

COORDINATION COMPOUNDS

NOMENCLATURE OF COORDINATION COMPOUNDS

❖ IUPAC NOMENCLATURE OF COMPLEXES

The rules for the systematic naming of co-ordination compounds are as follows.

- ◆ The positive part is named first followed by the negative part, whether it is simple or complex.
- ◆ In naming of a complex ion, the ligands are named first in alphabetical order, followed by naming of central metal atom /ion.
- ◆ When there are several monodentate ligands of the same kind, then we normally use the prefixes di, tri tetra, penta and hexa to show the number of ligands of that type. If ligand's name already contains any of these prefixes, then to avoid confusion in such cases, bis, tris and tetrakis are used instead of di, tri and tetra and name of the ligand is placed in parenthesis. For example, bis (ethylene diamine) for two ene-ligands.
- ◆ Negative ligands have suffix -o, positive ligands have suffix -ium, where as neutral ligands have no specific suffix.

The names of negative ligands ending with -ide are changed to 'o'. For example,

F ⁻	fluoro /fluoride	H ⁻	hydrido
Cl ⁻	chloro /chlorido	OH ⁻	hydroxo/hydroxido
Br ⁻	bromo / bromido	O ²⁻	oxo / oxido
I ⁻	iodo / iodido	O ₂ ²⁻	peroxo / Peroxido
HS ⁻	mercapto	S ²⁻	sulphido
CN ⁻	cyano/Cyanido		

Ligands ending with -ate/-ite are changed to -ato/-ito. For example, SO₄²⁻ (sulphato), SO₃²⁻ (sulphito) etc.

Positive groups end with -ium. For example, NH₂ – NH₃⁺ (hydrazinium) NO⁺ (nitrosonium)

- ◆ Neutral ligands have No special ending and usually common ligands are provided to neutral ligands except NH₃ (ammine) H₂O (aqua) CO (carbonyl), NO(Nitrosyl).
- ◆ The oxidation state of the central metal ion is shown by Roman numeral in brackets immediately following its name.
- ◆ Complex positive ions and neutral molecules have no special ending but complex negative ions end with ate. suffix.

Complex ions

Example	Negative complex	Positive /neutral complex
Ni	nickelate	nickel
Pb	plumbate	lead
Sn	stannate	tin
Fe	ferrate	iron

- ◆ If the complex compound contains two or more metal atoms, then it is termed as polynuclear Complex compound. The bridging ligand which links the two metal atoms together are indicated by the prefix μ -. If there are two or more bridging groups of the same kind, this is indicated by di- μ -, tri - μ - and so on. If a bridging group bridges more than two metal atoms, it is shown as μ_3 , μ_4 , μ_5 or μ_6 to indicate how many atoms it is bonded.
- ◆ Ambidentate ligands may be attached through different atoms. Thus, M-NO₂ is called nitro and M-ONO is called nitrito. Similarly, M-SCN (thiocyanato) or M-NCS (Isothiocyanato). These may be named systematically, thiocyanato-S and thiocyanate -N respectively to indicate which atom is bonded to the metal. This convention may be extended to other cases where the mode of linkage is ambiguous.
- ◆ If any lattice component such as water or solvent of crystallization are present, these follow their name, and are preceded by the number of these groups in Arabic numerical. These rules are illustrated by the following examples.

(a) Complex cations**IUPAC name**

$[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$	Hexaamminecobalt(III) chloride
$[\text{CoCl}(\text{NH}_3)_5]^{2+}$	Pentaamminechloridocobalt(III) ion
$[\text{CoSO}_4(\text{NH}_3)_4]\text{NO}_3$	Tetraamminesulphatocobalt (III) nitrate
$[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$	Triamminetrinitrito-N-cobalt(III)
$[\text{CoCl.CN.NO}_2.(\text{NH}_3)_3]$	Triamine-chloro-cyano-nitro-N-cobalt(III)
$[\text{Zn}(\text{NCS})_4]^{2+}$	Tetrathiocyannato-N-zinc(II) ion.
$[\text{Cd}(\text{SCN})_4]^{2+}$	Tetrathiocyanato-S-cadmium(II) ion.

(b) Complex anions

$\text{Li}[\text{AlH}_4]$	Lithium tetrahydridoaluminate (III)
$\text{Na}[\text{ZnCl}_4]$	Sodium tetrachloridozincate (II)
$\text{K}_4[\text{Fe}(\text{CN})_6]$	Potassium hexacyanidoferrate (II)
$\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$	Sodium pentacyanidonitrosyliumferrate (II)
$\text{K}_2[\text{OsCl}_5\text{N}]$	Potassium pentachloridonitridoosmate (VI)
$\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$	Sodium bis(thiosulphato)argentite (I)
$\text{K}_2[\text{Cr}(\text{CN})_2\text{O}_2(\text{O}_2)\text{NH}_3]$	Potassium amminedicyanidodioxidoperoxidochromate (VI)

(c) Organic groups

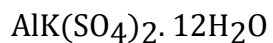
$[\text{Pt}(\text{py})_4]$ $[\text{PtCl}_4]$	tetrapyridineplatinum(II) tetrachloridoplatinate(II)
$[\text{Cr}(\text{en})_3]\text{Cl}_3$	d or ℓ Tris(ethylenediamine) chromium(III)chloride
$[\text{CuCl}_2(\text{CH}_3\text{NH}_2)_2]$	Dichloridodimethylaminecopper(II)
$\text{Fe}(\text{C}_5\text{H}_5)_2$	Bis(η^5 -cyclopentadienyl)iron(II)
$[\text{Cr}(\text{C}_6\text{H}_6)_2]$	Bis(η^6 -benzene)chromium(0)

(d) Bridging groups

$[(\text{NH}_3)_5\text{Co.NH}_2.\text{Co}(\text{NH}_3)_5](\text{NO}_3)_5$	μ -amidobis[pentaamminecobalt(III) nitrate]
$[(\text{CO})_3\text{Fe}(\text{CO})_3\text{Fe}(\text{CO})_3]$	Tri- μ -carbonyl-bis [tricarbonyl iron(0)]
$[\text{Be}_4\text{O}(\text{CH}_3\text{COO})_6]$	Hexa- μ -acetato(O,O')- μ_4 - oxidotetraberyllium(II)

(basic beryllium acetate)

(e) **Hydrates**



Aluminum potassium sulphate 12-water

Writing the formula of a coordination compound:

When writing the formula of complexes, the complex ion should be enclosed by square brackets. The metal is named first, then the coordinated groups are listed in the order : negative ligands, neutral ligands, positive ligands (and alphabetically according to the first symbol within each group).

