

Isomerism of Coordination Compounds

Definition: Compounds having the same molecular formula but different structures or spatial arrangements are called isomers and the phenomenon is referred as **isomerism**.

STRUCTURAL ISOMERISM:

(i) **Ionization isomerism** : Coordination compounds which have the same composition or molecular formula but gives different ions in solution are called ionization isomers. (exchange of anions between the coordination sphere and ionization sphere.)

Example: $[\text{Pt}(\text{NH}_3)_3\text{Br}]\text{NO}_2$ where (NO_2) anions are in solution
 $[\text{Pt}(\text{NH}_3)_3(\text{NO}_2)]\text{Br}$ where (Br) anions are in solution

(ii) **Coordination isomerism** : An interchange of ligands between complex cation and complex anion occurs.

Example: $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ and $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$

(iii) **Linkage isomerism** : Different types of connection of the ligand to the central metal ion.

Example: $[\text{Co}(\text{NH}_3)_5(\text{ONO})]\text{Cl}$ the nitrito isomer, connection via O
 $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}$ the nitro isomer, connection via N

(iv) **Hydrate isomerism** : Hydrate isomers are the type of isomers which have similar composition but differ in the presence of number of water molecules as ligands.

Example : $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$
 $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2 \cdot \text{H}_2\text{O}$
 $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$

STEREISOMERISM :

Stereoisomers differ only in the spatial arrangement of atoms of groups about the central metal atom. They are not "superimposable".

(i) **Optical isomerism or Enantiomerism:** Optical isomers are non-super imposable mirror images which differ in the rotation of direction upon exposure to the plane-polarised light. These isomers are called enantiomers.

(ii) **Diastereomers:**

Cis-trans isomerism : The isomerism which differs in the geometrical arrangement of the ligands around the central atom. Identical ligands occupy positions near to each other are described as cis - isomer and those identical ligands which occupy positions opposite to each other called trans - isomer.

fac-mer isomerism: If three identical ligands occupy the vertices of a octahedron's face, the isomer is called fac(ial) - isomer. If these three ligands form together with the central atom form a plane in the octahedron, the isomer is called mer(idional) - isomer.

TASKS :

- Give examples for four different types of structural isomers ?
- Explain optical isomerism with examples and In case of $[\text{CoCl}_2(\text{en})_2]^+$ why Trans form is optically inactive than cis form ?