B.Sc.(H) Chemistry
Semester - IV
Core Course - VIII (CC-VIII)
Inorganic Chemistry - III

I. Coordination Chemistry

15. Isomerism in Coordination Compounds-II

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Coordination Chemistry: 20 Lectures

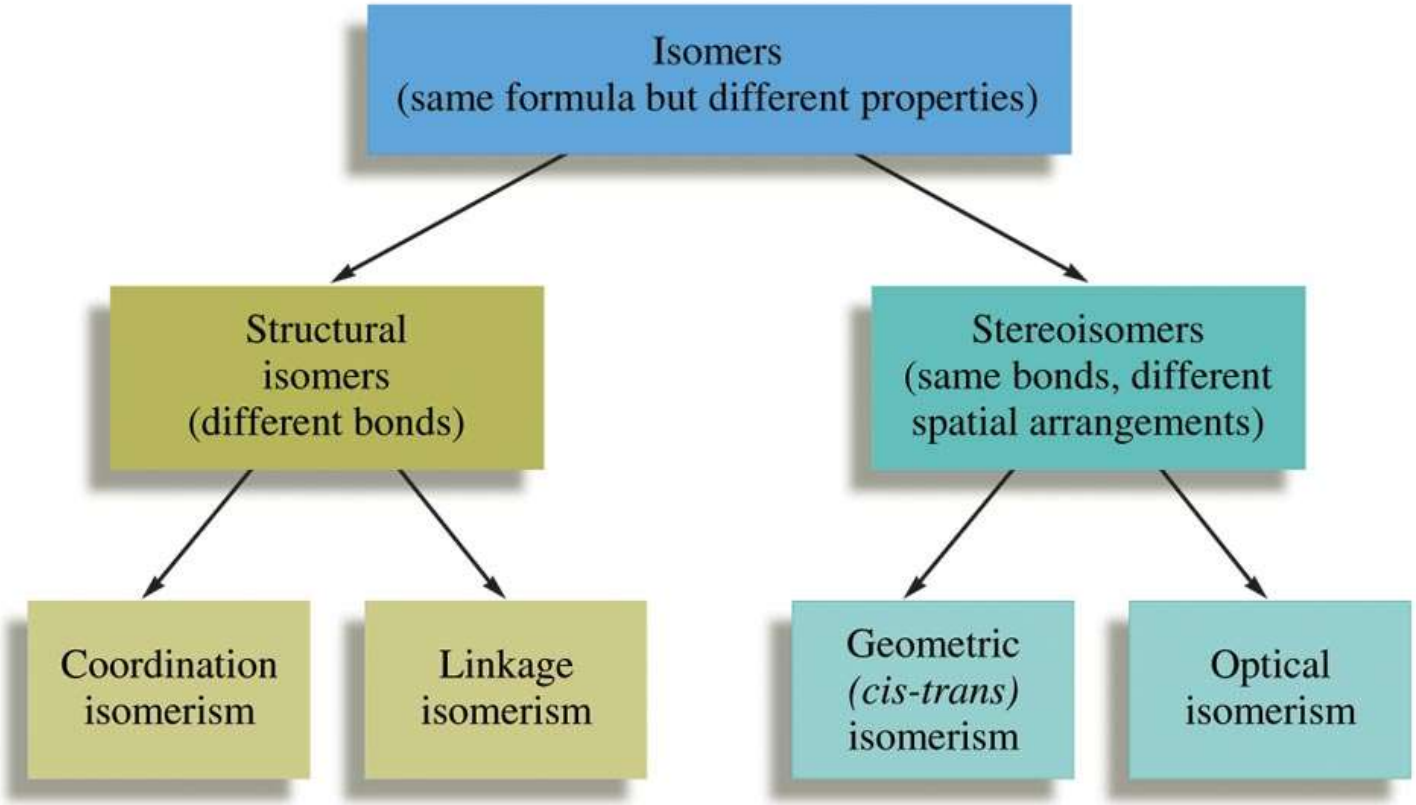
Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

Coverage:

1. Stereochemistry of Complexes With 4 and 6 Coordination Numbers
   (A) Geometrical Isomerism in Square Planar Compounds
   (B) Geometrical Isomerism in Octahedral Compounds
   (C) Optical Isomerism in Square Planar and Octahedral Compounds

