Working examples :

1. Suppose we have a coordination complex where the cation is a simple sodium ion. The anion is a tetravalent platinum complex coordinated to one ammonia, one nitrite ion, one bromide ion and a chloride ion. While writing the formula sodium is represented by Na without any positive charge. Then starts the square bracket followed by the symbol of the central atom i.e. Pt. The anions now follow the alphabetial order Br, Cl, NO_2 again without any negative charge. Then comes the neutral ligand NH_3 followed by the square bracket. Thus we arrive at $Na[PtBrCl(NO_2)(NH_3)]$.

2. We have a neutral complex of bivalent platinum having two chloride, one ammonia and one pyridine as coordinated ligands. So we first start with a square bracket. Then we put the symbol Pt for platinum. There is only one type of anionic ligand namely chloride, so that we have to write Cl_2. Of the two neutral ligands, C_5H_5N will precede NH_3. So the formula is : $[PtCl_2(C_5H_5N)(NH_3)]$.

3. Let us consider a complex where the molecular formula has two monopositive sodium ions (as counter ions) alongwith a complex anion having iron as the central atom and one NO and five CN^- groups as ligands. We start with Na_2 as the counter ion followed by a square bracket. Inside the bracket we first write Fe. NO is a neutral ligand and hence the five CN^- will precede NO. So the formula is : $Na_2[Fe(CN)_5NO]$.

10.6.2. Writing the name of mononuclear coordination complexes :

Sequence of ligand names and central atom : Interestingly naming a coordination complex does not follow the sequence used in writing its formula. For instance, while a formula starts with the central atom symbol, this atom symbol appears last in the naming. Ligands are named in alphabetical order irrespective of charge.

Number of ligands within coordination zone : The simple prefixes di–, tri–, tetra–, penta–, hexa– are generally used to indicate two, three, four, five, six ligands of each kind. For complicated polysyllabic ligands the corresponding prefixes are bis–, tris–, tetrakis–, pentakis–, hexakis-. For two coordinated ammonia group we should write diammine but for two methylamine groups bis(methylamine). Parentheses are not used for simpler prefixes di–, tri–, etc. but for bis–, tris–, etc. parentheses are binding.

Naming of ligands : Anionic ligands are named with an ending –o after the atom name of the anion : F^- (fluoro), Cl^- (chloro), NO_2^- (nitrito) etc. In general if the anion name ends in –ide, –ite, or –ate the final *e* is replaced by –o giving –ido–, –ito, and –ato respectively. Parentheses are used for inorganic anionic ligands containing numerical prefixes, such as (triphosphato), and for thio–, seleno-analogues of oxoanions containing more than one oxygen atom (eg. (thiosulphato–)).

Neutral and cationic ligand names are used without modification and except for aqua (H_2O), ammine (NH_3), carbonyl (CO) and nitrosyl (NO) are placed within parentheses. Given below are ligand names of neutral molecules and anions.

Formula	Usual name	Ligand name
F^-	fluoride	fluoro
Cl^-	chloride	chloro
Br^-	bromide	bromo

Formula	Usual name	Ligand name
I^-	iodide	iodo
H^-	hydride	hydrido (in general cases) hydro (for boron compounds)
O^{2-}	oxide	oxido/oxo
OH^-	hydroxide	hydroxo/hydroxido
N_3^-	azide	azido
CN^-	cyanide	cyano
NCS^-	thiocyanate	thiocyanato–*N* thiocyanato–*S*
CH_3COO^-	acetate	acetato
NO_2^-	nitrite	nitrito–*O* nitrito–*N* (nitro)
NO	nitrogen monoxide	nitrosyl
NH_3	ammonia	ammine
H_2O	water	aqua
N^{3-}	nitride	nitrido
CO	carbon monoxide	carbonyl

Naming ambident (ambidentate) ligands : For such ligands the donor atom has to be specified with italics after its name. For example, a thiocyanate ion coordinated through sulphur is written as thiocyanato–*S*. A nitrogen bonded thiocyanate is thiocyanate–*N*. The coordinated nitro group may be nitrito–*N* or nitrito–*O*. A Greek kappaκ may also be used before the donor atom : thiocyanato–κ*S* etc.

