(*di*-) stannide	Mg_2Sn	167.32	3.60	778		s aq, HCl
sulfate 7-water	$MgSO_4 \cdot 7H_2O$	246.47	1.67	anhyd 250		27.2 g/100 mL aq; sl s alc
sulfite 6-water	$MgSO_3 \cdot 6H_2O$	212.46	1.725	anhyd 200	mp: 2227	0.66^{25} aq
tungstate(VI)(2−)	$MgWO_4$	272.14	6.89			i aq; d acids
Manganese	Mn	54.9380	7.21^{20}	1244 fctetr	2095	d aq; s acids
acetate 4-water	$Mn(C_2H_3O_2)_2 \cdot 4H_2O$	245.09	1.589	80		38 g/100 mL^{50} aq; v s alc
bromide	$MnBr_2$	214.75	4.39	698	1027	147 g/100 mL^{20} aq; s alc
(*tri*-) carbide	Mn_3C	176.83	6.89	1520		d aq; s acid
carbonate	$MnCO_3$	114.95	3.125	d >200		0.0065^{25} aq; s acids
chloride	$MnCl_2$	125.84	2.977	650	1210	74 g/100 mL^{20} aq; s alc, pyr; i eth
chloride 4-water	$MnCl_2 \cdot 4H_2O$	187.91	2.01	97.5	anhyd 198	143 g/100 mL aq; s alc; i eth
decacarbonyl	$Mn_2(CO)_{10}$	389.98	1.75	d 110		i aq; s organic solvents

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Manganese (*continued*)						
diphosphate	$Mn_2P_2O_7$	283.82	3.707	1196		i aq; s acid
(II) fluoride	MnF_2	92.93	3.98	930	1820	0.66^{40} aq; s HF, conc HCl
(III) fluoride	MnF_3	111.93	3.54	d >600		hyd aq; s acid
hydroxide	$Mn(OH)_2$	88.95	3.258	d		0.002^{18} aq; s acids
iodide	MnI_2	308.75	5.04	638	1017	s aq
nitrate 6-water	$Mn(NO_3)_2 \cdot 6H_2O$	287.04	1.8	25.8		v s aq, alc
(II) oxide	MnO	70.94	5.37	1840		i aq; s acids
(III) oxide	Mn_2O_3	157.87	4.89	877 d		i aq; s HCl giving off Cl_2
(IV) oxide	MnO_2	86.94	5.08	$-O_2$, 530		s HCl; i HNO_3, cold H_2SO_4
(II,IV) oxide	Mn_3O_4	228.81	4.84	1567		i aq; s HCl
(VII) oxide	Mn_2O_7	221.87	2.396	ca. −20	ca. 25	explodes 85; v s aq
phosphinate hydrate	$Mn(PH_2O_2)_2 \cdot H_2O$	202.93		d to PH_3		15 g/100 mL aq; i alc
silicate, meta-	$MnSiO_3$	131.02	3.48	1290		i aq, HCl
sulfate	$MnSO_4$	151.00	3.25	700	d 850	52 g/100 mL aq; i alc
sulfate hydrate	$MnSO_4 \cdot H_2O$	169.02	2.95	anhyd 400–450		70 g/100 mL^{20} aq
sulfate 7-water	$MnSO_4 \cdot 7H_2O$	277.11	2.09	anhyd 280		115 g/100 mL^{20} aq
sulfide	MnS	87.00	3.99	1610		0.0006^{18} aq; s acids
titanate(IV)(2−)	Mn_2TiO_4	150.84	4.54	1360		
Mercury	Hg	200.59	13.534	−38.83	356.7	i aq; s HNO_3, hot conc H_2SO_4
(II) acetate	$Hg(C_2H_3O_2)_2$	318.68	3.28	178–180 d		g/100 mL: 40^{10} aq, 7.5^{15} MeOH
(II) benzoate	$Hg(C_7H_5O_2)_2$	424.83		165		v s NaCl soln; sl s alc
(I) bromide	Hg_2Br_2	560.99	7.307	subl 393 d		i aq, alc, eth; d hot HCl
(II) bromide	$HgBr_2$	360.40	6.05	237	322 subl	g/100 mL: 0.56^{20} aq; 20^{25} alc; v s HCl, HBr
(I) chloride	Hg_2Cl_2	472.09	7.16	subl 382	d without melting	s aqua regia; i aq, alc, eth
(II) chloride	$HgCl_2$	271.50	5.4	277	304	g/100 mL^{20}: 7.15 aq, 26 alc, 4 eth 8.3 glyc, 0.5 bz; s HOAc, EtAc
(II) cyanide	$Hg(CN)_2$	252.63	4.00	d 320		g/100 mL^{20}: 9.3 aq, 25 MeOH, 8 EtOH
(I) fluoride	Hg_2F_2	439.18	8.73	>570 d		hydrolyses in water

(II) fluoride	HgF_2	238.59	8.95	d 645	d >650	hyd aq; s HF
(II) fulminate	$Hg(ONC)_2$	284.62	4.42	explodes		sl s aq; s alc; dangerously flammable
(I) iodide	Hg_2I_2	654.99	7.70	290 d	subl 140	i aq, alc, eth; s KI
(II) iodide	HgI_2	454.40	6.28	259	350 subl	g/100 mL: 0.006^{25} aq, 0.8 alc, 0.8 eth, 1.7 acet
(I) nitrate 2-water	$Hg_2(NO_3)_2 \cdot 2H_2O$	561.22	4.79	70 d		hyd aq; s HNO_3
(II) nitrate	$Hg(NO_3)_2$	324.60	4.3	79	d	v s aq; s acet
(I) oxide	Hg_2O	417.18	9.8	d 100		i aq; s HNO_3
(II) oxide	HgO	216.59	11.14	d 500		0.005^{25} aq; s dil HCl, HNO , I^-, CN^-
(I) sulfate	Hg_2SO_4	497.24	7.56	d		0.06^{25} aq; s HNO_3
(II) sulfate	$HgSO_4$	296.65	6.47	d		d aq; s acid
(II) sulfide (cinnabar)	HgS	232.66	8.17	subl 583	→ blk HgO, 386	i aq; s aqua regia
(II) thiocyanate	$Hg(SCN)_2$	316.76	3.71	d 165		0.063^{25} aq; s HCl
Molybdenum	Mo	95.94	10.28	2622	4825	s hot H_2SO_4, HNO_3, fused KNO_3
(III) bromide	$MoBr_3$	335.65	4.89	subl 977		d alkalis
(IV) chloride	$MoCl_4$	237.75		317	407	s conc acids
(V) chloride	$MoCl_5$	273.19	2.928	194	268	s conc acids, dry eth, dry alc
(VI) fluoride	MoF_6	209.93	2.54	17.6	35.0	hyd aq; s alkalis; 31 g/100 g HF
hexacarbonyl	$Mo(CO)_6$	264.00	1.96	150 d	subl	s bz
(IV) oxide	MoO_2	127.94	6.47	d ≈1100		i aq
(VI) oxide	MoO_3	143.94	4.696_4^{26}	801	1155	0.05^{28} aq; s conc mineral acids, alk
(III) sulfide	Mo_2S_3	288.07	5.91^{15}	1807	d 1867	d hot HNO_3
(IV) sulfide	MoS_2	160.07	5.06_{15}^{15}	2375	subl 450	s aqua regia
Neodymium	Nd	144.24	7.01	1024	3074	s hot aq, acids
chloride	$NdCl_3$	250.60	4.134	760	1600	98 g/100 mL^{20} aq; s alc
oxide	Nd_2O_3	336.48	7.28	1900		s dilute acids
sulfate 8-water	$Nd_2(SO_4)_3 \cdot 8H_2O$	720.79	2.85	d 700–800		8.87 g/100 mL^{20} aq
Neon	Ne	20.180	0.8999 g/L^0	−248.67	−246.05	1.05 mL^{20} aq
Neptunium	Np	237.0482	20.2	644	>3900	s HCl
(IV) oxide	NpO_2	269	11.1	2547		
Nickel	Ni	58.69	8.908^{20}	1453	2884	i aq; s HNO_3
acetate 4-water	$Ni(C_2H_3O_2)_2 \cdot 4H_2O$	248.86	1.744	d		16 g/100 mL aq; s alc
acetylacetonate	$Ni(C_5H_7O_2)_2$	256.91	1.455^{17}	230	235^{11atm}	s aq, alc, bz, chl; i eth
bromide	$NiBr_2$	218.50	5.098	963	subl	100 g/100 mL^{20} aq
carbonate hydroxide (1/2)	$NiCO_3 \cdot 2Ni(OH)_2$	304.12	2.6			s dilute acids

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Nickel (*continued*)						
carbonyl	$Ni(CO)_4$	170.73	1.31	−19.3	43 (expl 60)	s EtOH, bz, acet
chloride	NiCl	129.60	3.51	1009	subl 973	61 g/100 mL^{20} aq
chloride 6-water	$NiCl_2 \cdot 6H_2O$	237.69				100 g/100 mL^{20} aq; s alc
cyanide 4-water	$Ni(CN)_2 \cdot 4H_2O$	182.79		anhyd 400		0.006^{18} aq; s KCN, NH_4OH
dimethylglyoxime	$Ni(HC_2H_6N_2O_2)_2$	288.92		subl 250		i aq; s abs alc, dilute acids
(*tri*-) disulfide	Ni_3S_2	240.21	5.87	790	d 2967	s HNO_3
fluoride	NiF_2	96.69	4.72	1450	1740	4 g/100 mL^{20} aq; i alc, eth
formate 2-water	$Ni(CHO_2)_2 \cdot 2H_2O$	184.78	2.154^{20}	anhyd 130	d 180–200	s aq; i alc
nitrate 6-water	$Ni(NO_3)_2 \cdot 6H_2O$	290.81	2.05	56.7	136.7	150 g/100 mL^{20} aq
(II) oxide	NiO	74.71	7.45	2000		s acids
(III) oxide	Ni_2O_3	165.42	4.83	$-O_2$, 600		s hot HCl, HNO_3, H_2SO_4
sulfate	$NiSO_4$	154.78	3.68	$-SO_3$, 840		29 g/100 mL^0 aq
sulfate 6-water	$NiSO_4 \cdot 6H_2O$	262.86	2.07	anhyd 280		40 g/100 mL^{20} aq
sulfide	NiS	90.77	5.3–5.6	976	d 2047	s HNO_3, KHS
tetracarbonyl	$Ni(CO)_4$	170.74	1.3185^{17}	−19.3	42.3	explodes 63; FP −4; s organic solvents
Niobium	Nb	92.9064	8.57^{20}	2468	4860	s fused alkali hydroxides
(V) chloride	$NbCl_5$	270.20	2.75	206	247.0	s HCl, CCl_4
(V) fluoride	NbF_5	187.91	2.696^{80}_4	80.0	234.9	hyd aq, alc; sl s CS_2, CCl_4
(V) oxide	Nb_2O_5	265.82	4.55	1512		s HF, hot H_2SO_4
Nitrogen	N_2	28.0341	1.165 g/L^{20}	−210.01	−195.79	mL/100 mL: 1.6^{20} aq, 0.112 alc
	$^{15}N_2$	30.01	1.25 g/L^{20}	−209.952	−195.73	
(I) oxide	N_2O	44.02	1.843 g/L^{20}	−90.81	−88.46	130^0 mL aq; s alc, eth
(II) oxide	NO	30.01	1.249 g/L^{20}	−163.64	−151.76	4.6 mL/100 mL^{20} aq
(III) oxide	N_2O_3	76.02	1.447 g/L^2	−100.7	2	s eth
(IV) oxide dimer	N_2O_4	92.02	1.448^{20}_4	−9.3	21.15 d	s conc HNO_3, conc H_2SO_4, chl
(V) oxide	N_2O_5	108.01	2.05	30	47.0	v s chl; s CCl_4
selenide	N_4Se_4	371.87	4.2	explosive		sl s bz, CS_2
sulfide	N_4S_4	184.28	2.24^{18}	180	185	s organic solvents
trichloride	NCl_3	120.37	1.653^{20}	−27	71	i aq; s bz, CS_2, CCl_4
trifluoride	NF_3	70.01	2.96 g/L^{20}	−208.5	−129.06	

