

SUBJECT - CHEMISTRY

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TOPIC - ISOMERISM

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**Isomerism:** Compounds having the same molecular formula are called isomers. They differ in physical and chemical properties. So, isomers are different compounds that have the same molecular formula. This phenomenon is called isomerism. Like organic compounds, complex compounds also show isomerism. The isomerism exhibited by complexes are of following types -

1. Ionisation isomerism, 2 structural or linkage isomerism  
3 polymerisation isomerism 4 Hydrate isomerism 5. Co-ordination isomerism 6. Co-ordination position isomerism 7. Geometrical isomerism, 8 optical isomerism.

**1 Ionisation isomerism:** This arises due to the exchange of groups between the complex ion and ligands outside it e.g. penta-ammine bromo cobalt(III) sulphate,  $[Co(NH_3)_5Br]SO_4$  - dark-violet and penta ammine sulphato cobalt(III) bromide  $[Co(NH_3)_5SO_4]Br$  - red are ionisation isomers. Three different ionisation isomers with composition  $CrCl_3 \cdot 6H_2O$  are known.

(I)  $[Cr(H_2O)_6]Cl_3$  violet

Hexa aquochromium(III) chloride

(II)  $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$  - Bluish green

Penta aquomonochloro(III) chloride 1-water

(III)  $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$  - Green.

Tetra aquodichloro chromium(III) chloride 2-water

2. Structural isomerism: Some ligands may become attached to the central metal through different donor atoms resulting in isomeric complexes e.g. nitro-N penta ammine cobalt(III) chloride,  $[Co(NH_3)_5NO_2]Cl_2$  and nitro-O penta ammine cobalt(III) chloride,  $[Co(NH_3)_5ONO]Cl_2$  are structural isomers as they differ in the mode of attachment of ligand ( $NO_2$ ) to the metal.
3. polymerisation isomerism: When simple molecules unite together to form a large molecule, the process is called polymerisation. The simple and large molecules are called monomer and polymer respectively. The monomer and polymer have the same empirical formula. Complexes having the same empirical formula are called polymerisation isomer e.g.  $[Pt(NH_3)_2Cl_2]$  and  $[Pt(NH_3)_4][PtCl_4]$  are polymerisation isomeric complexes.
4. Hydrate isomerism: water is itself a good ligand. It is frequently co-ordinated to metal atom in complexes. Isomerism associated with water as a ligand is called hydrate isomerism e.g.  $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$  and  $[Cr(H_2O)_4Cl]Cl_2 \cdot 2H_2O$  are hydrate isomers.
5. Co-ordination isomerism: This type of isomerism is shown by such complexes in which both cationic and anionic part are complex ions. Isomerism associated with the inter-change of ligands between cationic and anionic parts of complexes is called co-ordination isomerism. e.g.  $[Co(en)_3]^{3+}$ ,  $[Cr(CN)_6]^{3-}$  &  $[Cr(en)_3]^{3+}$ ,  $[Co(CN)_6]^{3-}$ ,  $[Pt^{2+}(NH_3)_4][Pt^{4+}Cl_6]$  and  $[Pt^{4+}(NH_3)_4Cl_2][Pt^{2+}Cl_4]$  are such isomers.
6. Co-ordination - position isomerism: The exchange of ligands between different metal nuclei gives rise to co-ordination - position isomerism e.g.

