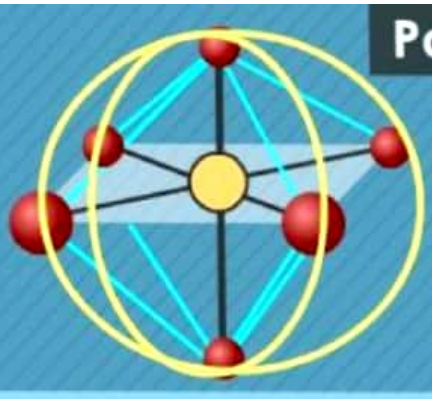
Part I

ISOMERISM IN COORDINATION COMPOUND



STRUCTURAL ISOMERISM

1 LINKAGE ISOMERISM

This type of isomerism is shown by the coordination compounds having ambidentate ligands.

$[Co(NH_3)_5(NO_2)]Cl$ and $[Co(NH_3)_5(ONO)]Cl$ or pentammine nitrito - N Cobalt (III) chloride and pentaammine nitrito - O'Cobalt (III) chloride.

2 COORDINATION ISOMERISM

This type of isomerism arises from the interchange of ligands between cationic and anionic complexes of different metal ions present in a complex.

$[Cr(NH_3)_6]\ [CO(CN)_6]$ and $[CO(NH_3)_6]\ [Cr(CN)_6]$

3 IONISATION ISOMERISM

This isomerism arises due to the exchange of ionisable anion with anionc ligand.

$[Co(NH_3)_5)\ SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$

4 SOLVATE ISOMERISM

This is also known as hydrate isomerism. In this isomerism, water is taken as solvent. It has different number of water molecules in the coordination sphere and outside it.

$[Co(H_2O)_6]Cl_3$, $[Co(H_2O)_4Cl_2]Cl.2H_2O$, $[Co(H_2O)_3Cl_3].3H_2O$

5 POLYMERIZATION ISOMERISM

Polymerization isomerism, in which *n* varies in the complex $[ML_m]_n$,it represents an additional way in which an empirical formula may give incomplete information about the nature of complex.

$[Co(NH_3)_3(NO_2)_3]_n$

$[Co(NH_3)_3(NO_2)_3]$	$[Co(NH_3)_6][Co(NO_2)_6]$	$[Co(NH_3)_5(NO2)][Co(NH_3)_2(NO_2)_4]_2$
n = 1	n = 2	n = 2

STEREOISOMERISM

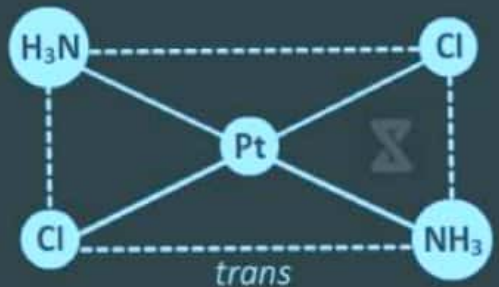
1 GEOMETRICAL ISOMERISM

Geometrical isomers are of two types i.e., cis and trans isomers. This isomerism is common in complexes with coordination number 4 and 6.

COMPLEXES WITH COORDINATION NUMBER 4

- Tetrahedral complexes do not show geometrical isomerism.
- Square planar complexes of formula $[MX_2L_2]$ (X and L are unidentate) show geometrical isomerism. The two X ligands may be arranged adjacent to each other in a cis isomer or opposite to each other in a trans isomer.

cis



trans

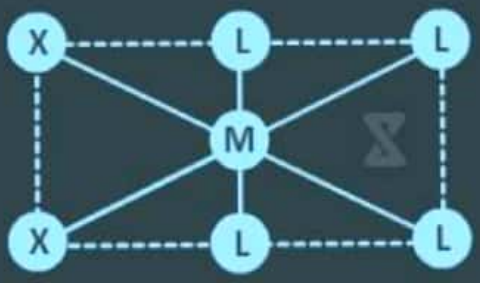
- Square planar complex of the type [MABXL] (where A, B, X, L, are unidentate ligands) shows three isomers, two cis and one trans.

$[Pt(NH3)(Br)(Cl)(Py)]$

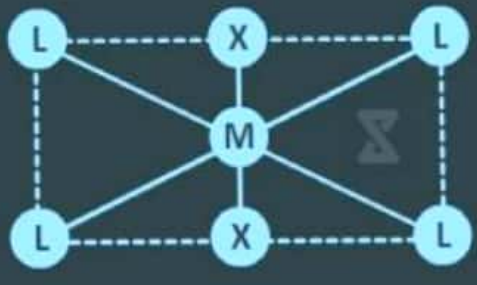
COMPLEXES WITH COORDINATION NUMBER 6

- Octahedral complexes of formula $[MX_2L_4]$, in which the two X ligands may be oriented cis or trans to each other

$[Co(NH_3)_4Cl_2)^+$



cis



trans

2 OPTICAL ISOMERISM

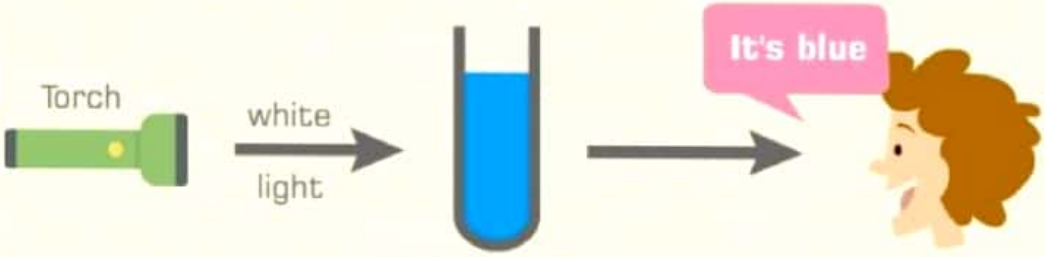
These are the complexes which have chiral structures. It arises when mirror images cannot be superimposed on one another. These mirror images are called enantiomers. The two forms are called dextro (d) and laevo (l) forms.

Tetrahedral complexes with formula $[M(AB)_2]$ show optical isomers and octahedral complexes (cis form) exhibt optical isomerism.

Colour of Co-ordination Compounds

What is Colour Wheel ?

Generally white light is a mix of two opposite colors on colour wheel. These two colour are called **component colours**.



Why we are seeing Blue, Why Not Red or Green ?

Let's see what happens inside the solution containing co-ordination compound when we cast a white light on it

White light of **energy E and wavelength λ** is passed through the solution

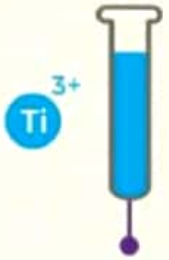
In presence of ligands, d-orbitals splits

This electron absorbs the **energy of wavelength λ** and gets excited to d_{z^2} orbital.

If the wavelength, that got absorbed by solution represents the **orange** colour in colour wheel, then its complinentary colour, **blue** will be seen by viewer

Colours shown by Metals in various oxidation states

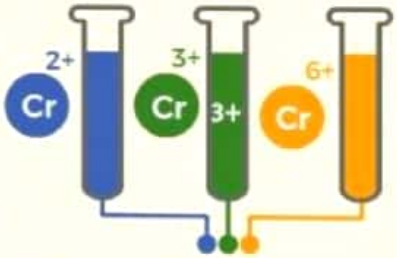
TITANIUM (Ti)



MANGANESE (Mn)

IRON (Fe)

CHROMIUM (Cr)



COBALT NICKEL COPPER