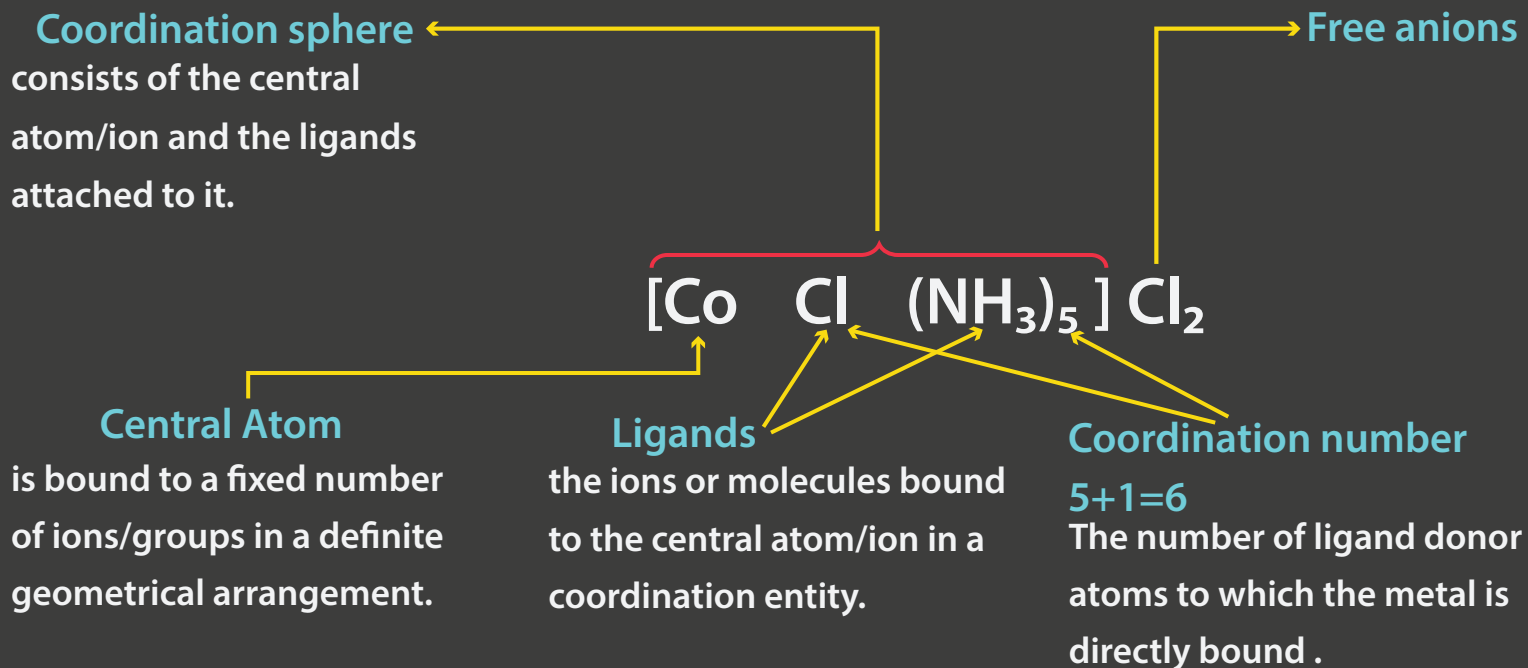


Coordination Compounds - Part I



IUPAC Nomenclature of Coordination

Name the Cation before the anion.

Name Ligands in the alphabetic order

Ligands have a numerical prefix

After ligands, Central metal atom/ion is named

Neutral ligands are given the same name as the uncoordinated molecule

The ligands are named alphabetically, ignoring the prefixes bis, tris, etc...

Anionic ligands are given names that end in the letter "o".

When the coordination entity is an anion, the name of the metal is altered to end in "ate"

Isomerism

Structural Isomerism

Stereoisomerism (space isomerism)

Ionization isomerism

Hydrate isomerism

Linkage isomerism

Coordination isomerism

Coordination position isomerism

Structural Isomerism

- **Coordination isomerism** observed in the coordination compounds having both cationic and anionic complex ions.



- **Ionization isomerism** afford different anions and cations in solution



- **Hydrate isomerism** arises when different number of water molecules are present inside and outside the coordination sphere.



