

Coordination Chemistry: Naming

Syllabus Learning Outcomes : 4

Complex is a metal atom or ion with attached groups called **ligands**.

Coordination sphere is the area of the central atom and ligands.

Coordination number is the number of points where ligands attach.

Complex ion is a complex that carries a charge.

Coordination compound is substance with one or more complexes.

Ligands form coordinate covalent bonds

- Transition metals have empty d-orbitals that can accept electron pairs.
- Ligands have electron pairs to donate.

Ligand type	Electron pairs donated
monodentate	1
bidentate	2
polydentate	more than 1
chelate	5 or 6

Ligands with attachment point in red

Neutral Ligands

NH ₃	ammine
H ₂ O	aqua
CO	carbonyl
CH ₃ NH ₂	methylamine

Anionic ligands

F ⁻	fluoro
Cl ⁻	chloro
Br ⁻	bromo
I ⁻	iodo
OH ⁻	hydroxo
CN ⁻	cyano
OSO ₃ ²⁻	sulfato

Some Polydentate Ligands

Name	Symbol	Formula
ethylenediamine	en	NH ₂ CH ₂ CH ₂ NH ₂
oxalato	ox	OOCCOO ²⁻
ethylenediaminetetraaceto	EDTA	(OOCCH ₂) ₂ NCH ₂ CH ₂ N(CH ₂ COO) ₂ ⁴⁻

Name coordination complexes and complex ions from formulas

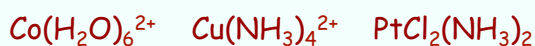
1. Name, as a single word, ligands in alphabetical order by name (ignoring Greek prefixes) then the central metal atom (or ion) of a complex.
2. Indicate the number of each ligand in a complex with a Greek prefix (di=2, tri=3, tetra=4, penta=5, hexa=6). If the ligand name has a Greek prefix, place parentheses around that name and prefix it with (bis=2, tris=3, tetrakis=4, pentakis=5, hexakis=6).

Name coordination complexes and complex ions from formulas

- Name **complex cations** with the name of the central metal. Name **complex anions** by adding the -ate to the end of the central metal (some metal **anions** have Latin-based names: cuprate=Cu, ferrate=Fe, aurate=Au, argentate=Ag, plumbate=Pb, stannate=Sn.). Always put a **Roman numeral** in parenthesis after the name of the metal to show its oxidation number.
- For coordination compounds, name the cation then the anion.

Write formulas from names of coordination complexes and complex ions

- For complex ions, write cation first, then ligands in alphabetical order by the symbols in the formula.
- Always enclose polyatomic ligands in parentheses
- For coordination compounds, write the cation then the anion with the complex in square brackets. For complex ions, indicate the charge outside square brackets.



Complex ion	Complex ion	Coordination compound
Hexaaquacobalt(II) ion	tetraamminecopper(II) ion	diamminedichloroplatinum(II)
C.N. 6	4	4
Ox# +2	+2	+2
Qcplx +2	+2	0
C. S. all	all	all
C. I. none	none	none



- Name: hexamine nickel(II) ion
- Coordination number: 6
- Metal oxidation number: +2
- Charge on complex: +2
- Coordination sphere: all
- Counter-ion to make coordination compound: Cl^- or any anion



- Name dichlorobis(ethylenediamine)cobalt(III) chloride
- Coordination number: 6, en bidentate
- Metal oxidation number: +3
- Charge on complex, +1
- Coordination sphere, all
- Counter-ion to make coordination compound: Cl^- or any anion

Potassium amminetrichloroplatinate(II)

- Formula: $\text{K}[\text{PtCl}_3(\text{NH}_3)]$
- Coordination number: 4
- Metal oxidation number: +2
- Charge on complex: -1
- Coordination sphere: all but K^+
- Counter-ion to make coordination compound: K^+ or any cation