Endings for names of coordination entities : Anionic coordination entities end in —ate after the stem name of the central metal atom being followed by the oxidation number in roman numeral in parenthesis. Thus anionic complexes of trivalent cobalt, bivalent iron, bivalent palladium, pentavalent chromium are designated cobaltate (III), ferrate (II), palladate (II), chromate(V), respectively. Neutral or cationic complexes simply end in the name of the central atom with the oxidation number in parentheses.

Oxidation number, charge number and ionic proportion :

Oxidation number of the central atom is indicated by a roman numerical in parentheses after its name. No positive sign is used but a negative sign may be used before the number if necessary. Arabic zero is used for zero oxidation number. Alternatively the net charge on the complex may be written in arabic number with appropriate + or – sign after the number, all in parentheses.

Ionic proportions of the coordination entities may be shown by using stoichiometric prefixes on the both the ions.

Working examples :

1. Let us name the complex $Na[PtBrCl(NO_2)(NH_3)]$

here sodium is the counter ion and platinum(II) is the central atom of the anionic plex. So naming has to start with sodium and end in platinate(II) or platinate(1–). Unlike formula, the ligands are to be named in alphabetical order irrespective of their charge and we have ammine, bromo, chloro and nitrito. Assuming nitrito coordination occurs through N we have to use nitrito–*N* or nitrito–κ*N*. Thus we have :

sodium amminebromochloronitrito–*N*–platinate(II)

sodium amminebromochloronitrito–*N*–platinate(1–)

2. Take the case of the complex $[Pt(Cl_2(C_5H_5N)(NH_3)]$

This is a neutral complex of platinum with oxidation number +2.

The alphabetical order of the ligands is ammine, chloro, pyridine. So we have :

amminedichloro(pyridine)platinum(II)

amminedichloro(pyridine)platinum(0)

3. Now let us attempt naming the complex $Na_2[Fe(CN)_5NO]$

Sodium is the counter ion while the central atom iron is in the anion so that the complex ion is to be written a coordinated ferrate. The order of the ligands will be cyanide and the nitrosyl. If the overall charge of anion is considered then the name is :

sodium pantacyanonitrosylferrate(2–)

If we wish to specify the oxidation state of iron we have :

sodium pentacyanonitrosylferrate(II) (assuming NO^+)

10.6.3. Writing the formulae and names of polynuclear complexes with ligand bridges or metal-metal bonds :

Complexes with ligand bridges : In general the rules developed above for mononuclear complexes apply here too. Bridging ligands are indicated by the Greek letter (mu)μ appearing before the ligand formula and separated by hyphen. If the bridging ligand appears more than once multiplicative prefixes are employed. The bridging index, the number of coordination centres connected by a bridging ligand, is indicated by a right subscript, μ_n, where n > 2. Bridging ligands are normally placed last in the formula. A bridging ligand is cited before a corresponding non-bridging ligand eg : di–μ-chlorotetrachloro...Multiple bridging is listed in descending order of complexity eg : μ_3-oxodi-μ-oxo-trioxo... Central atoms are listed in alphabetical order after the ligands. Two or more central atoms of one kind are shown by a numerical prefix. For polynuclear anionic species the suffix-ate and the number indicating the charge on the ion are added after the central atom.

