

# 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  |
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| 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.<br>Example: $K_4[Fe(CN)_6]$ | When two salts in stoichiometric ratio are crystallized together from their saturated solution they are called double salts<br><br>Example: $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$<br>(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:  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{CO}$ ,  $\text{CN}^-$
- 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 ( $\text{EDTA}^{4-}$ ) 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:  $\text{NO}_2^-$ , and  $\text{SCN}^-$ .  $\text{NO}_2^-$  can link through N as well as O while  $\text{SCN}^-$  can link through S as well as N atom.

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