

EXAMPLES:

KMgF_3	magnesium potassium fluoride (note orders)
$\text{NaTl}(\text{NO}_3)_2$	sodium thallium(I) nitrate
KNaCO_3	potassium sodium carbonate
$\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$	ammonium magnesium phosphate hexahydrate [or water(1/6)]
$\text{Na}(\text{UO}_2)_3[\text{Zn}(\text{H}_2\text{O})_6](\text{C}_2\text{H}_3\text{O}_2)_9$	hexaaquazinc sodium triuranyl(VI) nonaacetate
$\text{NaNH}_4\text{HPO}_4 \cdot 4\text{H}_2\text{O}$	ammonium sodium hydrogenphosphate tetrahydrate
$\text{AlK}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	aluminum potassium sulfate water(1/12)

Anions

Anions are to be cited in alphabetical order which may be different in names and formulas.

EXAMPLES:

$\text{NaCl} \cdot \text{NaF} \cdot 2\text{Na}_2\text{SO}_4$ or $\text{Na}_6\text{ClF}(\text{SO}_4)_2$	hexasodium chloride fluoride bis(sulfate) ³
$\text{Ca}_5\text{F}(\text{PO}_4)_3$	pentacalcium fluoride tris(phosphate) ³

Basic salts should be treated as double salts, not as oxo or hydroxo salts.

EXAMPLES:

$\text{MgCl}(\text{OH})$	magnesium chloride hydroxide
BiClO	bismuth chloride oxide (not bismuth oxychloride)
$\text{ZrCl}_2\text{O} \cdot 8\text{H}_2\text{O}$	zirconium dichloride oxide octahydrate
$\text{CuCl}_2 \cdot 3\text{Cu}(\text{OH})_2$ or $\text{Cu}_2\text{Cl}(\text{OH})_3$	dicopper chloride trihydroxide

B7 COORDINATION COMPOUNDS

The symbol for the central atom is placed first in the formula of coordination compounds followed by anionic ligands in the alphabetical order of the symbols and then neutral ligands in alphabetical order. The formula for the complex molecule or ion is enclosed in square brackets []. In names the central atom is placed after the ligands. The ligands are listed in alphabetical order regardless of charge and regardless of the number of each. Thus diammine is listed under "a" whereas dimethylamine is listed under "d."

The oxidation number of the central atom is indicated by the Stock notation (Roman numbers). Alternatively, the proportion of constituents may be given by means of stoi-

³The prefixes bis, tris, tetrakis, etc., are used for anions to avoid confusion with disulfate, etc., and for complex expressions to avoid ambiguity.

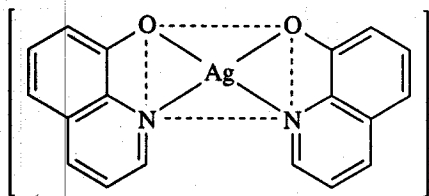
chiometric prefixes, or the charge on the entire ion can be designated by the Ewens-Bassett number (Arabic numbers). Formulas and names may be supplemented by italicized prefixes *cis*, *trans*, *fac* (*facial*), *mer* (*meridional*), and so on. Names of complex anions end in -ate. Complex cations and neutral molecules are given no distinguishing ending.

► B7.1 Names of Ligands

The names for anionic ligands end in -o (-ido, -ito, and -ato commonly).

EXAMPLES:

$\text{Li}[\text{AlH}_4]$	lithium tetrahydridoaluminate
$\text{K}_2[\text{OsCl}_5\text{N}]$	potassium pentachloronitridoosmate(VI) or potassium pentachloronitridoosmate(2-)
$\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$	sodium bis(thiosulfato)argentate(I) or (3-)
$[\text{Ni}(\text{C}_4\text{H}_7\text{O}_2\text{N}_2)_2]$	bis(2,3-butanedione dioximato)nickel(II) or omit (II)
$[\text{Cu}(\text{C}_5\text{H}_7\text{O}_2)_2]$	bis(2,4-pentanedionato)copper(II) or omit (II)
$\text{K}_2[\text{Cr}(\text{CN})_2\text{O}_2(\text{O}_2)\text{NH}_3]$	potassium amminedicyanodioxoperoxochromate(VI) or (2-)



bis(8-quinolinolato)silver(II) or omit (II)