Nitrosyl chloride	NOCl	65.47	1.592^{-5}	−61.5	−5.5	hyd aq; s fuming H_2SO_4
fluoride	NOF	49.01	2.788 g/L^{20}	−132.5	−59.9	hyd aq
hydrogen sulfate	$NOHSO_4$	127.08		d 73.5		d aq; s H_2SO_4
tetrafluoroborate	$NO[BF_4]$	116.83	2.185_4^{25}	subl 250$^{0.01mm}$		d aq
Nitryl chloride	NO_2Cl	81.46	2.81 g/L^{100}	−145	−14.3	d aq
fluoride	NO_2F	65.00	2.7 g/L^{20}	−166.0	−72.4	d aq
Osmium	Os	190.2	22.61^{20}	3045	5225	s molten alkali or oxidizing fluxes
hexafluoride	OsF_6	304.2		32.1	45.9	hyd aq
tetrachloride	$OsCl_4$	332.0	4.38_4^{20}	subl 450		slow hyd aq
tetraoxide	OsO_4	254.20	4.91	40.6	130.0	g/100 mL: 7.24^{25} aq; 375^{25} CCl_4; s bz, eth, alc
Oxygen	O_2	31.9988	1.331 g/L^{20}	−218.4	−182.96	mL/100 mL^{20}: 3.13 aq, 14.3 alc
difluoride	OF_2	54.00	2.26 g/L^{20}	−223.8	−145.3	6.8 mL/100 mL^0 aq
(*di*-) difluoride	O_2F_2	70.00	1.45^{bp} (lq)	−154	d − 100	
Ozone	O_3	48.00	1.998 g/L^{20}	−192.5	−111.9	49.4 mL/100 mL^0 aq
Palladium	Pd	106.42	12.023^{20}	1555	3167	s hot HNO_3, H_2SO_4
acetate	$Pd(C_2H_3O_2)_2$	224.49		205 d		i aq, alc; s acet, chl, eth
chloride	$PdCl_2$	177.30	4.0^{18}	680	d >680	s alc, acet, HCl
nitrate	$Pd(NO_3)_2$	230.42		d		s dil HNO_3
oxide	PdO	122.40	8.70^{20}	879 d		s 48% HBr; sl s aqua regia
Perchloryl fluoride	ClO_3F	102.46	0.637 g/L	−147.74	−46.67	
Phosphorus (white)	P_4 molecules	123.8950	1.823^{25}	44.15	280.3	g/100 mL: 2.86 bz, 2.50 chl, 1.25 CS_2; 0.025 abs alc, 1.0 eth
(red)	P_4	123.8950	2.34	597	subl 416	i aq; ignites in air, 260
hydride, *see* Phosphine						
pentabromide	PBr_5	430.56	3.46^{20}	106 d		d aq; s CCl_4, CS_2
pentachloride	PCl_5	208.27	2.119^{20}	subl 100	166 d	hyd aq; s CCl_4, CS_2
pentafluoride	PF_5	125.98	5.805 g/L	−93.8	−84.6	hyd aq
pentoxide (dimer)	P_4O_{10}	283.88	2.30	340	subl 360	d aq; s H_2SO_4
pentasulfide	P_2S_5	222.29	2.09	288	514	hyd aq; s alkali; 0.222^{17} CS_2
tribromide	PBr_3	270.73	2.85^{15}	−41.5	173.2	d aq, alc; s acet, CS_2
trichloride	PCl_3	137.35	1.575_4^{20}	−93.6	76.1	d aq, alc; s bz, chl
trifluoride	PF_3	87.98	3.907 g/L	−151.30	−101.38	hyd aq
trioxide (dimer)	P_4O_6	219.90	2.136_4^{20}	23.8	173 (N_2 atm)	hyd aq; s bz, CS_2
(*tetra*-) triselenide	P_4Se_3	360.80	1.31	245–246	360–400	flammable in air; s bz, acet, chl, CS_2
(*tetra*-) trisulfide	P_4S_3	220.09	2.03^{17}	167	407	100 g/100 mL^{17} CS_2; s tolune

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Phosphine	PH_3	34.00	1.529 g/L	−133.81	−87.78	mL/100 mL[17]: 1025 CS_2, 726 bz, 319 HOAc, 26 aq; s alc, eth
Phosphonium iodide	PH_4I	161.91	2.86	18.5	subl 62.5	d aq
Phosphoryl chloride difluoride	$POClF_2$	120.43	1.656^0	−96.4	3.1	
dichloride fluoride	$POCl_2F$	136.89	1.5497^{20}	−80.1	52.90	
tribromide	$POBr_3$	286.72	2.822	56	191.7 d	s bz, CS_2, eth
trichloride	$POCl_3$	153.35	1.645^{25}	1.25	105	d aq, alc
Platinum	Pt	195.08	21.09^{20}	1769	3824	s aqua regia, fused alkali
(II) chloride	$PtCl_2$	266.00	5.87	d 581		i aq, alc; s HCl, NH_4OH
(IV) chloride	$PtCl_4$	336.90	4.303^{25}	d 370		143 g/100 mL^{25} aq
(VI) fluoride	PtF_6	309.08	3.826 (lq)	61.3	69.14	
(II) oxide	PtO	211.09	14.9^{15}	d 550		i aq; s HCl
(IV) oxide	PtO_2	227.09	10.2	450		i aqua regia
(IV) sulfide	PtS_2	259.22	7.66	d 225		s HCl, HNO_3
Plutonium	Pu	239.052	19.816_4^{20}	639.5	3230	i aq; s acids
(III) bromide	$PuBr_3$	478.79	6.69	681	d >1300	s aq
(III) chloride	$PuCl_3$	345.42	5.70	760	1767	i aq; v s acids
(III) fluoride	PuF_3	296.06	9.32	1425	d 2000	hyd aq
(IV) fluoride	PuF_4	315.05	7.00	1037 d		i aq
(VI) fluoride	PuF_6	353.05	4.86	51.59	62.16	
(II) hydride	PuH_2	241.08	10.40	ca. 727		
(III) hydride	PuH_3	242.08	9.61	ca. 327		
(II) oxide	PuO	255.05	13.9	1900		
(III) oxide	Pu_2O_3	526.12	10.2	2085 (in He)		
(IV) oxide	PuO_2	271.05	11.46	2390 (in He)	d 2800	
(III) sulfide	Pu_2S_3	574.30	9.95	1727		
Polonium	Po	208.9824	9.196 alpha 9.398 beta	254	962	sl s aq; s acids
(IV) chloride	$PoCl_4$	350.79		300 (in Cl_2)	390 (in Cl_2)	sl hyd aq; v s HCl; s alc, acet
(IV) oxide	PoO	240.98	d 550			v s dilute HCl

Potassium	K	39.0983	0.89	63.38	759	d aq to KOH; s acids
acetate	$KC_2H_3O_2$	98.14	1.57	292		g/100 mL: 200 aq, 34 alc
arsenate	K_3AsO_4	256.21	2.8	1310		19 g/100 mL aq; slowly s glyc; s alc
borate(1−)	KBO_2	81.91		947	1401	71 g/100 mL^{30} aq
bromate	$KBrO_3$	167.00	3.27	≈350	d 370	6.9 g/100 mL^{20} aq
bromide	KBr	119.00	2.75	734	1435	g/100 mL: 65^{20} aq, 22 glyc, 0.4 alc
carbonate	K_2CO_3	138.21	2.29	901	d to K_2O	90 g/100 mL^{20} aq; i alc
chlorate	$KClO_3$	122.55	2.32	368	d >400	g/100 mL: 7.3^{20} aq, 2 glyc
chloride	KCl	74.55	1.988	771	1437	g/100 mL: 34^{20} aq, 7 glyc, 0.4 alc
chromate(VI)	K_2CrO_4	194.19	2.732	975		64 g/100 mL^{20} aq; i alc
citrate hydrate	$K_3C_6H_5O_7 \cdot H_2O$	324.42	1.98	anhyd 180	d 230	g/100 mL: 154 aq; 40 glyc
cyanate	KOCN	81.11	2.05	d ≈700		s aq; sl s alc
cyanide	KCN	65.12	1.55	634	1625	g/100 mL: 50 aq, 50 glyc, 4 MeOH
dichromate(VI)	$K_2Cr_2O_7$	294.19	2.676_4^{25}	398	d 500	11.7 g/100 mL^{20} aq
dicyanoargentate(I)	$K[Ag(CN)_2]$	199.01	2.36			25 g/100 mL^{30} aq
dihydrogen arsenate	KH_2AsO_4	180.03	2.867	288		g/100 mL: 19^6 aq, 63 glyc; i alc
dihydrogen phosphate	KH_2PO_4	136.09	2.338	d 400 (KPO_3)		22.6 g/100 mL^{20} aq; i alc
dioxide	KO_2	71.10	2.14	509	d	v s aq with decomposition
diphosphate(V) 3-water	$K_4P_2O_7 \cdot 3H_2O$	384.38	2.33	anhyd 300	mp: 1090	s aq; i alc
disulfate(IV)	$K_2S_2O_5$	222.32				s aq; flammable if ground
disulfate(VI) (pyrosulfate)	$K_2S_2O_7$	254.32	2.28	≈325		s aq
ethyldithiocarbonate	$KOCSSC_2H_5$	160.30	1.558	d 200		v s aq
fluoride	KF	58.10	2.48	859.9	1505	95 g/100 mL^{20} aq
formate	KCHO	84.12	1.91	167.5	d >mp	250 g/100 mL aq
gluconate	$KC_6H_{11}O_7$	234.25		d 180		v s aq; i alc, bz, chl
heptaiodobis-muthate(III)(4−)	$K_4[BiI_7]$	1253.82				d aq; s alkali iodide solutions
hexachloroplatinate(IV)	$K_2[PtCl_6]$	485.99	3.50	d 250		0.48^{20} aq
hexacyanoferrate(II) 3-water	$K_4[Fe(CN)_6] \cdot 3H_2O$	422.39	1.85	anhyd 100	d	28 g/100 mL^{20} aq
hexacyanoferrate(III)	$K_3[Fe(CN)_6]$	329.25	1.89	d		40 g/100 mL^{20} aq (slow); sl s alc
hexafluorosilicate	$K_2[SiF_6]$	220.27	2.27	d		sl s aq; i alc
hexafluorozirconate	$K_2[ZrF_6]$	283.41	3.58			2.7 g/100 mL^{20} aq
hexanitritocobaltate(III) 1.5-water	$K_3[Co(NO_2)_6] \cdot 1.5H_2O$	479.30		d 200		0.089^{18} aq; s HOAc; v sl s alc
hydride	KH	40.11	1.43	417 d		d aq
hydrogen carbonate	$KHCO_3$	100.11	2.17	d >100		34 g/100 mL^{20} aq; i alc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Potassium (*continued*)						
hydrogen difluoride	KHF	78.10	2.37	238.80	d 477	39 g/100 mL^{20} aq; s alc
hydrogen phosphate	K_2HPO_4	174.18		d to $K_2P_2O_7$		150 g/100 mL aq
hydrogen phthalate	$KHC_8H_4O_4$	204.22	1.636	d		8.3 g/100 mL aq; sl s alc
hydrogen sulfate	$KHSO_4$	136.17	2.24	197	d to $K_2S_2O_7$	48 g/100 mL^{20} aq
hydrogen sulfide	KHS	72.17	1.70	≈455		s aq, alc
hydrogen tartrate	$KHC_4H_4O_6$	188.18	1.956			0.5^{20} aq; s acids; v sl s alc
hydroxide	KOH	56.11	2.044	406	1323	g/100 mL: 112^{20} aq, 33 alc, 40 glyc
iodate	KIO_3	214.00	3.89	560 d		8.1 g/100 mL^{20} aq; i alc
iodide	KI	166.00	3.12	681	1345	g/100 mL: 144^{20} aq, 4.5 alc, 50 glyc
manganate(VI)	K_2MnO_4	197.13		190 d		s aq; stable in KOH
molybdate(VI)	K_2MoO_4	238.14	2.3	919	d 1400	160 g/100 mL aq
nitrate	KNO_3	101.10	2.11	333	d 400	g/100 mL: 32^{20} aq, 0.16 alc, s glyc
nitrite	KNO_2	85.10	1.915	441	d 350	306 g/100 mL^{20} aq; sl s alc
oxalate hydrate	$K_2C_2O_4 \cdot H_2O$	184.23	2.13	anhyd 160	d to K_2CO_3	36 g/100 mL^{20} aq
oxide	K_2O	94.20	2.35	350 d		d aq to KOH, s alc
oxobisoxalatodiaquatitanate(IV)	$K_2[TiO(C_2O_4)_2(H_2O)_2]$	354.18				v s aq
perchlorate	$KClO_4$	138.55	2.52	d 400		2.04^{25} aq; 0.0036^{25} BuOH; 0.0013 EtOAc
periodate	KIO_4	230.010	3.618	582		0.42^{20} aq, sl s KOH
permanganate	$KMnO_4$	158.03	2.7	d 240 → O_2		6.34 g/100 mL^{20} aq; d HCl
peroxide	K_2O_2	110.20		490		d aq
peroxodicarbonate hydrate	$K_2C_2O_6 \cdot H_2O$	216.24				6.5 g/100 mL aq; d hot aq
peroxodisulfate	$K_2S_2O_8$	270.32	2.48	d 100		2.5 g/100 mL^{20} aq; i alc
perrhenate	$KReO_4$	289.30	4.38	555	1370	0.99^{20} aq
phenolsulfonate hydrate	$KC_6H_4(OH)SO_3 \cdot H_2O$	240.28	1.87			s aq, alc
phosphate	K_3PO_4	212.27	2.564_4^{17}	1340		50.8 g/100 mL^{20} aq; i alc
selenocyanate	$KSeCN$	144.08		d 100		s aq
silicate(2−)	K_2SiO_3	154.29		976		s aq
sodium hexanitritocobaltate(III) hydrate	$K_2Na[Co(NO_2)_6] \cdot H_2O$	454.18	1.633	d 135		0.07 aq

