

CHEMISTRY STUDY MATERIALS FOR CLASS 12 (NCERT BASED REVISION NOTES)

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Coordination Compounds

Difference between coordination compound and double bond:

Coordination compound	Double salt
A coordination compound contains a central metal atom or ion surrounded by number of oppositely charged ions or neutral molecules. These ions or molecules re bonded to the metal atom or ion by a coordinate bond. Example: $K_4[Fe(CN)_6]$	When two salts in stoichiometric ratio are crystallized together from their saturated solution they are called double salts Example: $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ (Mohr's salt)
They do not dissociate into simple ions when dissolved in water.	They dissociate into simple ions when dissolved in water.

- 1. Coordination entity:** A coordination entity constitutes a central metal atom or ion bonded to a fixed number of ions or molecules. Example: in $K_4[Fe(CN)_6]$, $[Fe(CN)_6]^{4-}$ represents coordination entity.
- 2. Central atom or ion:** In a coordination entity, the atom/ion to which a fixed number of ions/groups are bound in a definite geometrical arrangement around it, is called the central atom or ion. E.g.: in $K_4[Fe(CN)_6]$, Fe^{2+} is the central metal ion.
- 3. Ligands:** A molecule, ion or group that is bonded to the metal atom or ion in a complex or coordination compound by a coordinate bond is called ligand. It may be neutral, positively or negatively charged.
Example: H_2O , CN^- , NO^+ etc.

- 4. Donor atom:** An atom of the ligand attached directly to the metal is called the donor atom. For example: in the complex $K_4[Fe(CN)_6]$, carbon is a donor atom.
- 5. Coordination number:** The coordination number (CN) of a metal ion in a complex can be defined as the number of ligand donor atoms to which the metal is directly bonded. For example: in the complex $K_4[Fe(CN)_6]$, the coordination number of Fe is 6.
- 6. Coordination sphere:** The central atom/ion and the ligands attached to it are enclosed in square bracket and is collectively termed as the coordination sphere. For example: in the complex $K_4[Fe(CN)_6]$, $[Fe(CN)_6]^{4-}$ is the coordination sphere.
- 7. Counter ions:** The ions present outside the coordination sphere are called counter ions. For example: in the complex $K_4[Fe(CN)_6]$, K^+ is the counter ion.
- 8. Coordination polyhedron:** The spatial arrangement of the ligand atoms which are directly attached to the central atom/ ion defines a coordination polyhedron about the central atom. The most common coordination polyhedra are octahedral, square planar and tetrahedral. For example: $[PtCl_4]^{2-}$ is square planar, $Ni(CO)_4$ is tetrahedral while $[Cu(NH_3)_6]^{3+}$ is octahedral.
- 9. Charge on the complex ion:** The charge on the complex ion is equal to the algebraic sum of the charges on all the ligands coordinated to the central metal ion.

- 10. Denticity:** The number of legating (linking) atoms present in ligand is called denticity.
- 11. Unidentate ligands:** The ligands whose only one donor atom is bonded to metal atom are called unidentate ligands. Example: H_2O , NH_3 , CO , CN^-
- 12. Didentate ligands:** The ligands which contain two donor atoms or ions through which they are bonded to the metal ion. For example: ethylene diamine ($\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$) has two nitrogen atoms,
- 13. Polydentate ligand:** When several donor atoms are present in a single ligand, the ligand is called polydentate ligand.
- Forexample: in $\text{N}(\text{CH}_2\text{CH}_2\text{NH}_2)_3$, the ligand is said to be polydentate.
- Ethylenediaminetetraacetate ion (EDTA^{4-}) is an important hexadentate ligand. It can bind through two nitrogen and four oxygen atoms to a central metal ion.
- 14. Chelate:** An inorganic metal complex in which there is a close ring of atoms caused by attachment of a ligand to a metal atom at two points. An example is the complex ion formed between ethylene diamine and cupric ion, $[\text{Cu}(\text{NH}_2\text{CH}_2\text{NH}_2)_2]^{2+}$.
- 15. Ambidentate ligand:** Ligands which can legate (link) through two different atoms present in it are called Ambidentate ligand. Example: NO_2^- , and SCN^- . NO_2^- can link through N as well as O while SCN^- can link through S as well as N atom.