Some common anionic ligands (systematic names):

H^-	hydrido ⁴	HS^-	mercapto (hydrogensulfido)
F^-	fluoro	S^{2-}	thio (sulfido)
Cl^-	chloro	CN^-	cyano
Br^-	bromo	CH_3O^-	methoxo or methanolato
I^-	iodo	C_6H_5^-	phenyl
O^{2-}	oxo (oxido)	C_5H_5^-	cyclopentadienyl
OH^-	hydroxo (hydroxido)	Other hydrocarbonanions are also given radical names without the -o ending.	
O_2^{2-}	peroxo [dioxido(2-)]		

Neutral and cationic ligands are given no special endings. Water and ammonia are called aqua and ammine, respectively, in complexes. Groups such as NO and CO are named as radicals and treated as neutral ligands.

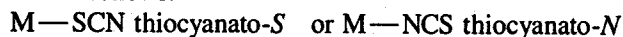
⁴Hydro is used in boron nomenclature.

EXAMPLES:

Ba[BrF ₄] ₂	barium tetrafluorobromate(III) or (1-)
K[CrF ₄ O]	potassium tetrafluoroxychromate(V) or (1-)
Na[BH(OCH ₃) ₃]	sodium hydrotrimethoxyborate(III) or (1-)
[CuCl ₂ (CH ₃ NH ₂) ₂]	dichlorobis(methylamine)copper(II) or omit (II)
[Pt(py) ₄][PtCl ₄]	tetrakis(pyridine)platinum(II) tetrachloroplatinate(II) or (2+) and (2-)
[Co(en) ₃] ₂ (SO ₄) ₃	tris(ethylenediamine)cobalt(III) sulfate or (3+)
K[PtCl ₃ (C ₂ H ₄)]	potassium trichloro(ethylene)platinate(II) or (1-)
[Al(OH)(H ₂ O) ₅] ²⁺	pentaquahydroxoaluminum(III) or (2+) ion
K ₃ [Fe(CN) ₅ NO]	potassium pentacyanonitrosylferrate(II) or (3-)
[CoCl ₃ (NH ₃) ₂ [(CH ₃) ₂ NH]]	diamminetrichloro(dimethylamine)cobalt(III)
K[SbCl ₅ C ₆ H ₅]	potassium pentachloro(phenyl)antimonate(V) or (1-)
[Fe(C ₅ H ₅) ₂]	bis(cyclopentadienyl)iron(II) or omit (II)
[Cr(C ₆ H ₆) ₂]	bis(benzene)chromium(0) or omit (0)
[Ru(NH ₃) ₅ N ₂]Cl ₂	pentaammine(dinitrogen)ruthenium(II) chloride or (2+)

► B7.2 Alternative Modes of Linkage

A Ligand that may be attached through different atoms, for example SCN⁻, may be distinguished as follows:



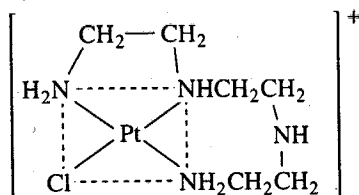
EXAMPLES:

$K_2 \left[Ni \left(\begin{array}{c} S-C=O \\ \\ S-C=O \end{array} \right)_2 \right]$	potassium bis(dithiooxalato- <i>S,S'</i>)nickelate(II) or (2-)
[Co(NO ₂) ₃ (NH ₃) ₃]	triamminetri(nitrito- <i>N</i>)cobalt(III)
[Co(ONO)(NH ₃) ₅]SO ₄	pentaammine(nitrito- <i>O</i>)cobalt(III) sulfate or (2+)
[Co(NCS)(NH ₃) ₅]Cl ₂	pentaammine(thiocyanato- <i>N</i>)cobalt(III) chloride

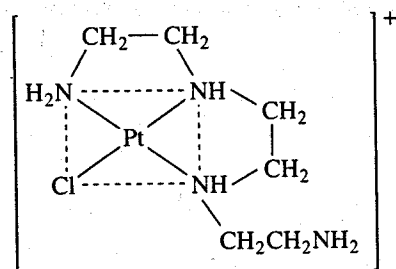
The Kappa Convention

The ligating atom of a ligand can be designated also by the Greek kappa, κ , preceding the italicized element symbol as thiocyanato- κS for SCN⁻ bonded through S. The κ convention is particularly helpful for polydentate ligands with not all donor atoms ligating and where the ligating atoms are not obvious. A right superscript to κ indicates the number of identically bound ligating atoms of a ligand.