sodium tartrate 4-water	$KNaC_4H_4O_6 \cdot 4H_2O$	282.23	1.790	70–80	anhyd 130–140	54 g/100 mL^{15} aq
sorbate	$KC_6H_7O_2$	150.22	1.363_{20}^{25}	d >270		g/100 mL: 58.2^{20} aq, 6.5 alc
stannate(IV) 3-water	$K_2SnO_3 \cdot 3H_2O$	298.94	3.197	anhyd 140		100 g/100 mL^{20} aq; i alc
stearate	$KOOCC_{17}H_{35}$	322.57				readily soluble hot aq or alc
sulfate	K_2SO_4	174.26	2.66	1069	1670	g/100 mL: 11^{20} aq, 1.3 glyc, i alc
sulfide	K_2S	110.26	1.74	948		
sulfite 2-water	$K_2SO_3 \cdot 2H_2O$	194.29		d		28.6 g/100 mL^{20} aq
tartrate hemihydrate	$K_2C_4H_4O_6 \cdot 0.5H_2O$	235.28	1.98	anhyd 155	d 200	138 g/100 mL^{20} aq
tellurate(IV)	K_2TeO_3	253.79				s aq
tetrachloroaurate(III)	$K[AuCl_4]$	377.88	3.75	d 357		61.8 g/100 mL^{20} aq
tetrafluoroborate	$K[BF_4]$	125.90	2.505_4^{20}	530		0.45^{20} aq
tetrahydridoborate	$K[BH_4]$	53.94	1.11	d 497		g/100 mL: 21^{25} aq, 3.5^{20} MeOH
tetraiodocadmate 2-water	$K_4[CdI_4] \cdot 2H_2O$	698.21	3.359_4^{21}			g/100 mL: 137^{15} aq, 71^{15} alc, 4 eth
tetraiodomercurate(II)	$K_2[HgI_4]$	786.48				v s aq; s alc, acet, eth
thiocyanate	KSCN	97.18	1.89	173	d 500	g/100 mL: 217^{20} aq, 200 acet, 8 alc
thiosulfate	$K_2S_2O_3$	190.33		d 400		155 g/100 mL^{20} aq; i alc
trihydrogen bisoxalate 2-water	$KH_3(C_2O_4) \cdot 2H_2O$	254.20	1.836	d		1.8 aq
trisoxalatoantimonate(III)	$K_3[Sb(C_2O_4)_3]$	503.12				a aq
trithiocarbonate	K_2CS_3	186.41		d		v s aq
uranyl(VI) acetate hydrate	$K(UO_2)(C_2H_3O_2)_2 \cdot H_2O$	504.28	3.296^{15}	anhyd 275		s aq
Praseodymium	Pr	140.9077	6.475 α-form	935	3520	s hot water and acids
chloride	$PrCl_3$	247.27	4.0	769 to 782	1710	104 g/100 mL^{13} aq; s alc
(III) oxide	Pr_2O_3	329.81	7.07	oxidizes to Pr_6O_{11}		i aq; s acids
(IV)	PrO_2	172.91	6.82	tr 350 to Pr_6O_{11}		
Promethium-147	Pm	146.915	7.22	1080	3000 est	
bromide	$PmBr_3$	386.7	5.38	727	1667	s aq
chloride	$PmCl_3$	153.4		737	1670	s aq
Protoactinium	Pa	231.0359	15.37	1568(8)	4227	
(IV) chloride	$PaCl_4$	372.85	4.72	subl 400		i aq; s HCl
(V) chloride	$PaCl_5$	408.31	3.74	301	420	hyd aq; s THF, CH_3CN
Radium	Ra	226.03	5.5	700.1	1737	d aq; s acids
bromide	$RaBr_2$	385.88	5.79	728	subl 900	s aq
chloride	$RaCl_2$	296.93	4.91	1000		s aq
Radon	Rn	222.0	9.73 g/L	−71	−62	23 mL/100 mL^{20} aq; s org solv

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Rhenium	Re	186.207	21.02	3180	5678	s HNO_3
chloride trioxide	$ReClO_3$	269.66		4.5	128	hyd in water to $HReO_4$; s CCl_4
(IV) fluoride	ReF_4	262.20	5.38	124.5	795	hyd aq
(VI) fluoride	ReF_6	300.20	3.58	18.5	33.8	52.5 g/100 mL anhyd HF; s HNO_3
(VII) fluoride	ReF_7	319.20	3.65	48.3	73.7	hyd aq
(VI) oxide	ReO_3	234.20	6.9–7.4	disprop 400	750	s HNO_3
(VII) oxide	Re_2O_7	484.41	6.1	300.3	360.3	v s aq, org solv
(VII) sulfide	Re_2S_7	596.88	4.866	d 460		i aq; s HNO_3
(VI) tetrachloride oxide	$ReCl_4O$	344.02	3.309	29.3	225	hyd aq; s CCl_4
Rhodium	Rh	102.9055	12.41^{20}	1963	3727	s fused $KHSO_4$
(III) chloride	$RhCl_3$	209.26	5.38	d 450		i aq; s KOH, KCN
(III) fluoride	RhF_3	159.90	5.4	subl 600		i acids, alkalis
(III) oxide	Rh_2O_3	253.81	8.20	d 1100		i aq reg, KOH
tetracarbonyldi-μ-chloro-dichloride	$Rh_2(CO)_4Cl_2$	388.76		124–125		s org solv except hydrocarbons
Rubidium	Rb	85.4678	1.532	39.31	691	d aq to RbOH
acetate	$RbC_2H_3O_2$	144.52		246		86 g/100 mL^{45} aq
bromide	RbBr	165.37	3.35	682	1346	108 g/100 mL^{20} aq
carbonate	Rb_2CO_3	230.95		837	d 900	g/100 mL: 450^{20} aq, 0.74_{19} alc
chlorate	$RbClO_3$	168.94	3.184	342		5.4 g/100 mL^{20} aq
chloride	RbCl	120.92	2.76	715	1390	g/100 mL: 91^{20} aq, 1.1 MeOH
dihydrogen phosphate	RbH_2PO_4	182.47		840		s aq
fluoride	RbF	104.47	3.2	833	1410	131 g/100 mL^{18} aq
hexachloroplatinate(IV)	$Rb_2[PtCl_6]$	578.75	3.94	d		0.028^{20} aq
hydroxide	RbOH	102.47	3.20	301		180 g/100 mL^{18} aq; s alc
iodide	RbI	212.37	3.55	642	1304	163 g/100 mL^{25} aq; s alc
nitrate	$RbNO_3$	147.47	3.11	305		l9.5 g/100 mL^{20} aq
oxide	Rb_2O	186.93	4.0	400 d		s aq → RbOH
sulfate	Rb_2SO_4	267.00	3.5	1050		48 g/100 mL^{20} aq
Ruthenium	Ru	101.07	12.45_4^{20}	2334	4150	s fused alkali, oxidizing fluxes
(III) chloride (hexagonal)	$RuCl_3$	207.43	3.11	d >500		i aq; s HCl, alc
(V) fluoride	RuF_5	196.06	3.90	86.5	227	d aq
(IV) oxide	RuO_2	133.07	6.97	d		i aq; s fused alkali

Samarium	Sm	150.36	7.52	1074	1794	s acids
(II) chloride	$SmCl_2$	221.27	3.687	855	2030	s aq dec; i alc
(III) chloride	$SmCl_3$	256.72	4.46	682	d	93.4 g/100 mL^{20} aq
(III) fluoride	SmF_3	207.36	6.643	1306	2427	i aq; s H_2SO_4
(III) oxide	Sm_2O_3	348.72	8.347	2335		s acids
(III) sulfate 8-water	$Sm_2(SO_4)_3 \cdot 8H_2O$	733.03	2.93	anhyd 450		2.7 g/100 mL^{20} aq
Scandium	Sc	44.956	2.985 hex	1541	2836	d aq
chloride	$ScCl_3$	151.31	2.39	967	967	v s aq; i alc
oxide	Sc_2O_3	137.91	3.864	2485		s hot or conc acids
sulfate 5-water	$Sc_2(SO_4)_3 \cdot 5H_2O$	468.17	2.519	anhyd 250	d 550	54.6 g/100 mL^{25} aq
Selenium (hexagonal)	Se	78.96	4.81_4^{20}	217	685	s eth, KOH, KCN; i aq, alc
(IV) bromide	$SeBr_4$	398.58	4.029	123		d aq; s HBr, chl, CS_2
(IV) chloride	$SeCl_4$	220.77	2.6	305	subl 196	d aq
(*di*-) dibromide	Se_2Br_2	317.73	3.604_4^{15}		225 d	d aq; s chl, CS_2
dibromide oxide	$SeBr_2O$	254.77	3.38^{50}	41.6	217 d	d aq
(*di*-) dichloride	Se_2Cl_2	228.83	2.774_4^{25}	−85	127 dec	d aq; s bz, chl, CS_2
dichloride oxide	$SeCl_2O$	165.867	2.44	8.5	177.2	d aq; misc bz, chl, CCl_4, CS_2
difluoride oxide	SeF_2O	132.96	2.8	15	125	d aq
(IV) fluoride	SeF_4	154.95	2.75	−10	106	reacts aq viol; misc alc, eth; s chl
(VI) fluoride	SeF_6	192.95	8.467 g/L	−34.6		
(*di*-) hexasulfide	Se_2S_6	350.32	2.44	121.5		s CS_2; 1.2 g/100 mL^{20} bz
(IV) oxide	SeO_2	110.96	3.95	340	subl 315	w/w %: 38^{14} aq, 10^{12} MeOH, 4.35 acet, 6.7^{14} EtOH, 1.1^{12} HOAc; s H_2SO_4
(*tetra*-) tetrasulfide	Se_4S_4	444.10	3.20	113 d		i aq; 0.04 g/100 mL^{20} bz; s CS_2
Silane	SiH_4	32.12	1.409 g/L	−185	−111.9	d aq slowly; i alc, bz, chl, eth
chloro-	SiH_3Cl	66.56	2.921 g/L	−118	−30.4	
dichloro-	SiH_2Cl_2	101.01	4.432 g/L	−122	8.3	d aq
iodo-	SiH_3I	158.01	2.035	−57	45.5	d aq
trichloro-	$SiHCl_3$	135.45	1.331	−128	33	d aq; s bz, chl
Silicon	Si	28.0855	2.33	1412	3265	s HF + HNO_3, fused alkali oxides
carbide (beta)	SiC	40.10	3.16	2830		s fused alkali oxides
dioxide (α quartz)	SiO_2	60.08	2.648	573 tr β quartz	2950	i aq; s HF
dioxide - tungsten trioxide - water (silicotungstic acid)	$SiO_2 \cdot 12WO_3 \cdot 26H_2O$	3310.66				v s aq, alc
disulfide	SiS_2	92.22	2.04	1090		s d aq, alc; i bz