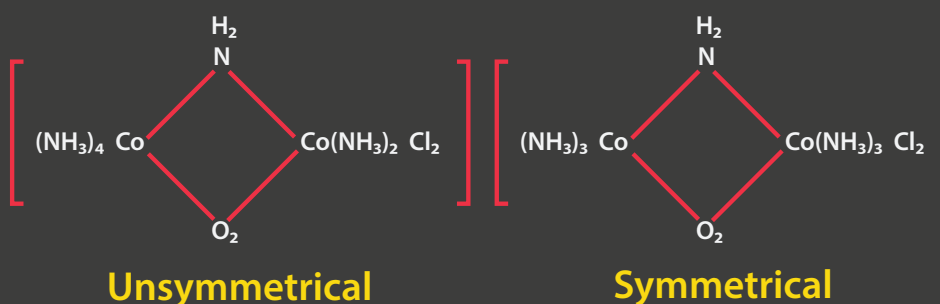
- **Linkage Isomerism** isomerism occurs in complex compounds which contain ambidentate ligands



- **Polymerisation Isomerism** it occurs between compounds having the same empirical formula, but different molecular weights.



- **Coordination position Isomerism** exhibited by polynuclear complexes by changing the position of ligands

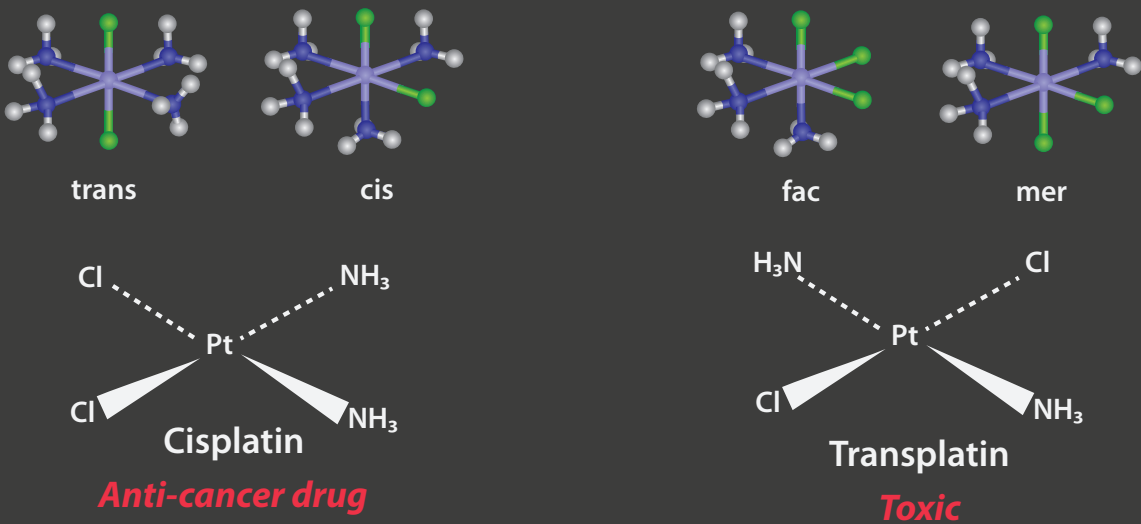


Coordination Compounds - Part III

Stereo Isomerism

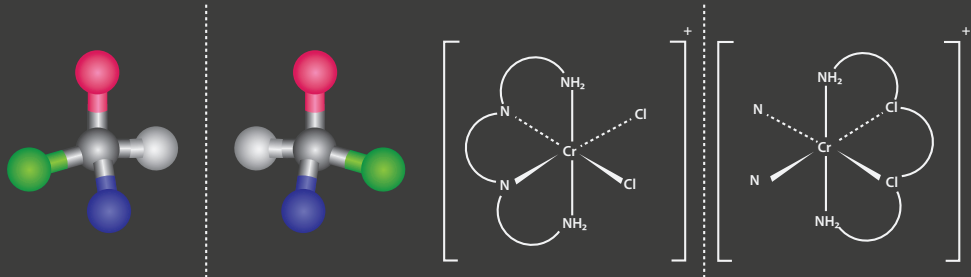
Geometric

Ligands at different locations relative to one another.



Optical

Nonsuperimposable mirror images of each other.



Werner's Theory

Basically explains the structure of the complex compounds

Postulates

- Metals consist of two types of valencies; Primary and Secondary
- Primary is fulfilled by anions which are non directional.
- Secondary are fulfilled by Ligands which are directional

Limitations

- Why Complex compounds are formed by few metals?
- Why Coordinate bonds are directional in nature?
- Why these compounds show magnetic and optical properties?

Valence Bond Theory

Explains Bonding in terms of Hybridisation and explains the magnetic behaviour of the hybridised bonds.

