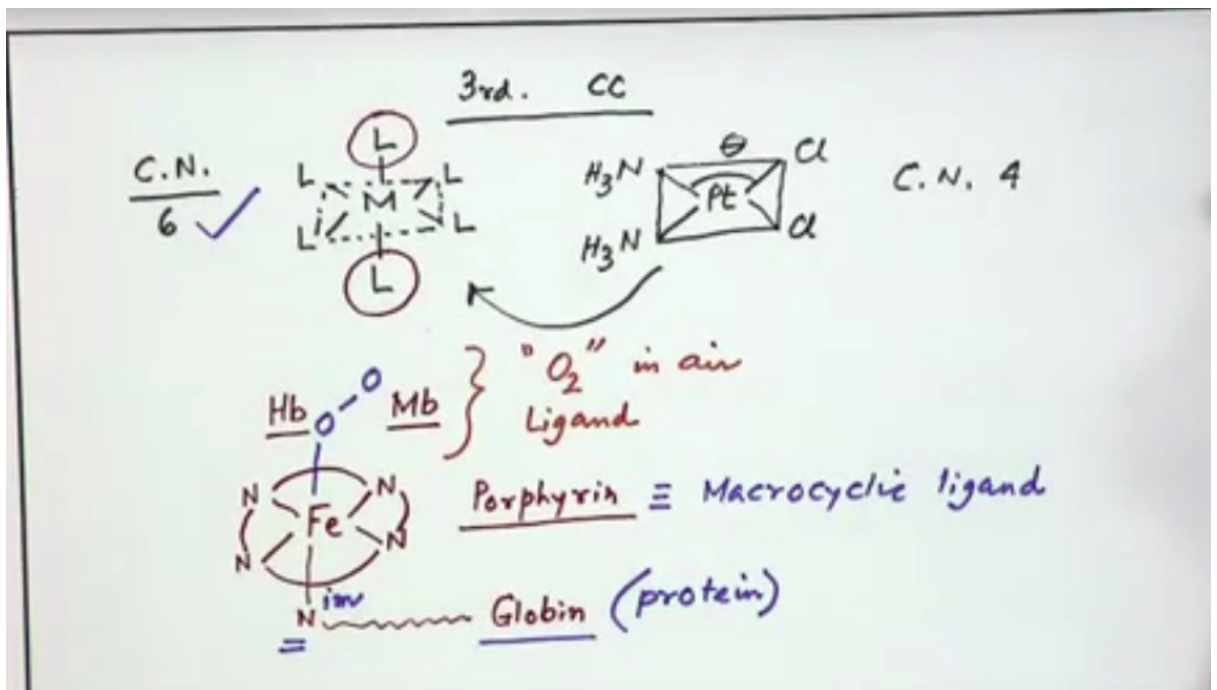
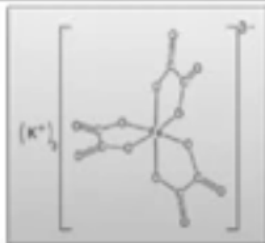


# Lecture 3 Notes

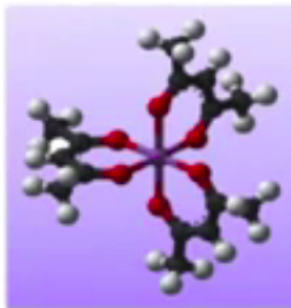


$trans-[Co(NH_3)_4 Cl_2]^+$

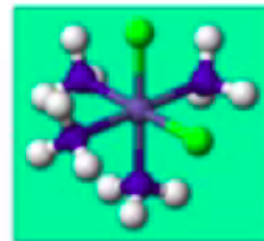


Potassium trisoxalatoferrate(III)

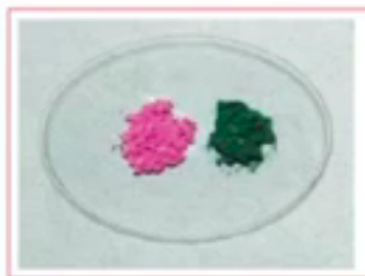
CN 6



$\Delta$ -Mn(acac)<sub>3</sub>, with Jahn-Teller tetragonal elongation



$cis-[Co(NH_3)_4 Cl_2]^+$



Geometric isomers are possible in octahedral complexes when two or more different ligands are present.

**Left:** *cis*-tetraamminedichlorocobalt(III) chloride  
**Right:** *trans*-tetraamminedichlorocobalt(III) chloride

## Naming Coordination Compounds

1. The cation is named before the anion.  
In  $K_3[Fe(CN)_6]$  and  $[Co(NH_3)_4Cl_2]Cl$  compound,  $K^+$  and  $[Co(NH_3)_4Cl_2]^+$  cations respectively, are named first.
2. Within a complex ion, the ligands are named first, in alphabetical order, and the metal ion is named last.
3. The names of anionic ligands end with the letter *o*, whereas a neutral ligand is usually called by the name of the molecule. The exceptions are  $H_2O$  (aqua),  $CO$  (carbonyl), and  $NH_3$  (ammine).
4. When several ligands of a particular kind are present: Greek prefixes di-, tri-, tetra-, penta-, and hexa- to name them. Thus, the ligands in the cation  $[Co(NH_3)_4Cl_2]^+$  are 'tetraamminedichloro.' If contains a Greek prefix, use the prefixes *bis* (2), *tris* (3), and *tetrakis* (4), e.g. *bis(ethylenediamine)*
5. ON of the metal ion is written in Roman numerals following the name of the metal ion.  $[Cr(NH_3)_4Cl_2]^+$ , is tetraamminedichlorochromium (III) ion.
6. When the complex is an anion, its name ends in *-ate*. The anion  $[Fe(CN)_6]^{4-}$  is called hexacyanoferrate(II) ion.

Name of Anions Containing Metal Atoms	
Metal	Name of Metal in Anionic Complex
Aluminum	Aluminate
Chromium	Chromate
Cobalt	Cobaltate
Copper	Cuprate
Gold	Aurate
Iron	Ferrate
Lead	Plumbate
Manganese	Manganate
Molybdenum	Molybdate
Nickel	Nickelate
Silver	Argentate
Tin	Stannate
Tungsten	Tungstate
Zinc	Zincate

Q1. Write the systematic names of the following coordination compounds: (a)  $\text{Ni}(\text{CO})_4$ , (b)  $\text{NaAuF}_4$ , (c)  $\text{K}_3[\text{Fe}(\text{CN})_6]$ , (d)  $[\text{Cr}(\text{en})_3]\text{Cl}_3$ .

a) The CO ligands are neutral species and therefore the Ni atom bears no net charge. The compound is called tetracarbonylnickel(0).

b) The complex anion has a negative charge ( $\text{AuF}_4^-$ ). The compound is sodium tetrafluoroaurate(III).

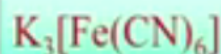
c) The compound is potassium hexacyanoferrate(III).

d) the compound is *tris*(ethylenediamine)chromium(III) chloride.

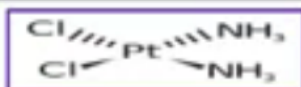
Amminetetraaquachromium(II) sulfate:



Potassium hexacyanoferrate(III):



cisplatin (the penicillin of cancer drugs) is perhaps a proper name because it has been one of the most commonly prescribed as well as a first and successful treatment for many cancer diagnoses.



Diamminedichloroplatinum

## Isomerism in Coordination Compounds

They have the same chemical formula but a different arrangement of atoms.