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Silicon (*continued*)						
tetrabromide	$SiBr_4$	347.70	2.81	5.2	154	hyd aq viol
tetrachloride	$SiCl_4$	169.90	1.5	−68.8	57.6	hyd aq; s bz, CCl_4, eth
tetrafluoride	SiF_4	104.08	4.567 g/L	−90.3	−86	hyd aq; s HF
tetraiodide	SiI_4	535.70	4.1	120.5	287.3	d aq; 2.2 g/100 mL^{27} CS_2
(*tri*-) tetranitride	Si_3N_4	140.28	3.17	1878		i aq; s HF
Silver	Ag	107.8682	10.49	961.78	2164	s HNO_3
acetate	$AgC_2H_3O_2$	166.91	3.259	d		1.04^{20} aq; s dil HNO_3
antimonide	Ag_3Sb	445.35		559		
azide	AgN_3	149.89	4.9	exp ~252		i aq; s KCN, HNO_3 (explosive)
bromide	AgBr	187.77	6.473	432	1500	i aq; s KCN
carbonate	Ag_2CO_3	275.75	6.077	218		0.003^{20} aq; s KCN, HNO_3, NH_4OH
chlorate	$AgClO_3$	191.32	4.430_4^{20}	231	d 270	10 g/100 mL^{15} aq
chloride	AgCl	143.32	5.56	455	1547	i aq; 7.7 g/100 mL NH_4OH, KCN, $Na_2S_2O_3$
chromate(VI)	Ag_2CrO_4	331.73	5.625^{25}			0.002^{20} aq; s HNO_3, NH_4OH
cyanide	AgCN	133.89	3.95	320 d		i aq; s KCN
fluoride	AgF	126.87	5.852	435	≈1150	182 g/100 mL^{20} aq; s HF, CH_3CN
(II) fluoride	AgF_2	145.87	4.57	690	d 700	hyd viol aq
iodate	$AgIO_3$	282.77	5.525^{20}	>200	d	0.053^{25} aq; 40 g/100 mL 10% NH_4OH
iodide (alpha)	AgI	234.77	5.683^{30}	558	1505	i aq; s KCN, KI, $(NH_4)_2CO_3$
nitrate	$AgNO_3$	169.87	4.352^{19}	212	d 440	g/100 mL: 216^{20} aq, 3.3 alc, 0.4 acet
nitrite	$AgNO_2$	153.87	4.453	d >140		0.33^{25} aq; d dilute acids
oxalate	$Ag_2C_2O_4$	303.76	5.03^4	explodes 140		0.004^{20} aq; s HNO_3, NH_4OH
oxide	Ag_2O	231.73	7.222_4^{25}	d 200 (d light)		0.002^{25} aq; s dil HNO_3, NH_4OH
(II) oxide	AgO	123.87	7.483_4^{25}	d >100		i aq; d alk and acids
perchlorate	$AgClO_4$	207.32	2.806^{25}	d 486		557 g/100 mL^{20} aq; s bz, glyc, pyr
permanganate	$AgMnO_4$	226.80	4.49	d by light		0.9 aq; d alc

phosphate	Ag_3PO_4	418.62	6.37	849		0.006 aq; v s dil HNO_3, KCN, $(NH_4)_2CO_3$
selenate(IV)	Ag_2SeO_3	342.69	5.93	530	d >530	sl s aq; s HNO_3
sulfate	Ag_2SO_4	311.80	5.45	660	d 1085	0.80^{20} aq (slow); s HNO_3, NH_4OH, H_2SO_4
sulfide (agentite)	Ag_2S	247.80	7.234_4^{20}	845	d	i aq; s HNO_3, alk CN's
Sodium	Na	22.98977	0.968^{20}	97.82	881.4	d aq to NaOH
acetate	$NaC_2H_3O_2$	82.03	1.528	324		75 g/100 mL^{20} aq
acetate 3-water	$NaC_2H_3O_2 \cdot 3H_2O$	136.08	1.45	anhyd 120	d >120	g/100 mL: 125^{20} aq, 5.1 alc
aluminate(1−)	$NaAlO_2$	81.97	4.63	1650		v s aq; i alc
aluminum sulfate 12-water	$NaAl(SO_4)_2 \cdot 12H_2O$	458.28	1.61	−60		110 g/100 mL^{15} aq; i alc
amide	$NaNH_2$	39.01	1.39	210	subl 400	d >500, reacts aq viol
ammonium phosphate 4-water	$NaNH_4HPO_4 \cdot 4H_2O$	209.07	1.54	≈80	anhyd >280	14.3 g/100 mL aq
arsenate(III)(1−)	$NaAsO_2$	129.91	1.87			v s aq; sl s alc
ascorbate	$NaC_6H_7O_6$	198.11		d 218		62 g/100 mL^{20} aq
azide	NaN_3	65.01	1.846^{20}	d to Na + N_2		41 g/100 mL^{20} aq; 0.3 alc
benzoate	$NaO_2C_6H_5$	144.11				g/100 mL: 63^{25} aq; 1.3 alc
bismuthate(V)(1−)	$NaBiO_3$	279.96		d		i cold aq; dec by hot aq & acids
bismuthide	Na_3Bi	277.95		766		d aq
bromate	$NaBrO_3$	150.89	3.34	381 d		40 g/100 mL^{20} aq; i alc
bromide	NaBr	102.89	3.200_4^{20}	755	1390	g/100 mL: 90^{20} aq, 6 alc; 16 MeOH
carbonate	Na_2CO_3	105.99	2.533^{20}	858.1	d	29 g/100 mL^{20} aq; s glyc; i alc
carbonate hydrate	$Na_2CO_3 \cdot H_2O$	124.00	2.25	anhyd 100		g/100 mL: 33 aq, 14 glyc; i alc
carbonate 10-water	$Na_2CO_3 \cdot 10H_2O$	286.14	1.46	34 d		50 g/100 mL aq; s glyc
carbonate - hydrogen carbonate 2-water (trona)	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$	226.02	2.112			13 g/100 mL^0 aq
chlorate(V)	$NaClO_3$	106.44	2.5	248	d >300 → O_2	g/100 mL: 96^{20} aq, 0.77 alc, 25 glyc
chloride	NaCl	58.44	2.17	800.8	1465	g/100 mL: 36^{20} aq, 10 glyc
chlorite	$NaClO_2$	90.44		d 180–200		34 g/100 mL^{17} aq
chromate(VI)	Na_2CrO_4	161.97	2.72	792		84 g/100 mL^{20} aq
citrate 2-water	$Na_3C_6H_5O_7 \cdot 2H_2O$	294.10		anhyd 150		77 g/100 mL^{25} aq; i alc
cyanate	NaOCN	65.01	1.89	550		s aq d; 0.22^0 alc
cyanide	NaCN	49.01	1.6	563		58.7 g/100 mL^{20} aq
cyanohydridoborate	$Na[BH_3CN]$	62.84	1.12	>240 d		g/100 mL: 212 aq, 37.2 THF; v s NaOH; i bz, eth

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Sodium (*continued*)						
dichromate 2-water	$Na_2Cr_2O_7 \cdot 2H_2O$	298.00	2.348_4^{25}	anhyd 100; mp 356	d 400	73.1 g/100 mL^{20} aq
diethyldithiocarbamate	$NaS_2CN(C_2H_5)_2 \cdot 3H_2O$	225.31		anhyd 94–96		s aq, alc
dihydrogen arsenate(V) hydrate	$NaH_2AsO_4 \cdot H_2O$	181.94	2.53	anhyd 130	d 200	s aq
dihydrogen diphosphate(V)	$Na_2H_2P_2O_7$	221.94	1.9	d 220		4.5 g/100 mL^0 aq
dihydrogen phosphate(V) dihydrate	$NaH_2PO_4 \cdot 2H_2O$	156.01	1.91	anhyd 100	d $NaPO_3$, 200	71 g/100 mL^0 aq; i alc
dimethylarsonate 3-water (cacodylate)	$NaO_2As(CH_3)_2$	214.03		anhyd 120		g/100 mL: 200 aq, 40 alc
dioxide	NaO_2	54.99		552		
diphosphate(V)	$Na_4P_2O_7$	265.90	2.53	988		2.26^0 aq
dithionate(V) 2-water	$Na_2S_2O_6 \cdot 2H_2O$	242.14	2.19	anhyd 110	d 267 to Na_2SO_4 + SO_2	13.4 g/100 mL^{20} aq; i alc
dithionate(III)	$Na_2S_2O_4$	174.11		d		22 g/100 mL^{20} aq; sl s alc
diuranate(VI)	$Na_2U_2O_7$	634.03				i aq; s acids
dodecylbenzenesulfonate	$NaO_3SC_6H_4C_{12}H_{25}$	348.49				
dodecylsulfate	$NaO_3SOC_{12}H_{25}$	288.38				10 g/100 mL aq
ethoxide	$NaOC_2H_5$	68.06		>300		d aq; s abs alc
ethylenebis(iminodiacetate) (EDTA)	$(NaOOCCH_2)_2NC_2H_4$-$N(CH_2COONa)_2$	380.20				103 g/100 mL aq
ethylsulfate	$NaO_3SOC_2H_5$	148.12				140 g/100 mL aq; s alc
fluoride	NaF	41.99	2.78	996	1704	4 g/100 mL^{15} aq; i alc
formate	$NaHCO_2$	68.01	1.92	253	d >253	81 g/100 mL^{20} aq; s glyc; sl s alc
gluconate	$NaC_6H_{11}O_7$	218.14				59 g/100 mL^{25} aq; sl s alc; i eth
glycerophosphate	$Na_2C_3H_5(OH)_2PO_4$	216.04		d >130		67 g/100 mL aq; i alc
hexachloroplatinate(IV) 6-water	$Na_2[PtCl_6] \cdot 6H_2O$	561.88	2.50	$-6H_2O$, 110		v s aq; s alc