Postulates

- Central atom makes available vacant orbitals equal to its coordination number
- These vacant hybrid orbitals form bonds with ligands which are directional in nature

Limitations

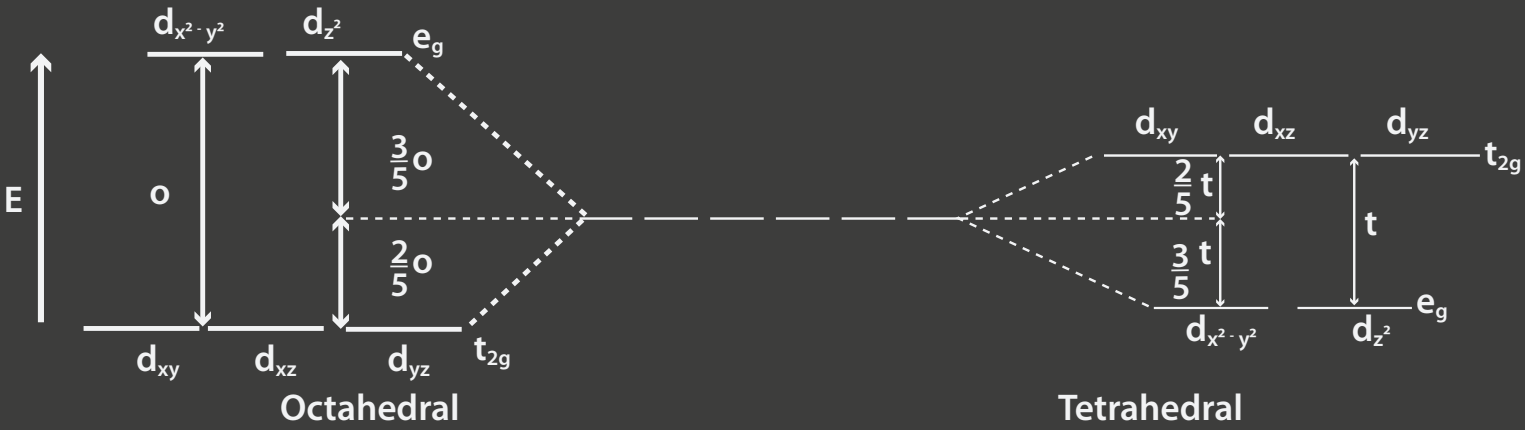
- Couldn't explain colour and electronic spectra of complexes
- Couldn't explain structure of $[Cu(NH_3)_4]^{2+}$
- Couldn't explain pairing of electrons in presence of ligands

Hybridisation and Geometry of complex

Complex Compound or Iron	Magnetic Behaviour	Hybridisation	Shape
$[Fe(CN)_6]^{3-}$	Paramagnetic	d^2sp^3	Octahedral
$[Fe(CN)_6]^{4-}$	Diamagnetic	d^2sp^3	Octahedral
$[Ni(CN)_4]^{2-}$	Diamagnetic	dsp^2	Square Planar
$[Cu(NH_3)_4]SO_4$	Paramagnetic	dsp^2	Square Planar
$[Ni(NH_3)_4]SO_4$	Paramagnetic	sp^3	Tetrahedral
$[Cu(CN)_4]^{2-}$	Paramagnetic	dsp^2	Square Planar
$[Fe(H_2O)_6]^{3+}$	Paramagnetic	d^2sp^3	Octahedral
$[Cr(CN)_6]^{3-}$	Paramagnetic	d^2sp^3	Octahedral
$[Co(CN)_6]^{3-}$	Diamagnetic	d^2sp^3	Octahedral
$[Co(NH_3)_6]^{3+}$	Diamagnetic	d^2sp^3	Octahedral

Crystal Field Theory

Ligand field destroys the degeneracy of d orbitals and splits it into two or more energy levels.



In an octahedral complex, there are six ligands attached to the central transition metal. The d-orbital splits into two different levels. The bottom three energy levels are named d_{xy} , d_{xz} , and d_{yz} (collectively referred to as t_{2g}). The two upper energy levels are named $d_{x^2-y^2}$, and d_{z^2} (collectively referred to as e_g).

In a tetrahedral complex, there are four ligands attached to the central metal. The d orbitals also split into two different energy levels. The top three consist of the d_{xy} , d_{xz} , and d_{yz} orbitals. The bottom two consist of the $d_{x^2-y^2}$ and d_{z^2} orbitals. The reason for this is due to poor orbital overlap between the metal and the ligand orbitals. The orbitals are directed on the axes, while the ligands are not.

Ligands in order of their field strength:

