COORDINATION COMPOUND

• **Coordination compound:** Those addition compound which retain their identity i.e. doesn't lose their identity in solution are called co-ordination compounds.

E.g \rightarrow When KCN solution is added to Fe(CN)₂ solution, the species formed no longer give test of Fe²⁺ and CN⁻.Other example is [Cu(NH₃)₄]SO₄

 $K_4[Fe(CN)_6] \rightarrow 4K^+ + [Fe(CN)6]^{4-}$

<u>Addition compounds</u>: Compounds made up of two more stable compounds by crystallization in a fixed stoichiometry ratio is called as addition compounds.

 $1.kCl + MgCl_2 + 6H_2O \rightarrow KCl.MgCl_2.6H_2O$

 $2.CuSO_4 + 4NH_3 + H_2O \rightarrow CuSO_4.4NH_3.H_2O$

 $3.K_2SO_4 + Al_2(SO_4)_3 + 24H_2O \rightarrow K_2SO_4.Al_2(SO_4)_3.24H_2O$ (potash Alum)

Double salts: Those addition compounds which lose their identity in solutions are called double salts.

$E.g \rightarrow$

1. $K_2SO_4AI_2(SO_4)_324H_2O \rightarrow 2K^+ + 2AI^{3+} + 4SO_4^{2-} + 24H_2O$

2.FeSO₄(NH₄)₂SO₄.6H₂O (Mohr Salt)→Fe²⁺ +2NH⁴⁺ +2SO₄²⁻ +6H₂O

[CBSE2019]

Write the difference between double salt and co-ordination compound.

Werner's theory of Co-ordination compounds:

Experiment: Werner's co-ordination theory in 1893 was the first attempt to explain the bonding in co-ordination complexes. He prepared a series of complexes by combination of cobalt chloride(CoCl₃) and ammonia(NH₃), called werner's series. On adding excess of silver nitrate solution(in cold) a series of compounds were formed, some of the chloride ions could be precipitated as AgCl but some remained in solution.

Molecular Formula	colour	No. of cl- ions precipitated
1.CoCl ₃ .6NH ₃	Yellow	3
2. CoCl₃.5NH₃	Purple	2
3.CoCl ₃ .4NH ₃	Green	1
4.CoCl ₃ .3NH ₃	Violet	0
5.CoCl ₃ .5NH ₃ .H ₂ O	Red	5

NOTE:

CoCl3 + 6NH3 \rightarrow CoCl3.6NH3 + AgNO3(cold sol.) \rightarrow 3moles of AgCl ppt was formed

Werner's Theory: Werner was the first to formulate this idea about the structure of coordination compounds. The main postulates are-

i)In coordination compounds metals show two types of valency \rightarrow primary and secondary valency

ii)The primary valences are normally ionisable and satisfied by negative ions.

iii)The secondary valences are non-ionisable. These are satisfied by neutral molecules or negative ions.

iv)The ions/groups bound by secondary valency to metal have spatial arrangements corresponding to different co-ordination numbers.

NOTE: i) Primary valency corresponds to oxidation state of metal.

ii) Secondary valency corresponds to co-ordination no. of central metal.

Terminology related to co-ordination compounds:

i)<u>Co-ordination entity</u>: The central atom or ion and ligand attached to it are enclosed in square brackets are collectively known as Co-ordination sphere.

ii) <u>Ligand</u>: The donor atoms, ions or molecules which donate a pair of electrons to the central metal atom/ion are called ligands.

 $E.g \rightarrow [Fe(CN)_6]^{4-}$ here Fe is a central atom and CN^- is ligand



iii) <u>Co-ordination number</u>: It is the number of co-ordinates bonds formed between central metal atom and ligand.

iv)Denticity: The number of donor atoms present in a ligand is called denticity of a ligand.

Unidentate/monodentate ligand: Only one donor atom [Cl⁻, NH₃, H₂O etc.]