hexacyanoferrate(II) 10-water	$Na_4[Fe(CN)_6] \cdot 10H_2O$	484.06	1.46	anhyd 82	d 435	28 g/100 mL^{20} aq
hexacyanoferrate(III) hydrate	$Na_3[Fe(CN)_6] \cdot H_2O$	298.93				18.9 g/100 mL^{0} aq
hexafluoroaluminate	$Na_3[AlF_6]$	209.94	2.97	1009		s aq
hexanitritocobaltate(III)	$Na_3[Co(NO_2)_6]$	403.98				v s aq; sl s alc
hydride	NaH	24.00	1.39	425 d		ign spontaneously moisture; d alc viol
hydrogen arsenate(V) 7-water	$Na_2HAsO_4 \cdot 7H_2O$	312.01	1.87	anhyd 130	d 150	61 g/100 mL^{15} aq; s glyc; sl s alc
hydrogen carbonate	$NaHCO_3$	84.01	2.20	to Na_2CO_3	270	8 g/100 mL^{20} aq; i alc
hydrogen difluoride	$NaHF_2$	62.00	2.08	d >160		3.7 g/100 mL^{20} aq
hydrogen phosphate 7-water	$Na_2HPO_4 \cdot 7H_2O$	268.07	1.7	d		25 g/100 mL^{40} aq; v sl s alc
hydrogen sulfate	$NaHSO_4$	120.06	2.435	315	d	50 g/100 mL^{20} aq; d alc
hydrogen sulfide	NaHS	56.06	1.79	350		s aq, alc, eth
hydrogen sulfite	$NaHSO_3$	104.06	1.48	d		g/100 mL: 29 aq, 1.4 alc
hydroxide	NaOH	40.00	2.130	323	1388	g/100 mL: 108^{20} aq, 14 abs alc, 24 MeOH; s glyc
hydroxymethanesulfinate dihydrate	$Na[HOCH_2SO_2] \cdot 2H_2O$	154.12		63–64	d >64	v s aq; i abs alc, bz, eth
hypochlorite 5-water	$NaClO \cdot 5H_2O$	164.52	1.6	18	d by CO_2 from air	29 g/100 mL^{0} aq
iodate	$NaIO_3$	197.89	4.28	d		8.1 g/100 mL^{20} aq
iodide	NaI	149.89	3.67	660	1304	g/100 mL: 200^{20} aq, 100 glyc, 50 alc; s acet
lactate	$NaOOCCHOHCH_3$	112.06		d		misc aq, alc
methoxide	$NaOCH_3$	54.02		>300		d aq; s alc
molybdate(VI) 2-water	$Na_2MoO_4 \cdot 2H_2O$	241.95	≈3.5	anhyd 100	mp 687	65 g/100 mL^{20} aq
nitrate	$NaNO_3$	85.00	2.26	307	d ≈500	g/100 mL: 88^{20} aq, 0.8 alc
nitrite	$NaNO_2$	69.00	2.17	271	d >320	67 g/100 mL^{20} aq
oxalate	$Na_2C_2O_4$	134.00	2.34	d ≈250		3.4 g/100 mL^{20} aq; i alc
oxide	Na_2O	61.98	2.27	dull red heat	d >400	d aq to NaOH violently
pentacyanonitrosylferrate(III) 2-water (nitroprusside)	$Na_2[Fe(CN)_5NO] \cdot 2H_2O$	297.65	1.72			40 g/100 mL^{16} aq

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Sodium (*continued*)						
perchlorate	$NaClO_4$	122.44	2.52	480 d		g/100 mL^{25}; 114 aq, 1.5 BuOH, 8.4 EtOAc
periodate	KIO_4	213.89	3.865	d ≈300		10.3 g/100 mL^{20} aq
peroxide	Na_2O_2	77.98	2.805	675	d	v s aq (dec)
peroxoborate 4-water	$NaBO_3 \cdot 4H_2O$	153.88		d >60		2.5 g/100 mL aq
peroxodisulfate(VI)	$Na_2S_2O_8$	238.11		d		55 g/100 mL aq; d by alc
perrhenate	$NaReO_4$	273.19	5.24	300		33 g/100 mL^{20} aq
phosphate	Na_3PO_4	163.94	2.537	1340		12.1 g/100 mL^{20} aq
phosphate 12-water	$Na_3PO_4 \cdot 12H_2O$	380.12	1.62	73.4	$-11H_2O$, 100	28.3 g/100 mL^{20} aq; i alc
phosphinate hydrate	$NaPH_2O_2 \cdot H_2O$	105.99		anhyd 200	d to PH_3	100 g/100 mL^{20} aq; s glyc, alc
propanoate	$NaOOCC_2H_5$	96.06				g/100 mL^{25}: 100 aq, 4.1 alc
salicylate	$NaOOCC_6H_4OH$	160.10				g/100 mL: 110^{20} aq, 11 alc, 25 glyc
selenate(VI)	Na_2SeO_4	188.94	3.098			27 g/100 mL^{20} aq
silicate(2−) meta-	Na_2SiO_3	122.06	2.614	1089		s aq; hyd by hot aq; i alc
silicate(2−) 5-water	$Na_2SiO_3 \cdot 5H_2O$	212.14	1.749	72.2	anhyd 100	v s aq
silicate(4−)	Na_4SiO_4	184.04		1018		s aq
stannate(IV) 3-water	$Na_2SnO_3 \cdot 3H_2O$	266.71		d 140 (slow)		59 g/100 mL^{20} aq; i alc
stearate	$NaOOCC_{17}H_{35}$	306.47		d		sl s aq
sulfate	Na_2SO_4	142.04	2.7	8800	d 2227	28 g/100 mL^{20} aq
sulfate 10-water	$Na_2SO_4 \cdot 10H_2O$	322.20	1.46	32.4	anhyd 100	67 g/100 mL^{25} aq; s glyc; i alc
sulfide	Na_2S	78.05	1.856	1172 vacuo		18.6 g/100 mL^{20} aq; sl s alc
sulfide 9-water	$Na_2S \cdot 9H_2O$	240.18	1.43	d ≈50		200 g/100 mL aq; sl s alc
sulfite	Na_2SO_3	126.04	2.63	d		31 g/100 mL^{20} aq; s glyc; i alc
tartrate dihydrate	$Na_2C_4H_4O_6 \cdot 2H_2O$	230.08	1.82	anhyd ~120		29 g/100 mL^{6} aq; i alc
tetraborate	$Na_2B_4O_7$	201.22	2.4	742.5		2.6^{20} aq
tetraborate 10-water (borax)	$Na_2B_4O_7 \cdot 10H_2O$	381.37	1.73	75 d	anhyd 320	g/100 mL: 6.3 aq, 100 glyc
tetrachloroaluminate	$Na[AlCl_4]$	191.78	2.01	151		s aq
tetrachloroaurate	$Na[AuCl_4] \cdot 2H_2O$	397.80		d >100		166 g/100 mL^{27} aq; s alc, chl
tetrafluoroborate	$Na[BF_4]$	109.82	2.47	384	d	108 g/100 mL^{27} aq
tetrahydridoborate	$Na[BH_4]$	37.83	1.074	497	d 315	18^{25} DMF; 16.4^{20} MeOH (reacts)

thiocyanate	$NaSCN$	81.07		287		134 g/100 mL^{20} aq
thiosulfate	$Na_2S_2O_3$	158.11	2.345			s aq; i alc
thiosulfate 5-water	$Na_2S_2O_3 \cdot 5H_2O$	248.19	1.69	anhyd 100	d > 100	70 g/100 mL^{20} aq (dec slowly)
trimetaphosphate 6-water	$(NaPO_3)_3 \cdot 6H_2O$	414.04	1.786	53	anhyd 100	22 g/100 mL aq; i alc
tungstate(VI) dihydrate	$Na_2WO_4 \cdot 2H_2O$	329.85	3.25	anhyd 100	mp: 695.6	88 g/100 mL^0 aq; i alc
vanadate(V)	$NaVO_3$	121.93				s hot aq
Strontium	Sr	87.62	2.64	757	1366	d to $Sr(OH)_2$ in water
bromide	$SrBr_2$	247.43	4.216	657	2045	100 g/100 mL^{20} aq
carbonate	$SrCO_3$	147.63	3.5	d 1100 to SrO + CO_2		i aq; s acids
chlorate	$Sr(ClO_3)_2$	254.52	3.152	120 d → O_2		167 g/100 mL^{20} aq
chloride	$SrCl_2$	158.53	3.052	874	1250	52.9 g/100 mL^{20} aq
chromate(VI)	$SrCrO_4$	203.61	3.89	d		0.12^{20} aq; s HCl
fluoride	SrF_2	125.62	4.24	1477	2460	0.011^{20} aq; s hot HCl
hydrogen phosphate	$SrHPO_4$	183.60	3.544			i aq; s acids
hydroxide	$Sr(OH)_2$	121.64	3.625	535	$-H_2O$, 744	0.8^{20} aq
iodate	$Sr(IO_2)_2$	437.43	5.045^{15}			0.03^{15} aq
iodide	SrI_2	341.43	4.42	402	1773 d	178 g/100 mL^{20} aq; s alc
lactate 3-water	$Sr(OOCCHOHCH_3)_2 \cdot 3H_2O$	319.81		anhyd 150		33 g/100 mL aq
nitrate	$Sr(NO_3)_2$	211.63	2.99	570	645	69.5 g/100 mL^{20} aq; sl s alc, acet
oxide	SrO	103.62	4.7	2430		0.69^{20} aq
perchlorate	$Sr(ClO_4)_2$	286.52	3.00^{25}			g/100 mL^{25}: 157 aq, 71 BuOH, 77 EtOAc, 90 acet
peroxide	SrO_2	119.62	4.78	215 d		0.018^{20} aq; d hot aq
sulfate	$SrSO_4$	183.68	3.96	1607		0.013^{20} aq; sl s acid
sulfide	SrS	119.69	3.70	2227		sl s aq; s acid (dec)
Sulfinyl bromide (Thionyl)	$SOBr_2$	207.87	2.688_4^{20}	−52	140	hyd aq (slow); misc bz, chl, CCl_4
chloride	$SOCl_2$	118.97	1.638	−104.5	76	hyd aq; misc bz, chl, CCl_4
fluoride	SOF_2	86.06	3.776 g/L	−129.5	−43.8	hyd aq; s bz, chl, eth
Sulfonyl chloride (Sulfuryl)	SO_2Cl_2	134.97	1.6674_4^{20}	−54.1	69.3	hyd aq; misc bz, eth, HOAc
diamide	$SO_2(NH_2)_2$	96.11	1.807	93	d 250	s aq, hot EtOH, acet
fluoride	SO_2F_2	102.06	4.478 g/L	−135.8	−55.38	mL gas/100 mL: 4 aq, 24 alc, 136 CCl_4, 210 toluene
Sulfur (gamma)	S	32.066	1.92	106.8	444.72	23 g/100 mL^0 CS_2; s alc, bz
(alpha) orthorhombic	S_8	256.53	2.08^{20}	tr 94.5 to beta form	444.6	i aq; s organic solvents
(beta) monoclinic tr slowly to rhombic	S_8	256.53	1.96	115.21	444.6	23 g/100 mL^0 CS ; s alc, bz

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Sulfur (*continued*)						
(*di*-) decafluoride	S_2F_{10}	254.11	2.08	−52.7	30	d fusion with KOH
(*di*-) dichloride	ClSSCl	135.04	1.688	−77	137	hyd aq; s alc, bz, eth, CS_2, CCl_4
dichloride	SCl_2	102.97	1.622	−122	59.5	hyd aq
dioxide	SO_2	64.07	2.811 g/L	−75.47	−10	mL/100 mL: 3937^{20} aq, 25 alc, 32 MeOH; s chl, eth
hexafluoride	SF_6	146.06	6.409 g/L	−50.8	subl −63.8	sl s aq; s alc, KOH
tetrafluoride	SF_4	108.06	4.742 g/L	−121.0	−38	d aq viol; v s bz
trioxide (alpha)	SO_3	80.06		62.3	vp 73mm at 25	stable modification
(beta)	SO_3	80.06		32.5	vp 344mm at 25	
(gamma)	SO_3	80.06	1.92	16.8	44.8	v s aq (slow)
Sulfuryl, *see* Sulfonyl						
Tantalum	Ta	180.9479	16.69	2996	5429	s HF, fused alkali (slowly)
(V) bromide	$TaBr_5$	580.47	4.99	265	349	hyd aq; s abs alc, eth
carbide	TaC	192.96	14.3	3880	4780	sl s HF
(*di*-) carbide	Ta_2C	373.91	15.1	3327		
(V) chloride	$TaCl_5$	358.21	3.68	216	239.3	hyd aq; s abs alc
diboride	TaB_2	202.57	11.2	3140		
(V) fluoride	TaF_5	275.94	4.74^{20}	96.8	229.5	s aq, eth, conc HNO_3
(V) iodide	TaI	815.47	5.80	496	543	hyd aq; s eth
nitride	TaN	194.95	13.7	3090		sl s aq reg; reacts alkalis
(V) oxide	Ta_2O_5	441.89	8.2	1785		s HF; d fused $KHSO_4$ or KOH
Technetium-98	Tc	97.9072	11	2157	4265	s HNO_3, aq reg, conc H_2SO_4
(VI) fluoride	TcF_6	212.91	3.0	37.4	55.3	s HCl
(IV) oxide	TcO_2	130.91	6.9	subl 1000		s acid, alkali
(VII) oxide	Tc_2O_7	309.81		119.5	310.6	s aq
Tellurium	Te	127.60	6.24	449.8	989.9	s HNO_3, KOH, conc H_2SO_4
(IV) bromide	TeBr	447.22	4.3	380	≈20 d	s HBr, eth, HOAc
(II) chloride	$TeCl_2$	198.51	6.9	208	328	disprop with eth, diox; s acid
(IV) chloride	$TeCl_4$	269.41	3.0	225	380	hyd aq; s HCl, abs alc, bz
(IV) fluoride	TeF_4	203.59		129	d >195	d aq
(VI) fluoride	TeF_6	241.59	10.601 g/L	−37.68	subl −38.9	hyd aq, KOH

(IV) iodide	TeI_4	635.22	5.05	280		hyd aq; s HI, alkali; sl s acet
(IV) oxide	TeO_2	159.60	5.9	733	1245	s HCl, HF, NaOH
Terbium	Tb	158.9254	8.23	1356	3230	s acids
chloride	$TbCl_3$	265.28	4.35	588	1550	v s aq
nitrate 6-water	$Tb(NO_3)_3 \cdot 6H_2O$	453.03		89.3		s aq
Thallium	Tl	204.383	11.85	303.5	1457	i aq; s HNO_3
(I) bromide	TlBr	284.29	7.5	460	820	0.05^{20} aq; s alc
(I) carbonate	Tl_2CO_3	468.78	7.11	272		4.1 g/100 mL^{20} aq; i alc
(I) chloride	TlCl	239.84	7.00	430	720	0.33^{20} aq; i alc
(I) cyanide	TlCN	230.40	6.523	d		16.8 g/100 mL^{28} aq; s alc, acid
(I) ethoxide	$TlOC_2H_5$	249.44	3.49	−3	d 130	s eth; sl s alc; d aq
(I) fluoride	TlF	223.38	8.36	326	826	78.6%[15] aq
(III) fluoride	TlF_3	261.38	8.65	550 d		d aq
(I) iodide (rhombic)	TlI	331.29	7.1	442	823	i aq, alc; s KI
(I) nitrate	$TlNO_3$	266.39	5.55	206	d 450	9.55 g/100 mL^{20} aq; i alc
(I) oxide	Tl_2O	424.77	9.52	579	1080	v s aq; s acid, alc
(III) oxide (hexagonal)	Tl_2O_3	456.77	10.2	834	$-O_2$, 875	i aq; d by HCl, H_2SO_4
(I) selenate(VI)	Tl_2SeO_4	551.73	6.875	>400		2.8 g/100 mL^{20} aq; i alc, eth
(I) selenide	Tl_2Se	487.73	9.05	340		i aq, acid
(I) sulfate	Tl_2SO_4	504.83	6.77	632	d	4.87 g/100 mL^{20} aq
(I) sulfide	Tl_2S	440.83	8.39	448	1367	0.02^{20} aq; s mineral acids
Thiocarbonyl chloride	S═CCl	114.98	1.509^{15}		73.5	d aq; s eth
Thiocyanogen	$(SCN)_2$	116.16		ca. −2		d aq; s alc, CS_2, eth
Thionyl, *see* Sulfinyl						
Thiophosphoryl tribromide	$PSBr_3$	302.78	2.85^{17}	38.0	209 d	s aq, eth, CS_2
trichloride (alpha)	$PSCl_3$	169.41	1.635	−40.8	125	hyd aq; s bz, chl, CS_2
trifluoride	PSF_3	120.03		−148.8	−52.2	
Thiosulfinyl difluoride	S═SF_2	102.13		−165	−10.6	hyd aq
Thorium	Th	232.038	11.7	1750	4788	s acids
chloride	$ThCl_4$	373.85	4.59	770	921	s aq, alc
fluoride	ThF_4	308.03	6.1	1110	1680	s acids
iodide	ThI_4	739.66	6.00	570	837	hyd aq
nitrate	$Th(NO_3)_4$	400.06		d 630, ThO_2		191 g/100 mL^{20} aq; v s alc
oxide	ThO_2	264.04	10.0	3390	4400	s hot H_2SO_4
sulfate 9-water	$Th(SO_4)_2 \cdot 9H_2O$	586.30	2.77	anhyd 400		1.57 g/100 mL^{25} aq
Thullium	Tm	168.9342	9.32	1545	1950	s acids
chloride	$TmCl_3$	275.29		824	1490	s aq, alc
fluoride	TmF_3	225.93	7.971	1158	2230	s H_2SO_4

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Tin (white)	Sn	118.710	7.265	231.928	2602	s conc HCl, hot H_2SO_4
(II) acetate	$Sn(C_2H_3O_2)_2$	236.80	2.31	182.5	240	d aq; s dilute HCl
(II) bromide	$SnBr_2$	278.52	5.12	215	639	85 g/100 mL^0 aq; s alc, eth
(IV) bromide	$SnBr_4$	438.33	3.34	31	205	v a (hyd) aq; s acet, alc
(II) chloride	$SnCl_2$	189.61	3.90	246.9	623	84 g/100 mL^0 aq; s acet, alc, eth
(IV) chloride	$SnCl_4$	260.52	2.234	−3.3	114.1	s aq (hyd), alc, acet, bz, eth
(II) fluoride	SnF_2	156.71	4.57	213	850	30% aq
(IV) fluoride	SnF_4	194.70	4.78		subl 705	hyd aq
hexafluorozirconate	$Sn[ZrF_6]$	323.92	4.21			s aq
(II) iodide	SnI_2	372.52	5.285	320	714	0.98^{20} aq (d); s bz, chl, alk Cl^- or I^-
(IV) iodide	SnI_4	626.33	4.46	143	364	hyd aq; s alc, bz, chl, eth, CCl_4, CS_2
(II) oxalate	SnC_2O_4	206.73	3.56	280 d		s dilute HCl
(II) oxide	SnO	134.71	6.45	to SnO_2, 300		s acids, conc KOH
(IV) oxide	SnO_2	150.71	6.95	1630		s hot conc KOH (slow)
(II) selenide	SnSe	197.67	6.179	861		s aqua regia, alkali sulfides
(II) sulfate	$SnSO_4$	214.77	4.15	to SnO_2, 378		18.9 g/100 mL^{20} aq; s dilute H_2SO_4
(II) sulfide	SnS	150.78	5.08	880	1210	s conc HCl, hot conc H_2SO_4
(IV) sulfide	SnS_2	182.84	4.5	d 600		s aq reg, alkali hydroxides & sulfides
(II) telluride	SnTe	246.31	6.5	790		i aq
Titanium (hexagonal)	Ti	47.867	4.506	1668	3287	s hot acid, HF
(III) bromide	$TiBr_3$	287.58	4.24		subl 794	
(IV) bromide	$TiBr_4$	367.48	3.37	39	230	hyd aq; 187 g/100 mL abs alc
(II) chloride	$TiCl_2$	118.77	3.13	1035	1500	d aq; s alc
(III) chloride	$TiCl_3$	154.23	2.64	425 d		s aq (heat evolved), alc
(IV) chloride	$TiCl_4$	189.68	1.73	−25	136.4	s cold aq, alc
dihydride	TiH_2	49.88	3.752	d 450		
(IV) fluoride	TiF_4	123.86	2.798	>400	subl 285.5	s aq (slow hyd); s alc, pyr
(IV) iodide	TiI_4	555.49	4.3	150	377	s dry nonpolar solvents
(IV) isopropoxide	$Ti[OCH(CH_3)_2]_4$	284.22	0.9711_4^{20}	~20	220	d aq; s bz, chl, eth
(II) oxide	TiO	63.87	4.95	1750	3660	s H_2SO_4

(III) oxide	Ti_2O_3	143.73	4.486	1842		s H_2SO_4, hot HF
(IV) oxide (rutile)	TiO_2	79.87	4.23	1843		s HF, hot conc H_2SO_4
oxide sulfate	$TiOSO_4$	159.94				d aq
(III) sulfate	$Ti_2(SO_4)_3$	383.93				s dilute HCl, dilute H_2SO_4
Tungsten	W	183.84	19.25	3387	5900	s HNO_3 + HF, fusion NaOH + $NaNO_3$
(V) bromide	WBr_5	583.36		286	333	hyd aq; s chl, eth
(VI) bromide	WBr_6	663.26	6.9	309	subl 327	hyd aq; s eth CS_2
(V) chloride	WCl_5	361.10	3.875	242	286	hyd aq
(VI) chloride	WCl_6	396.56	3.52	279	347	hyd aq; s CS_2, CCl_4
dichloride dioxide	WCl_2O_2	286.74	4.67	265	d 369	hyd aq; s HCl
(VI) fluoride	WF_6	297.83	3.441	2.3	17.5	hyd aq; s anhyd HF
(IV) oxide	WO_2	215.84	10.8	1550	d 1724	s acids, KOH
(VI) oxide	WO_3	231.84	7.16	1472	1837	i aq; s hot alkali
(IV) sulfide	WS_2	247.97	7.6	d 1250		s HNO_3 + HF
tetrachloride oxide	WCl_4O	341.65	11.92	211	227	hyd aq
tetrafluoride oxide	WF_4O	275.83	5.07	106	186	
Uranium	U	238.0289	19.1	1135	4131	s acid
(IV) bromide	UBr_4	557.65	5.55	519	777	v s aq
(III) chloride	UCl_3	344.39	5.51	837	1657	v s aq
(IV) chloride	UCl_4	379.84	4.725	590	790	v s aq (d); s polar org solvents
(V) chloride	UCl_5	415.29		287	527	d aq; s CS_2
(VI) chloride	UCl_6	450.75	3.6	177	392	hyd aq; s chl
(IV) fluoride	UF_4	314.02	6.70	1036	1417	s conc acids (d); alk (d)
(VI) fluoride	UF_6	352.02	5.09	64.0	subl 56.5	hyd aq; s chl, CCl_4
(III) hydride	UH_3	241.05	11.1			i aq
(IV) iodide	UI_4	745.65	5.6	506	757	s aq
(IV) oxide (pitchblende)	UO_2	270.03	10.97	2827		s conc HNO_3
(VI) oxide	UO_3	286.03	7.29	d 1300		i aq; s HCl, HNO_3
octaoxide [(V,VI) oxide]	U_3O_8	842.08	8.38	d 1300 to UO_2		s HNO_3
peroxide 2-water	$UO_4 \cdot 2H_2O$	338.06		d 90–195 to U_2O_7 (slow)	d >200 to UO_2	d by HCl
Uranyl(VI) acetate 2-water	$UO_2(C_2H_3O_2)_2 \cdot 2H_2O$	422.13	2.893	anhyd 110	d 275	7.7 g/100 mL[15] aq; sl s alc
chloride	UO_2Cl_2	340.93	5.43	577		320 g/100 mL[18] aq; s acet, alc
fluoride	UO_2F_2	308.03	6.37	d 300		v s aq
nitrate 6-water	$UO_2(NO_3)_2 \cdot 6H_2O$	502.13	2.807	60	d 118	155 g/100 mL[20] aq; v s alc, eth
sulfate 3-water	$UO_2SO_4 \cdot 3H_2O$	420.14	3.28	d 100		g/100 mL: 21 aq, 4 alc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Vanadium	V	50.9415	6.11^{19}	1917	3421	s HF, HNO_3, hot H_2SO_4, aq reg
(IV) chloride	VCl_4	192.75	1.82	−25.7	148	hyd aq; s nonpolar solvents
dichloride oxide	VCl_2O	137.86	2.88	disprop 384		hyd (slow) aq; s abs alc, HOAc
(III) fluoride	VF_3	107.94	3.363	≈1400	subl 800	i almost all organic solvents
(IV) fluoride	VF_4	126.94	3.15	subl 120 (vac) & disprop		s aq, acet, HOAc
(V) fluoride	VF_5	145.93	2.50	19.5	48	hyd aq; v s anhyd HF, acet, alc
(II) oxide	VO	66.94	5.76	1790		s HCl
(III) oxide	V_2O_3	149.88	4.87	1940		sl s acids
(IV) oxide	VO_2	82.94	4.34	1967		s acids, alkalis
(V) oxide	V_2O_5	181.88	3.35	670	d 1800	0.07 aq; s conc acids, alkalis
(IV) oxide sulfate	$VOSO_4$	163.00				s aq
(III) sulfate	$V_2(SO_4)_3$	390.07		410 (vac)		s (slow) aq, HNO_3
(III) sulfide	V_2S_3	198.08	4.72	d 600		s hot acids, alkali sulfides
Xenon	Xe	131.29	5.761 g/L	−111.8	−108.04	10.8 mL/100 mL^{20} aq
difluoride	XeF	169.29	4.32	129.0	subl 114.3	2.5 g/100 mL^0 aq
hexafluoride	XeF_6	245.28	3.56	49.5	75.6	hyd aq
tetrafluoride	XeF_4	207.28	4.04	117.1	subl 115.7	hyd aq; s F_3CCOOH
trioxide	XeO_3	179.29	4.55	explodes 25		s aq giving xenic acid
Ytterbium	Yb	173.04	6.90	819	1196	s acids
(II) chloride	$YbCl_2$	243.95	5.27	721	1930	s aq
(III) chloride 6-water	$YbCl_3 \cdot 6H_2O$	387.49	2.57	anhyd 180	mp: 865	v s aq
(III) fluoride	YbF_3	230.04	8.17	1157	2230	s H_2SO_4
(III) nitrate 4-water	$Yb(NO_3)_3 \cdot 4H_2O$	431.12				s aq
(III) oxide	Yb_2O_3	394.08	9.18	2435		s dilute acids
(III) sulfate 8-water	$Yb_2(SO_4)_3 \cdot 8H_2O$	778.39	3.3			34.8 g/100 mL^{20} aq
Yttrium	Y	88.9059	4.472	1522	3345	s hot water (d)
chloride	YCl_3	195.26	2.61	721	1510	79 g/100 mL^{20} aq; s alc
fluoride	YF_3	145.90	4.0	1152	2230	s conc acids (d)

nitrate 6-water	$Y(NO_3)_3 \cdot 6H_2O$	383.01	2.68	$-3H_2O$, 100		171 g/100 mL[20] aq
oxide	Y_2O_3	225.81	5.03	2440	4300	s acids
sulfate 8-water	$Y_2(SO_4)_3 \cdot 8H_2O$	610.12	2.56	anhyd 400	d >1000	9.6 g/100 mL[20] aq
Zinc	Zn	65.39	7.14	419.527	907	i aq; s acids, alkalis (slow)
acetate dihydrate	$Zn(C_2H_3O_2)_2 \cdot 2H_2O$	219.51	1.735	237 d		g/100 mL: 41.6[20] aq, 3.3 alc
arsenate(III)(1−)	$Zn(AsO_2)_2$	279.23				s acids
arsenate(V)(3−) 8-water	$Zn_3(AsO_4)_2 \cdot 8H_2O$	618.13	3.33			s acids and alkalis
bromide	$ZnBr_2$	225.20	4.5	394	697	g/100 mL: 471[25] aq, 200 alc; s KOH, eth
carbonate	$ZnCO_3$	125.40	4.4	$-CO_2$, 300		0.02[25] aq; s acids, KOH, NH_4 salts
chloride	$ZnCl_2$	136.29	2.907	290	732	g/100 ml: 395[20] aq, 77 alc, 50 glyc; v s acet
chromate(VI)	$ZnCrO_4$	181.39	3.40			s acids
cyanide	$Zn(CN)_2$	117.43	1.852	d 800		0.058[18] aq; s acids, KCN, KOH
fluoride	ZnF_2	103.39	4.9	872	1500	s HNO_3, HCl, NH_4OH
hexafluorosilicate 6-water	$Zn[SiF_6] \cdot 6H_2O$	315.56	2.104	d 100		v s aq
iodate	$Zn(IO_3)_2$	415.20	5.063	d		0.87[20] aq; s HNO_3, KOH
iodide	ZnI_2	319.20	4.74	446	625 d	g/100 mL: 332[20] aq, 50 glyc; v s alc
nitrate 6-water	$Zn(NO_3)_2 \cdot 6H_2O$	297.49	2.067	$-6H_2O$, 131		146 g/100 mL[0] aq; v s alc
oxide	ZnO	81.39	5.60	1975		i aq; s acids, KOH, NH_4OH
peroxide	ZnO_2	97.39	1.57	d >150	explodes 212	d (slow) aq; s dilute acids (d)
1,4-phenolsulfonate 8-water	$Zn[C_6H_4(OH)SO_3]_2 \cdot 8H_2O$	555.84		anhyd 120		g/100 mL: 63 aq, 56 alc
phosphate(V)	$Zn_3(PO_4)_2$	386.11	3.998	900		s acids, NH_4OH
phosphide	Zn_3P_2	258.12	4.55	420	1100	d aq, HCl (viol); s bz, CS_2
propionate	$Zn(C_3H_5O_2)_2$	211.53				32%[15] aq; 2.8%[15] alc
selenide	ZnSe	144.35	5.65	>1100		d dilute HNO_3
silicate(2−)	Zn_2SiO_4	222.86	4.10	1512		i aq or dilute acids
stearate	$Zn(C_{18}H_{35}O_2)_2$	632.34	1.095	130		d dil acids; s bz; i aq, alc, eth
sulfate	$ZnSO_4$	161.45	3.8	680 d		53.8%[20] aq
sulfate 7-water	$ZnSO_4 \cdot 7H_2O$	287.56	1.97	anhyd 280	d >500	g/100 mL: 167 aq, 40 glyc; i alc
sulfide (wirzite)	ZnS	97.46	4.09	1722		i aq; s dilute mineral acids
telluride	ZnTe	192.99	6.34	1239		d (slow) aq or dilute HCl
thiocyanate	$Zn(SCN)_2$	181.56				0.14 aq; s alc

TABLE 3.2 Physical Constants of Inorganic Compounds (*Continued*)

Name	Formula	Formula weight	Density	Melting point, °C	Boiling point, °C	Solubility in 100 parts solvent
Zirconium	Zr	91.224	6.52	1852	3577	s aq reg, HF, hot H_3PO_4, fusion with KOH + KNO_3
(IV) bromide	$ZrBr_4$	410.84	3.98	450	subl 357	
carbide	ZrC	103.23	6.73	3532	5100	sl s conc H_2SO_4
(II) chloride	$ZrCl_2$	162.13	3.6	727	1292	d aq
(IV) chloride	$ZrCl_4$	233.03	2.80	437 (25 atm)	subl 334	hyd aq to $ZrCl_2O$; s alc, eth
diboride	ZrB_2	112.85	6.17	3245	d 4193	
dichloride oxide 8-water	$ZrCl_2O \cdot 8H_2O$	322.25	1.91	anhyd 210	d 410	v s aq, alc
dihydride	ZrH_2	93.24	5.61			i aq
(IV) fluoride	ZrF_4	167.22	4.436	932[tp]	subl 912	1.32 g/100 mL^{20} aq
(IV) hydroxide	$Zr(OH)_4$	159.25	3.25	to ZrO_2, 500		s mineral acids
(IV) iodide	ZrI_4	598.84		499 (sealed tube)	subl 432.5	s aq (d), eth
(IV) nitrate 5-water	$Zr(NO_3)_4 \cdot 5H_2O$	429.32		d 100		v s aq; s alc
(IV) oxide	ZrO_2	123.22	5.68	2678	4300	s hot H_2SO_4, HF (slow)
(IV) silicate(4−)	$ZrSiO_4$	183.31	4.56	d 1540 to ZrO_2 + SiO_2		unaffected by aqueous reagents
sulfate 4-water	$Zr(SO_4)_2 \cdot 4H_2O$	355.41	2.80	anhyd 380		52.5 g/100 g aqueous solution

TABLE 3.3 Synonyms and Mineral Names

Acanthite, *see* Silver sulfide
Alabandite, *see* Manganese sulfide
Alamosite, *see* Lead(II) silicate(2−)
Altaite, *see* Lead telluride
Alumina, *see* Aluminum oxide
Alundum, *see* Aluminum oxide
Alunogenite, *see* Aluminum sulfate 18-water
Amphibole, *see* Magnesium silicate(2−)
Andalusite, *see* Aluminum silicon oxide (l/1)
Anglesite, *see* Lead sulfate
Anhydrite, *see* Calcium sulfate
Anhydrone, *see* Magnesium perchlorate
Aragonite, *see* Calcium carbonate
Arcanite, *see* Potassium sulfate
Argentite, *see* Silver sulfide
Argol, *see* Potassium hydrogen tartrate
Arkansite, *see* Titanium(IV) oxide
Arsenolite, *see* Arsenic(III) oxide dimer
Arsine, *see* Arsenic hydride
Auric and aurous, *see* under Gold
Azoimide, *see* Hydrogen azide
Azurite, *see* Copper(II) carbonate—dihydroxide (2/1)

Baddeleyite, *see* Zirconium(IV) oxide
Baking soda, *see* Sodium hydrogen carbonate
Barite (barytes), *see* Barium sulfate
Bieberite, *see* Cobalt sulfate 7-water
Bismuthine, *see* Bismuth hydride
Bismuthinite, *see* Bismuth sulfide
Bleaching powder, *see* Calcium hydrochlorite
Bleaching solution, *see* Sodium hydrochlorite
Blue copperas, *see* Copper(II) sulfate 7-water
Boracic acid, *see* Hydrogen borate
Borax, *see* Sodium tetraborate 10-water
Braunite, *see* Manganese(III) oxide
Brimstone, *see* Sulfur
Bromellite, *see* Beryllium oxide
Bromosulfonic acid, *see* Hydrogen bromosulfate
Bromyrite, *see* Silver bromide
Brookite, *see* Titanium(IV) oxide
Brucite, *see* Magnesium hydroxide
Bunsenite, *see* Nickel oxide