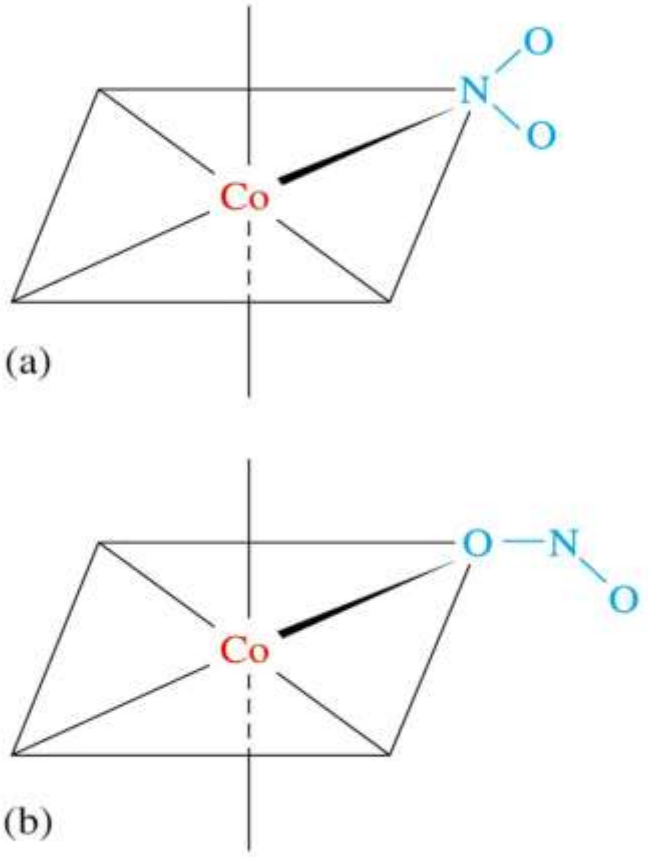
Some Classes of Isomers



Structural Isomerism

- **Coordination Isomerism:**
  - **Composition of the complex ion varies.**
  - **$[Cr(NH_3)_5SO_4]Br$ and $[Cr(NH_3)_5Br]SO_4$**
- **Linkage Isomerism:**
  - **Composition of the complex ion is the same, but the point of attachment of at least one of the ligands differs.**

Linkage Isomerism of NO_2^-



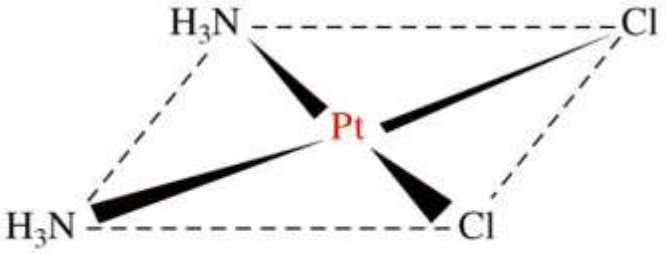
Stereoisomerism

- **Geometrical Isomerism (*cis-trans*):**
  - **Atoms or groups of atoms can assume different positions around a rigid ring or bond.**
  - ***Cis* – same side (next to each other)**
  - ***Trans* – opposite sides (across from each other)**

Geometrical (*cis-trans*) Isomerism for a Square Planar Compound

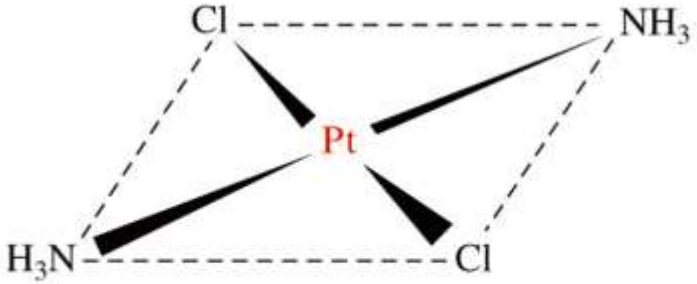
(a) *cis* - isomer
(b) *trans* - isomer

***Cis* - isomer**



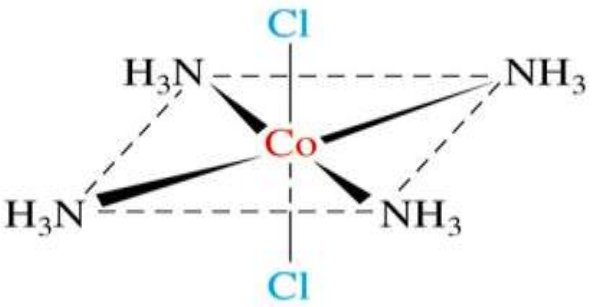
(a)

***Trans*- isomer**

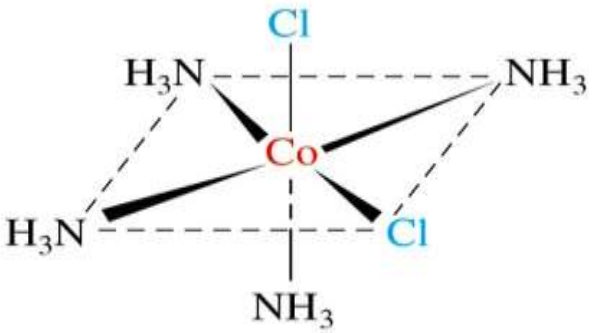


(b)

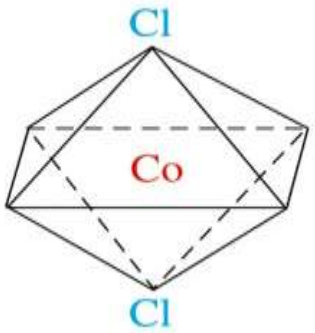
Geometrical (*cis-trans*) Isomerism for an Octahedral Complex Ion



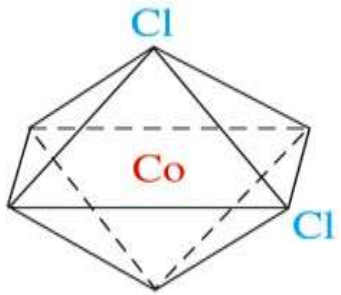
***trans* - isomer**



***cis* - isomer**



***trans* - isomer**

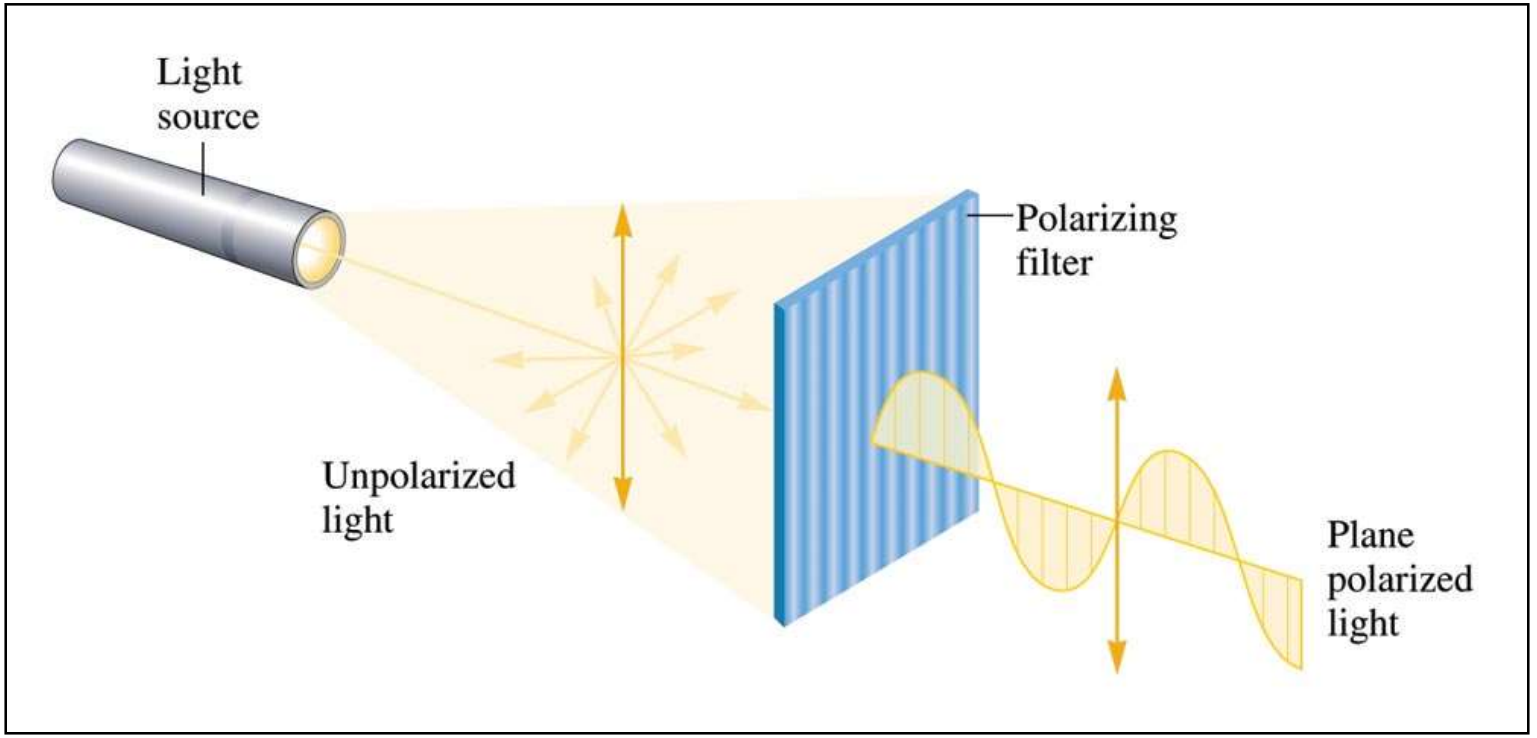


***cis* - isomer**

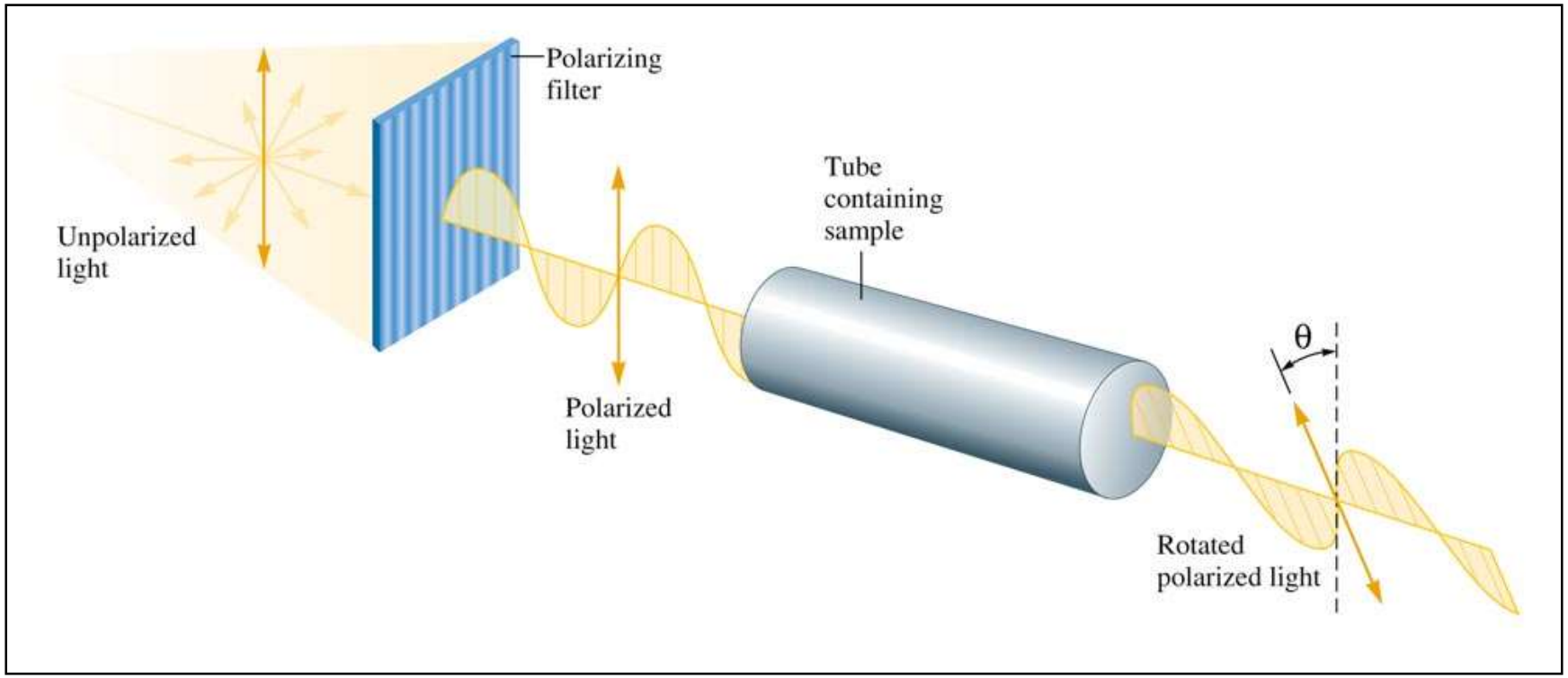
Stereoisomerism

- **Optical Isomerism:**
  - **Isomers have opposite effects on plane-polarized light.**

Unpolarized Light Consists of Waves Vibrating in Many Different Planes



The Rotation of the Plane of Polarized Light by an Optically Active Substance



- **Exhibited by molecules that have nonsuperimposable mirror images (chiral molecules).**
- **Enantiomers – isomers of nonsuperimposable mirror images.**

Chirality

- **Mirror images are nonsuperimposable.**
- **A molecule can be chiral if it has no rotation-reflection axes (S_n)**
- **Chiral molecules have no symmetry elements or only have an axes of proper rotation (C_n).**

  CBrClFI, Tetrahedral molecule (different ligands)

  Octahedral molecules with bidentate or higher chelating ligands

  Octahedral species with $[Ma_2b_2c_2]$, $[Mabc_2d_2]$, $[Mabcd_3]$, $[Mabcde_2]$, or [Mabcdef]

Questions

Qu. Does $[Co(en)_2Cl_2]Cl$ exhibit geometrical isomerism?

Ans. Yes

Qu. Does it exhibit optical isomerism?

Ans. ***Trans* form – No**

***Cis* form – Yes**

THANK YOU