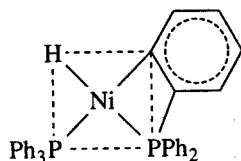
EXAMPLES:



[*N,N'*-bis(2-amino- κN -ethyl)-1,2-ethanediamine- κN]chloroplatinum(II)



[*N*-(2-amino- κN -ethyl)-*N'*-(2-aminoethyl)-1,2-ethanediamine- $\kappa^2 N,N'$]chloroplatinum(II)



[2-(diphenylphosphino- κP)-phenyl- κC^1]hydrido-(triphenylphosphine- κP)nickel(II)

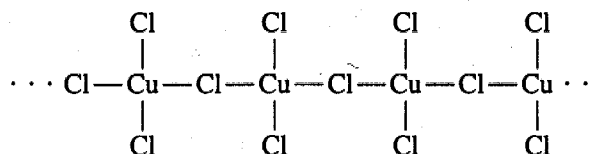
► B7.3 Di- and Polynuclear Compounds

Bridging groups are indicated by adding the Greek letter μ immediately before the names of the groups. Two or more bridging groups of the same kind are indicated by di- μ , and so on. If a bridging group bridges more than two metals, use μ_3 , μ_4 , and so on. Bridging groups are listed followed by other groups in alphabetical order unless the symmetry of the molecule permits a simpler name (first example). If the same ligand is present in bridging and nonbridging roles, it is cited first as a bridging ligand.

EXAMPLES:

$[(\text{NH}_3)_5\text{Cr} - \text{OH} - \text{Cr}(\text{NH}_3)_5]^{5+}$	μ -hydroxo-bis(pentaamminechromium)(5+) ion or (III)
$[(\text{CO})_3\text{Fe}(\text{CO})_3\text{Fe}(\text{CO})_3]$	tri- μ -carbonyl-bis(tricarbonyliron)
$[\{\text{Au}(\text{CN})(\text{C}_3\text{H}_7)_2\}_4]$	cyclo-tetra- μ -cyano-tetrakis(dipropylgold)
$[\text{Be}_4\text{O}(\text{CH}_3\text{COO})_6]$	hexa- μ -acetato(<i>O,O'</i>)- μ_4 -oxo-tetraberyllium(II) or omit (II)
$[(\text{CH}_3\text{Hg})_4\text{S}]^{2+}$	μ_4 -thio-tetrakis[methylmercury(II)] ion or (2+)

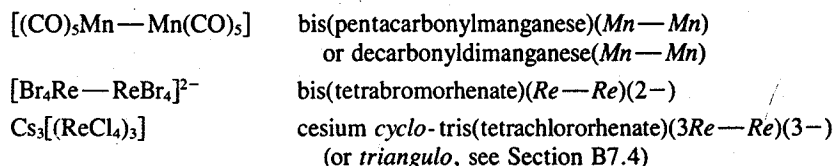
Extended structures may be indicated by the prefix *catena- μ* , for example, CsCuCl_3 contains the anion



The compound may be named cesium *catena-μ-chloro-dichlorocuprate*(II). If the structure were in doubt, however, the substance would be called cesium copper(II) chloride (as a double salt).

Metal-metal bonding may be indicated by italicized atomic symbols of the appropriate metal atoms, separated by a long dash and enclosed in parentheses.

EXAMPLES:



Unsymmetrical Dinuclear Entities

Unsymmetrical dinuclear species may have different central atoms and/or different ligands or different numbers of ligands on the central atoms. They are named by citing the ligands and bridging groups in a *single* alphabetical ordered series, followed by the names of the central atoms in alphabetical order. The central atoms are numbered 1 and 2 to provide numerical locants for the ligands and the points of attachment of bridging groups.

If the central atoms are different, central 1 is the more electropositive element in the sequence going down group 17, then groups 16, 15, 14, and so on. It is the approximate sequence of electronegativities by groups. If the central atoms are identical, central atom 1 is designated with priority⁵ decreasing from criteria 1 to 4:

1. Atom with higher oxidation number
2. Atom with higher coordination number
3. Atom with greater variety of bonding atoms
4. Atom to which is attached the side group with the name first in alphabetical order.