Cacodylate, *see* Sodium dimethylarsonate 3-water
Caesium, *see* under Cesium
Calamine, *see* Zinc carbonate
Calcia, *see* Calcium oxide
Calcite, *see* Calcium carbonate
Calomel, *see* Mercury(I) chloride
Caro's acid, *see* Hydrogen peroxosulfate
Cassiopeium, *see* Lutetium
Cassiterite, *see* Tin(IV) oxide
Caustic potash, *see* Potassium hydroxide
Caustic soda, *see* Sodium hydroxide
Celestite, *see* Strontium sulfate
Cementite, *see* tri-Iron carbide
Cerargyrite, *see* Silver chloride
Cerussite, *see* Lead carbonate
Chalcanthite, *see* Copper(II) sulfate 5-water
Chalcocite, *see* Copper(I) sulfide
Chalk, *see* Calcium carbonate
Chile nitre, *see* Sodium nitrate
Chile saltpeter, *see* Sodium nitrate
Chloromagnesite, *see* Magnesium chloride
Chlorosulfonic acid, *see* Hydrogen chlorosulfate
Cinnabar, *see* Mercury(II) sulfide
Claudetite, *see* Arsenic(III) oxide dimer
Clausthalite, *see* Lead selenide
Clinoenstatite, *see* Magnesium silicate(2−)
Columbium, *see* under Niobium
Corrosive sublimate, *see* Mercury(II) chloride
Corundum, *see* Aluminum oxide
Cotunite, *see* Lead chloride
Covellite, *see* Copper(II) sulfide
Cream of tartar, *see* Potassium hydrogen tartrate
Crocoite, *see* Lead chromate(VI)(2−)
Cryolite, *see* Sodium hexafluoroaluminate
Cryptohalite, *see* Ammonium hexafluorosilicate
Cupric and cuprous, *see* under Copper
Cuprite, *see* Copper(I) oxide

Dakin's solution, *see* Sodium hypochlorite
Dehydrite, *see* Magnesium perchlorate
Dental gas, *see* Nitrogen(I) oxide
Diamond, *see* Carbon
Dichlorodisulfane, *see* di-Sulfur dichloride
Diuretic salt, *see* Potassium acetate
Dolomite, *see* Calcium magnesium carbonate (1/1)
Dry ice, *see* Carbon dioxide (solid)

Enstatite, *see* Magnesium silicate(2−)
Epsom salts, *see* Magnesium sulfate 7-water
Epsomite, *see* Magnesium sulfate 7-water
Eriochalcite, *see* Copper(II) chloride

Fayalite, *see* Iron(II) silicate(4−)
Ferric and ferrous, *see* under Iron
Fluorine oxide, *see* Oxygen difluoride
Fluoristan, *see* Tin(II) fluoride
Fluorite, *see* Calcium fluoride
Fluorosulfonic acid, *see* Hydrogen fluorosulfate
Fluorspar, *see* Calcium fluoride
Forsterite, *see* Magnesium silicate(4−)
Freezing salt, *see* Sodium chloride
Fulminating mercury, *see* Mercury fulminate

Galena, *see* Lead sulfite
Glauber's salt, *see* Sodium sulfate 10-water
Goethite, *see* Iron(II) hydroxide oxide
Goslarite, *see* Zinc sulfate 7-water
Graham's salt, *see* Sodium phosphate(1−)
Graphite, *see* Carbon

TABLE 3.3 Synonyms and Mineral Names (*Continued*)

Greenockite, *see* Cadmium sulfide
Gruenerite, *see* Iron(II) silicate(2−)
Guanajuatite, *see* Bismuth selenide
Gypsum, *see* Calcium sulfate 2-water

Halite, *see* Sodium chloride
Hausmannite, *see* Manganese(II,IV) oxide
Heavy hydrogen, *see* Hydrogen[^2H] or name followed by *-d*
Heavy water, *see* Hydrogen[^2H] oxide
Heazlewoodite, *see tri*-Nickel disulfide
Hematite, *see* Iron(III) oxide
Hermannite, *see* Manganese silicate
Hessite, *see* Silver telluride
Hieratite, *see* Potassium hexafluorosilicate
Hydroazoic acid, *see* Hydrogen azide
Hydrophilite, *see* Calcium chloride
Hydrosulfite, *see* Sodium dithionate(III)
Hypo (photographic), *see* Sodium thiosulfate 5-water
Hypophosphite, *see* under Phosphinate

Ice, *see* Hydrogen oxide (solid)
Iceland spar, *see* Calcium carbonate
Iodyrite, *see* Silver iodide

Jeweler's borax, *see* Sodium tetraborate 10-water
Jeweler's rouge, *see* Iron(III) oxide

Kalinite, *see* Aluminum potassium bis(sulfate)
Kernite, *see* Sodium tetraborate
Kyanite, *see* Aluminum silicon oxide (1/1)

Laughing gas, *see* Nitrogen(I) oxide
Lautarite, *see* Calcium iodate
Lawrencite, *see* Iron(II) chloride
Lechatelierite, *see* Silicon dioxide
Lime, *see* Calcium oxide
Litharge, *see* Lead(II) oxide
Lithium aluminum hydride, *see* Lithium tetrahydridoaluminate
Lodestone, *see* Iron(II,III) oxide
Lunar caustic, *see* Silver nitrate
Lye, *see* Sodium hydroxide

Magnesia, *see* Magnesium oxide
Magnesite, *see* Magnesium carbonate
Magnetite, *see* Iron(II,III) oxide
Malachite, *see* Copper carbonate dihydroxide
Manganosite, *see* Manganese(II) oxide
Marcasite, *see* Iron disulfide
Marshite, *see* Copper(I) iodide
Mascagnite, *see* Ammonium sulfate
Massicotite, *see* Lead oxide
Mercuric and mercurous, *see* under Mercury
Metacinnabar, *see* Mercury(II) sulfide
Millerite, *see* Nickel sulfide
Mirabilite, *see* Sodium sulfate
Mohr's salt, *see* Ammonium iron(II) sulfate 6-water
Moissanite, *see* Silicon carbide
Molybdenite, *see* Molybdenum disulfide
Molybdite, *see* Molybdenum(VI) oxide
Molysite, *see* Iron(III) chloride
Montroydite, *see* Mercury(II) oxide
Morenosite, *see* Nickel sulfate 7-water
Mosaic gold, *see* Tin disulfide
Muriatic acid, *see* Hydrogen chloride, aqueous solutions

Nantokite, *see* Copper(I) chloride
Natron, *see* Sodium carbonate
Naumannite, *see* Silver selenide
Neutral verdigris, *see* Copper(II) acetate
Nitre (niter), *see* Potassium nitrate
Nitric oxide, *see* Nitrogen(II) oxide
Nitrobarite, *see* Barium nitrate
Nitromagnesite, *see* Magnesium nitrate 6-water
Nitroprusside, *see* Sodium pentacyanonitrosylferrate(II) 2-water

Oldhamite, *see* Calcium sulfide
Opal, *see* Silicon dioxide
Orpiment, *see* Arsenic trisulfide
Oxygen powder, *see* Sodium peroxide

Paris green, *see* Copper acetate arsenate(III) (1/3)
Pawellite, *see* Calcium molybdate(VI)(2−)
Pearl ash, *see* Potassium carbonate
Perborax, *see* Sodium peroxoborate
Periclase, *see* Magnesium oxide
Persulfate, *see* Peroxodisulfate
Phosgene, *see* Carbonyl chloride
Phosphine, *see* Hydrogen phosphide
Pickling acid, *see* Hydrogen sulfate
Pitchblende, *see* Uranium(IV) oxide
Plaster of Paris, *see* Calcium sulfate hemihydrate
Plattnerite, *see* Lead(IV) oxide
Polianite, *see* Manganese(IV) oxide
Polishing powder, *see* Silicon dioxide
Potash, *see* Potassium carbonate
Potassium acid phthalate, *see* Potassium hydrogen phthalate
Prussic acid, *see* Hydrogen cyanide
Pyrite, *see* Iron disulfide
Pyrochroite, *see* Manganese(II) hydroxide
Pyrohytpophosphite, *see* diphosphate(IV)
Pyrolusite, *see* Manganese(IV) oxide
Pyrophanite, *see* Manganese titanate(IV)(2−)
Pyrophosphate, *see* Diphosphate(V)
Pyrosulfuric acid, *see* Hydrogen disulfate

Quartz, *see* Silicon dioxide
Quicksilver, *see* Mercury

Realgar, *see* di-Arsenic disulfide
Red lead, *see* Lead(II,IV) oxide
Rhodochrosite, *see* Manganese carbonate

TABLE 3.3 Synonyms and Mineral Names (*Continued*)

Rhodonite, *see* Manganese silicate(1−)
Rochelle salt, *see* Potassium sodium tartrate 4-water
Rock crystal, *see* Silicon dioxide
Rutile, *see* Titanium(IV) oxide

Sal soda, *see* Sodium carbonate 10-water
Saltpeter, *see* Potassium nitrate
Scacchite, *see* Manganese chloride
Scheelite, *see* Calcium tungstate(VI)(2−)
Sellaite, *see* Magnesium fluoride
Senarmontite, *see* Antimony(III) oxide
Siderite, *see* Iron(II) carbonate
Siderotil, *see* Iron(II) sulfate 5-water
Silica, *see* Silicon dioxide
Silicotungstic acid, *see* Silicon oxide—tungsten oxide—water (l/12/26)
Sillimanite, *see* Aluminum silicon oxide (l/1)
Smithsonite, *see* Zinc carbonate
Soda ash, *see* Sodium carbonate
Spelter, *see* Zinc metal
Sphalerite, *see* Zinc sulfide
Spherocobaltite, *see* Cobalt(II) carbonate
Spinel, *see* Magnesium aluminate(2−)
Stannic and stannous, *see* under Tin
Stibine, *see* Antimony hydride
Stibnite, *see* Antimony(III) sulfide
Stolzite, *see* Lead tungstate(VI)(2−)
Strengite, *see* Iron(III) phosphate
Strontianite, *see* Strontium carbonate
Sugar of lead, *see* Lead acetate
Sulfamate, *see* Amidosulfate
Sulphate, *see* Sulfate
Sulfurated lime, *see* Calcium sulfide
Sulfuretted hydrogen, *see* Hydrogen sulfide
Sulphur, *see* Sulfur
Sulfuryl, *see* Sulfonyl
Sycoporite, *see* Cobalt sulfide
Sylvite, *see* Potassium chloride
Szmikite, *see* Manganese(II) sulfate hydrate

Tarapacaite, *see* Potassium chromate(VI)
Tellurite, *see* Tellurium dioxide
Tenorite, *see* Copper(II) oxide
Tephroite, *see* Manganese silicate(1−)
Thenardite, *see* Sodium sulfate
Thionyl, *see* Sulfinyl
Thorianite, *see* Thorium dioxide
Topaz, *see* Aluminum hexafluorosilicate
Tridymite, *see* Silicon dioxide
Troilite, *see* Iron(II) sulfide
Trona, *see* Sodium carbonate—hydrogen carbonate dihydrate
Tschermigite, *see* Aluminum ammonium bis(sulfate)
Tungstenite, *see* Tungsten disulfide
Tungstite, *see* Hydrogen tungstate

Uraninite, *see* Uranium(IV) oxide

Valentinite, *see* Antimony(III) oxide
Verdigris, *see* Copper acetate hydrate
Vermillion, *see* Mercury(II) sulfide
Villiaumite, *see* Sodium fluoride
Vitamin B_3, *see* Calcium (+)pantothenate

Washing soda, *see* Sodium carbonate 10-water
Whitlockite, *see* Calcium phosphate
Willemite, *see* Zinc silicate(4−)
Wolfram, *see* Tungsten
Wuestite, *see* Iron(II) oxide
Wulfenite, *see* Lead molybdate(VI)(2−)
Wurtzite, *see* Zinc sulfide

Zincite, *see* Zinc oxide
Zincosite, *see* Zinc sulfate
Zincspar, *see* Zinc carbonate
Zirconia, *see* Zirconium oxide