Examples :

$[\{Cr(NH_3)_5\}_2\ (\mu\text{-}OH)]\ Cl_5$	...μ-hydroxo-bis (pentamminechromium) (5+) pentachloride
$[\{Fe(NO)_2\}_2\ \{\mu\text{-}P(C_6H_5)_2\}_2]$	...bis(μ-diphenylphosphido) bis (dinitrosyliron)
$[\{Cr(C_2O_4)_2\}_2\ (\mu\text{—}OH)_2]^{4-}$	...di-μ-hydroxo-bis(bis(oxalato) chromate(III)
$[\{Co(NH_3)_3\}_2\ (\mu\text{-}OH)_2\ (\mu\text{-}NO_2)]\ Br_3$	di-μ-hydroxo-μ-nitrito-κ*N*-κ*O*-bis(triammine)cobalt(III) bromide

$(C_2O_4^{2-}, O^{2-})$ cobaltate(III)

10.6.5. Illustrations : Given below is a long list of examples of chemical formulae of coordination complexes alongwith their naming as per recommendations (1990) of IUPAC.

1. $[Co(NO_2)_3(NH_3)_3]$
triamminetrinitrito-κ *N*-cobalt(III)
2. $[Co(N_3)(NH_3)_5]SO_4$
pentaammineazidocobalt(III) sulphate
3. $[Co(ONO)(NH_3)_5]SO_4$
pentaamminenirito-κ*O*-cobalt(III) sulphate
4. $[Co(NH_3)_6][Cr(CN)_6]$
hexaamminecobalt(III) hexacyanochromate(III)
5. $[CoCl(NH_3)_5]^{2+}$
pentaamminechlorocobalt(III) ion
6. $[Co(NH_3)_6]ClSO_4$
hexaamminecobalt(III) chloride sulphate
7. $[CoCl(NO)_2(NH_3)_4]Cl$
tetraamminechloronitrito-κ *N*-cobalt(III) chloride
8. $[Co(H_2O)_2(NH_3)_4]Cl_3$
tetraamminediaquacobalt(III) chloride
9. $[Co(en)_2(bpy)]^{3+}$
bipyridinebis(ethylenediamine)cobalt(III) ion
bipyridinebis(ethylenediamine)cobalt(3+)

10. $Na[Co(CO)_4]$
    sodium tetracarbonylcobaltate(−1)
11. $[CoBr(NCS)(en)_2]^+$
    bromobis(ethylenediamine)thiocyanato-κ*N*-cobalt(III)
    bromobis(ethylenediamine)thiocyanato-κ*N*-cobalt(1+)
12. $[CoCl(NO_2)(en)_2]^+$
    chlorobis(ethylenediamine)nitrito-κ*N*-cobalt(III)
13. $[Co(SO_4)(NH_3)_5]$ $[Zn(OH)_4]$
    pentaamminesulphatocobalt(III) tetrahydroxozincate(II)
14. $[CoCl_2(en)_2]NO_3$
    dichlorobis(ethylenediammine)cobalt(III) nitrate
15. $[Co(CO_3)(NH_3)_4]_3$ $[Fe(CN)_6]$
    tetraamminecarbonatocobalt(III) hexacyanoferrate(III)
16. $[Cr(NCS)_4(NH_3)_2]^-$
    diamminetetrathiocyanato-κ*N*-chromate(1−)
    diamminetetrathiocyanato-κ*N*-chromate(III)
17. $K[CrF_4O]$
    potassium tetrafluorooxochromate(V)
18. NH_4 $[Cr(NCS)_4(NH_3)_2]$
    ammonium diamminetetrathiocyanato-κ*N*-chromate(III)
19. $[Cr(C_2O_4)(en)_2][Cr(C_2O_4)_2(H_2O)_2]$
    bis(ethylenediamine) (oxalato)(chromium)(III) diaquabis(oxalato) chromate(III)
20. $[CuCl_2(CH_3NH_2)_2]$
    dichlorobis(methylamine)copper(II)
21. $[Cu(NH_3)_4]$ $[CuCl_4]$
    tetraamminecopper(II) tetrachlorocuprate(II)
22. $[Fe(H_2O)_6]^{3+}$
    hexaaquairon(III) / hexaaquairon(3+)
23. $[Fe(CO)_4]^{2-}$
    tetracarbonylferrate(II)/tetracarbonylferrate(2−)
24. $K_4[Fe(CN)_6]$
    tetrapotassium hexacyanoferrate(II)
    potassuim hexacyanoferrate(II)
    potassium hexacyanoferrate (4−)
25. $[Fe(CO)_5]$
    pentacarbonyliron(0)
26. $H_4[Fe(CN)_6]$
    tetrahydrogen hexacyanoferrate(II)

