

**Task:**

please tell me the rules of nomenclature of co-ordination compound with example??

**Answer:**

A **complex** is a substance in which a metal atom or ion is associated with a group of neutral molecules or anions called **ligands**. **Coordination compounds** are neutral substances (i.e. uncharged) in which **at least** one ion is present as a complex.

The coordination compounds are named in the following way.

**A.** To name a coordination compound, no matter whether the complex ion is the cation or the anion, **always name the cation before the anion**. (This is just like naming an ionic compound.)

**B.** In naming the complex ion:

1. **Name the ligands first, in alphabetical order, then the metal atom or ion.** **Note:** The **metal atom or ion** is written **before** the **ligands** in the **chemical formula**.

2. The names of some common ligands are listed in Table 1.

✎ For anionic ligands end in "-o"; for anions that end in "-ide" (e.g. chloride), "-ate" (e.g. sulfate, nitrate), and "-ite" (e.g. nitrite), change the endings as follows: -ide → -o; -ate → -ato; -ite → -ito

✎ For neutral ligands, the common name of the molecule is used e.g.  $H_2NCH_2CH_2NH_2$  (ethylenediamine). **Important exceptions:** water is called 'aqua', ammonia is called 'ammine', carbon monoxide is called 'carbonyl', and the  $N_2$  and  $O_2$  are called 'dinitrogen' and 'dioxygen'.

**Table 1. Names of Some Common Ligands**

Anionic Ligands	Names		Neutral Ligands	Names
$Br^-$	bromo		$NH_3$	ammine
$F^-$	fluoro		$H_2O$	aqua
$O^{2-}$	oxo		$NO$	Nitrosyl
$OH^-$	Hydroxo		$CO$	Carbonyl
$CN^-$	cyano		$O_2$	dioxygen
$C_2O_4^{2-}$	oxalato		$N_2$	dinitrogen
$CO_3^{2-}$	carbonato		$C_5H_5N$	pyridine
$CH_3COO^-$	acetato		$H_2NCH_2CH_2NH_2$	ethylenediamine

3. Greek prefixes are used to designate the number of each type of ligand in the complex ion, e.g. di-, tri- and tetra-. If the ligand already contains a Greek prefix (e.g. ethylenedi**am**ine) or if it is polydentate ligands (ie. can attach at more than one binding site) the prefixes bis-, tris-, tetrakis-, pentakis-, are used instead. The numerical prefixes are listed in Table 2.

**Table 2. Numerical Prefixes**

Number	Prefix	Number	Prefix	Number	Prefix
1	mono	5	penta (pentakis)	9	nona (ennea)
2	di (bis)	6	hexa (hexakis)	10	deca
3	tri (tris)	7	hepta	11	undeca
4	tetra (tetrakis)	8	octa	12	dodeca

4. After naming the ligands, name the central metal. If the complex ion is a cation, the metal is named same as the element. For example, Co in a complex cation is call cobalt and Pt is called platinum. If the complex ion is an anion, the name of the metal ends with the suffix –ate. For example, Co in a complex anion is called cobaltate and Pt is called platinatate. For some metals, the Latin names are used in the complex anions e.g. Fe is called ferrate (not ironate).

**Table 3: Name of Metals in Anionic Complexes**

Name of Metal	Name in an Anionic Complex
Iron	Ferrate
Copper	Cuprate
Lead	Plumbate
Silver	Argenate
Gold	Aurate
Tin	Stannate

5. Following the name of the metal, the oxidation state of the metal in the complex is given as a Roman numeral in parentheses.

C. To name a neutral complex molecule, follow the rules of naming a complex cation.  
**Remember:** Name the (possibly complex) cation **BEFORE** the (possibly complex) anion.

For historic reasons, some coordination compounds are called by their common names. For example,  $\text{Fe}(\text{CN})_6^{3-}$  and  $\text{Fe}(\text{CN})_6^{4-}$  are named ferricyanide and ferrocyanide respectively, and  $\text{Fe}(\text{CO})_5$  is called iron carbonyl.

**Examples** 1.  $[\text{Cr}(\text{NH}_3)_3(\text{H}_2\text{O})_3]\text{Cl}_3$

**Name:** *triamminetriaquachromium(III) chloride*

**Solution:** *The complex ion is inside the parentheses, which is a cation.*

*The ammine ligands are named before the aqua ligands according to alphabetical order.*

*Since there are three chlorides binding with the complex ion, the charge on the complex ion must be +3 (since the compound is electrically neutral).*

*From the charge on the complex ion and the charge on the ligands, we can calculate the oxidation number of the metal. In this example, all the ligands are neutral molecules. Therefore, the oxidation number of chromium must be same as the charge of the complex ion, +3.*

2.  $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Br}_3$

**Name:** *pentaamminechloroplatinum(IV) bromide*

**Solution:** *The complex ion is a cation, the counter anion is the 3 bromides.*

*The charge of the complex ion must be +3 since it bonds with 3 bromides.*

*The  $\text{NH}_3$  are neutral molecules while the chloride carries - 1 charge. Therefore, the oxidation number of platinum must be +4.*

3.  $[\text{Pt}(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)_2\text{Cl}_2]\text{Cl}_2$

**Name:** *dichlorobis(ethylenediamine)platinum(IV) chloride*

**Solution:** *ethylenediamine is a bidentate ligand, the bis- prefix is used instead of di-*

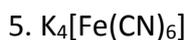
4.  $[\text{Co}(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)_3]_2(\text{SO}_4)_3$

**Name:** *tris(ethylenediamine)cobalt(III) sulfate*

**Solution:** *The sulfate is the counter anion in this molecule. Since it takes 3 sulfates to bond with two complex cations, the charge on each complex cation must be +3.*

*Since ethylenediamine is a neutral molecule, the oxidation number of cobalt in the complex ion must be +3.*

*Again, remember that you never have to indicate the number of cations and anions in the name of an ionic compound.*



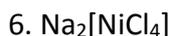
**Name:** *potassium hexacyanoferrate(II)*

**Solution:** *potassium is the cation and the complex ion is the anion.*

*Since there are 4  $K^+$  binding with a complex ion, the charge on the complex ion must be - 4.*

*Since each ligand carries -1 charge, the oxidation number of Fe must be +2.*

*The common name of this compound is potassium ferrocyanide.*



**Name:** *sodium tetrachloronickelate(II)*

**Solution:** *The complex ion is the anion so we have to add the suffix -ate in the name of the metal.*



**Name:** *diamminetetrachloroplatinum(IV)*

**Solution:** *This is a neutral molecule because the charge on  $Pt^{+4}$  equals the negative charges on the four chloro ligands.*

*If the compound is  $[Pt(NH_3)_2Cl_2]Cl_2$ , eventhough the number of ions and atoms in the molecule are identical to the example, it should be named: diamminedichloroplatinum(II) chloride, a big difference.*