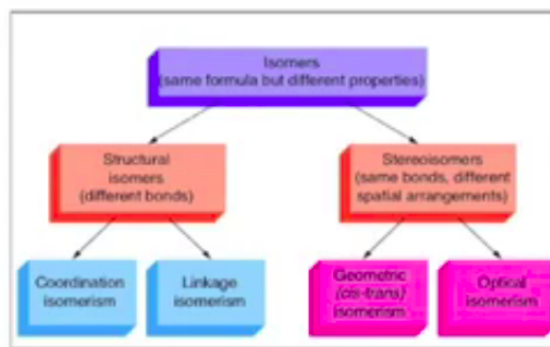
(a) Stereoisomerism

(i) Geometrical isomerism (ii) Optical isomerism

(b) Structural isomerism

(i) Linkage isomerism (ii) Coordination isomerism

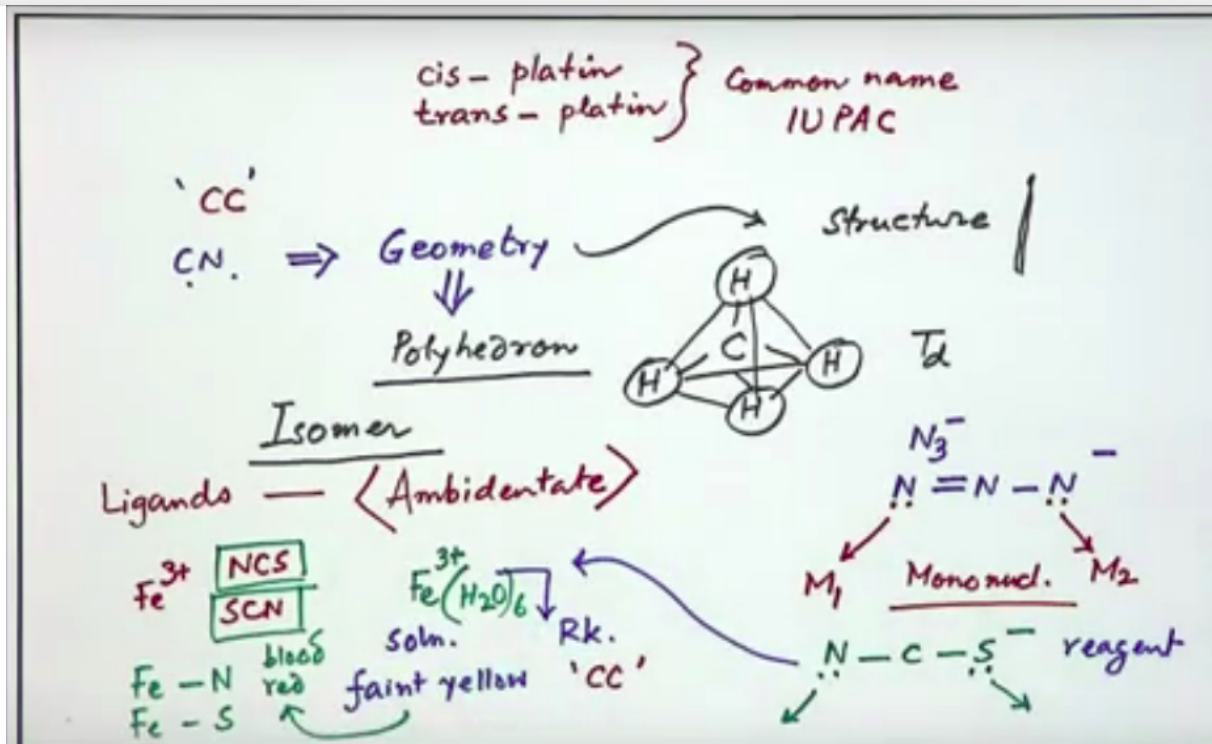
(iii) Ionisation isomerism (iv) Solvate isomerism



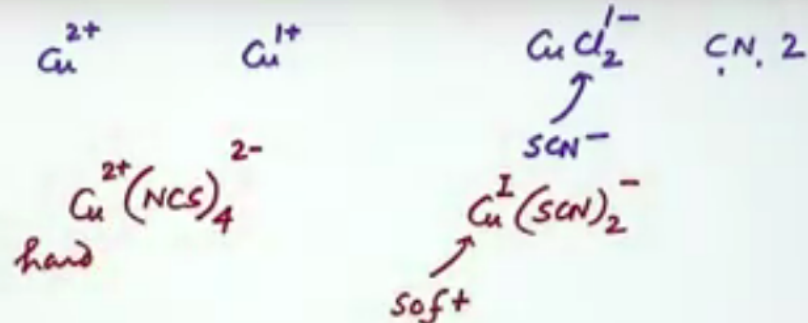
## Linkage Isomerism

The compound containing ambidentate ligand.

Complexes containing the thiocyanate ligand,  $\text{NCS}^-$ , which may bind through the nitrogen to give  $\text{M-NCS}$  or through sulfur to give  $\text{M-SCN}$ .







### Coordination Isomerism

It arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex.

Such as  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ , in which the  $\text{NH}_3$  ligands are bound to  $\text{Co}^{3+}$  and the  $\text{CN}^-$  ligands to  $\text{Cr}^{3+}$ .

### Ionization Isomerism

It arises when the counter ion in a complex salt is itself a potential ligand and can displace a ligand which can then become the counter ion.

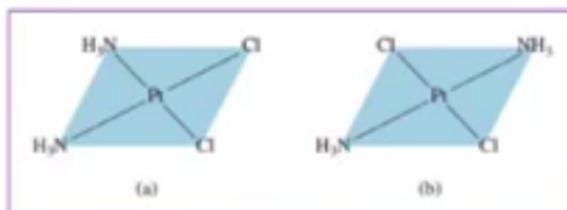
An example is provided by the ionization isomers  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$  and  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ .

### Solvate Isomerism

Also known as 'hydrate isomerism', where water is involved as a solvent. This is similar to ionization isomerism.

Solvate isomers differ by whether or not a solvent molecule is directly bonded to the metal ion or present as solvent of crystallization in the crystal lattice.

## Geometrical Isomerism



These two isomers have **different properties** (melting point, boiling point, color, solubility in water, and dipole moment).

Another type of **geometrical isomerism** occurs in octahedral coordination entities of the type  $[\text{Ma}_3\text{b}_3]$  like  $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$  --- *fac* and *mer*