27. $[Ru(NH_3)_5(N_2)]Cl_2$
pentaammine(dinitrogen)ruthenium(II) chloride
28. $K_4[Ni(CN)_4]$
potassium tetracyanonickelate(0)
29. $K_2[NiF_6]$
potassium hexafluoronickelate(IV)
30. $[Ni(PCl_3)_4]$
tetrakis(trichlorophosphine)nickel(0)
31. $Li[AlH_4]$
lithium tetrahydridoaluminate(III)
32. $[BCl_2H_2]^-$
dichlorodihydroborate(1–)
33. $H[B(C_6H_5)_4]$
hydrogen tetraphenylborate(1–)
34. $Na[B(NO_3)_4]$
sodium tetranitratoborate(1–) / sodium tetranitratoborate(III)
35. $Ba[BrF_4]_2$
barium tetrafluorobromate(III) / barium tetrafluorobromate(1–)
36. $[PF_6]^-$
hexafluorophosphate (1–) / hexafluorophosphate(V)
37. $K[PtCl_3(C_2H_4)]$
potassium trichloro(ethylene)platinate(II)
38. $[PtCl_3(C_2H_4)]^-$
trichloro(ethylene)platinate(II) ion
trichloro(ethylene)platinate(1–)
39. $[PtCl(NH_2CH_3)(NH_3)_2]Cl$
diamminechloro(methylamine)platinum(II) chloride
40. $K_2[Pt(NO_2)_4]$
potassium tetranitrito-κ*N*-platinate(2–)
41. $[HF_2]^-$
difluorohydrogenate(1–)
42. $K_2[OsCl_5N]$
potassium pentachloronitridoosmate(2–)
43. $[WF_5N(CH_3)_2]$
pentafluoro(dimethylamido)tungsten(VI)
44. $[GeF_4\{N(CH_3)_3\}]$
tetrafluoro(trimethylamine)germanium(IV)
45. $[Hg(C_6H_5)(CHCl_2)]$
(dichloromethyl)(phenyl)mercury(II)

46. $[U(C_3H_7O_2)_2O_2]$
    bis(acetylacetonato)dioxouranium(VI)
47. $[V(C_3H_7O_2)_2O(C_5H_5N)]$ / $[VO.(C_3H_7O_2)_2(C_5H_5N)]$
    bis(acetylacetonato)oxo(pyridine)vanadium(IV)
    bis(acetylaetonato)(pyridine)oxovanadium(IV)
48. $(NH_4)_2[V(C_2O_4)_2O]$ / $(NH_4)_2[VO(C_2O_4)_2]$
    ammonium bis(oxalato)oxovanadate(IV)
49. $[ReCl(CO)_3(py)_2]$
    tricarbonylchlorobis(pyridine)rhenium(I)
50. $[Re(CO)_3(py)_2]$
    tricarbonylbis(pyridine)rhenium(0)
51. $Na_3[Ag(S_2O_3)_2]$
    sodium bis(thiosulphato)argentate(I)
    sodium bis(thiosulphato)argentate(3–)
52. $[Au(C_2H_5)_2(en)]Br$
    diethyl(ethylenediamine)gold(III) bromide
53. $K[Os(N)O_3]$
    potassium nitridotrioxoosmate(1–)
    potassuim nitridotrioxoosmate(VIII)
54. μ-amido-μ-hydroxobis(tetramminecobalt(III)) chloride.