Each criterion is applied only if the previous criterion fails to make a distinction. The kappa convention is used to indicate the ligating atom(s) and its (their) role. A right superscript to κ indicates the number of equivalent ligating atoms bonded to a central atom. The numerical locant (1 or 2) of the central atom is placed before κ .

⁵ B. P. Block, W. H. Powell, and W. C. Fernelius, *Inorganic Chemical Nomenclature*, American Chemical Society, Washington, D.C., 1990, pp. 50-54.

EXAMPLES:

$[(\text{CO})_2\text{Co}—\text{Re}(\text{CO})_5]$ 2 1	nonacarbonyl- $1\kappa^5\text{C}$, $2\kappa^4\text{C}$ -2-cobalt-1-rhenium(<i>Co—Re</i>)
$[(\text{Ph}_3\text{As})\text{Au}—\text{Mn}(\text{CO})_5]$ 2 1	pentacarbonyl- $1\kappa^5\text{C}$ -(triphenylarsine- $2\kappa\text{As}$)-2-gold-1-manganese(<i>Au—Mn</i>)
$[(\text{H}_3\text{N})_5\text{Cr}(\text{OH})\text{Cr}(\text{NH}_3)_4(\text{NH}_2\text{Me})]\text{Cl}_5$ 1 2	nonaammine- $1\kappa^5\text{N}$, $2\kappa^4\text{N}$ - μ -hydroxo-(methylamine) $2\kappa\text{N}$ -dichromium(5+) chloride
$[(\text{Et}_2\text{PhP})_3(\text{Cl})_2\text{Re}-\text{N}-\text{Pt}(\text{PEt}_3)(\text{Cl})_2]$ 1 2	tetrachloro- $1\kappa^2$, $2\kappa^2$ -tris(diethylphenylphosphine- $1\kappa\text{P}$)- μ -nitrido-(triethylphosphine- $2\kappa\text{P}$)-2-platinum-1-rhenium

► B7.4 Metal Cluster Compounds

The geometrical shape of the cluster is designated by *triangulo*, *quadro*, *tetrahedro*, *octahedro*, and so on.

EXAMPLES:

$\text{Os}_3(\text{CO})_{12}$	dodecacarbonyl- <i>triangulo</i> -triosmium($3\text{Os}—\text{Os}$) or <i>cyclo</i> -tris(tetracarbonylosmium)($3\text{Os}—\text{Os}$)
$\text{Cs}_3[\text{Re}_3\text{Cl}_{12}]$	cesium dodecachloro- <i>triangulo</i> -trirhenate($3\text{Re}—\text{Re}$)(3-) or cesium <i>cyclo</i> -tris(tetrachlororhenate)($3\text{Re}—\text{Re}$)(3-)
B_4Cl_4	tetrachloro- <i>tetrahedro</i> -tetraboron($6\text{B}—\text{B}$) or <i>tetrahedro</i> -tetrakis(chloroboron)
$[\text{Nb}_6\text{Cl}_{12}]^{2+}$	dodeca- μ -chloro- <i>octahedro</i> -hexaniobium(2+) ion
$[\text{Mo}_6\text{Cl}_8]^{4+}$	octa- μ_3 -chloro- <i>octahedro</i> -hexamolybdenum(4+) ion
$\text{Cu}_4\text{I}_4(\text{PEt}_3)_4$	tetra- μ_3 -iodo-tetrakis(triethylphosphine)- <i>tetrahedro</i> -tetracopper

Some aspects of the designation of geometrical and optical isomers are covered in Chapter 9, and the naming of boron compounds is discussed briefly in Chapter 17. For more details and for rules dealing with isopolyanions, heteropolyanions, and nonstoichiometric phases, and for tables of names of ions and radicals, see the original 283-page report.

Table B.1 The elements

Name	Symbol	Atomic number	Name	Symbol	Atomic number
Actinium	Ac	89	Astatine	At	85
Aluminum	Al	13	Barium	Ba	56
Americium	Am	95	Berkelium	Bk	97
Antimony	Sb	51	Beryllium	Be	4
Argon	Ar	18	Bismuth	Bi	83
Arsenic	As	33	Boron	B	5

(Continued)