Nomenclature of Coordination compounds

International Union of pure and applied chemistry (IUPAC) provides rules for nomenclature of coordination compounds.

The basic rules are summarized here.

1- The positive ion is named first followed by negative ion.

2- When writing the name of a complex the ligands are quoted in alphabetical order, regardless of their change (followed by metal).

3- When writing the formula of complexes, ligands are named before the metal.

The coordinated groups are listed in the order:

(a) Negative ligand → neutral ligand → positive ligand.

(Alphabetical order should follow in each group)

The name of negative ligand end in -o, for ex.

F^- - fluoro

H^- - Hydrido

HS^- - mercapto

Cl^- - Chloro

OH^- - Hydroxo

(b) Neutral groups have no special endings

e.g.

NH_3	–	amine
H_2O	–	aqua
CO	–	carbonyl
NO	–	nitrosyl
N_2	–	dinitrogen
O_2	–	dioxygen

The organic ligands are usually given their common names, e.g. phenyl, methyl, ethylene-diamine, pyridine, triphenylphosphine.

(c) Positive groups end in -ium,

e.g. NH_2-NH_2 – hydrazinium

4- Prefix di, tri, tetra, penta and hexa show the number of ligands of same type.

An exception occurs when the name of the ligand include a number, e.g. dipyridyl or ethylenediamine To avoid confusion in such cases, bis, tris and tetrakis are used instead of di, tri, tetra and the name of ligand is placed in a brackets.

5- The oxidation state of the central metal is shown by a Roman numeral in brackets immediatly following its name.

6- Complex positive ions and neutral molecules have no special ending but complex negative ions end in -ate.

7- For bimetallic or multimetallic complexes, the bridging ligands which link the two metal atoms together are indicated by prefix μ-
If there are two or more bridging groups of same kind, this is indicated by di-μ, tri-μ etc. Bridging groups are listed alphabetically with the other groups.
If 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 is bonded to.

8- The ambidentate ligands are named based on their bonding atoms. e.g.

M - NO_2	-	nitro
M - ONO	-	nitrito
M - SCN	-	thiocyanato
M - NCS	-	isothiocyanato

9- If any lattice components such as water or solvent of crystallisation are present, these follow the name, and are preceeded by the number of these groups in Arabic numerals.

Examples:

(i) Complex cation:

$[Co(NH_3)_6]Cl_3$: Hexaamine cobalt (III) chloride

$[Co(SO_4)(NH_3)_4]NO_3$: Tetraaminesulphato cobalt (III) nitrate

(ii) Complex anion

$Na_2[ZnCl_4]$: Sodiumtetrachlorozincate (II)

$K_4[Fe(CN)_6]$: Potassium hexacyanoferrate (II)

(iii) Organic groups

$[Pt(Py)_4][PtCl_4]$: Tetrapyridine platinum (II). tetrachloroplatinate (II)

$[Cr(C_6H_6)_2]$: Bis (benzene) chromium (0)

(iv) Bridging groups

$[(NH_3)_5Co.NH_2.Co(NH_3)_5](NO_3)_5$:

μ - amido bis [pentaamine cobalt (III)] nitrate

(v) Hydrates

$AlK(SO_4)_2.12H_2O$: Aluminiumpotassium sulphate 12-water

Problems for practice - I

1. Write the IUPAC name of the following metal complexes.

complex	IUPAC Name
$[Co\,Cl(NH_3)_5]^{2+}$	:
$[Co(NO_2)_3(NH_3)_3]$	:
$[CoCl(CN)(NO)(NH_3)_3]$	:
$[Zn(NCS)_4]^{2+}$	:
$Li[AlH_4]$	:
$Na_3[Ag(S_2O_3)_2]$ ↓ hint: thiosulphato	:
$[Be_4O(CH_3COO)_6]$ ↓ hint: acetato	:

Problems for Practice - II

1. Write the formula of the following coordination compounds using IUPAC names.

IUPAC Name	formula of coordination compound
Tetrathio cyanato-S-cadmium (II) :	
Potassium pentacyanonitrosyl ferrate(II):	
Potassium pentachloro nitrido osmate (VI):	
Dichlorobis (dimethyl amine) copper(II) :	
Bis (cyclopentadienyl) iron (II) :	
Bis (benzene) chromium (0) :	
Tri-μ-carbonyl-bis(tricarbonyl iron (0)):	

Suggested Readings:

1- Basic inorganic chemistry: F. A. Cotton, G. Wilkinson and Paul Gaus, 3rd edition (1995)

2- Concise inorganic chemistry, J. D. Lee, 5th edition (1996) Chapman & Hall, London.