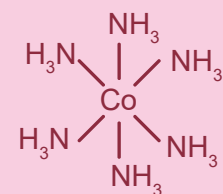


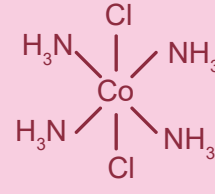
# COORDINATION COMPOUNDS

**COMPLEX SALT**  
Doesn't dissociate completely into ions

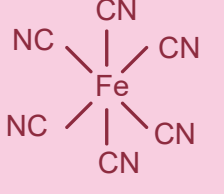
## HOMOLEPTIC COMPLEX



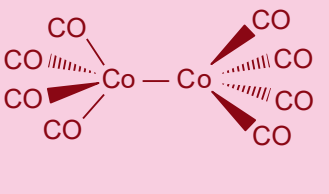
## HETEROLEPTIC COMPLEX



## HOMONUCLEAR COMPLEX



## HETRONUCLEAR COMPLEX



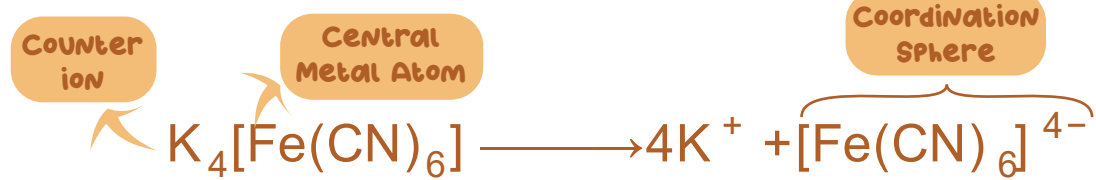
## NOMENCLATURE

### Naming of Mononuclear Complex

**Naming of mononuclear complex**  
1. Cation is named first  
2. Naming of ligands is done in alphabetical order  
3. Anionic ligands end in -o. Neutral and cationic are same.  
4. Prefixes mono, di, tri, etc are used.  
It is followed by roman numeral in parenthesis.  
Example: Triamminetriaqua chromium (III) chloride  
 $[\text{Cr}(\text{NH}_3)_3(\text{H}_2\text{O})_3]\text{Cl}_3$

### Formula of Mononuclear Complex

1. Central atom is listed first.  
2. Ligands are placed in alphabetical order.  
3. Formula is enclosed in square bracket.  
4. No space between ligands and metal.  
5. Charge is indicated outside brackets.  
6. Charge on cation(s) balanced by charge of anion(s)  
Example:



## LIGAND

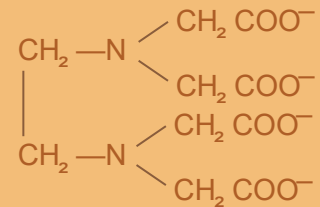
### UNIDENTATE

$\text{CN}^-$ ,  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$  etc

### BIDENTATE



### POLYDENTATE

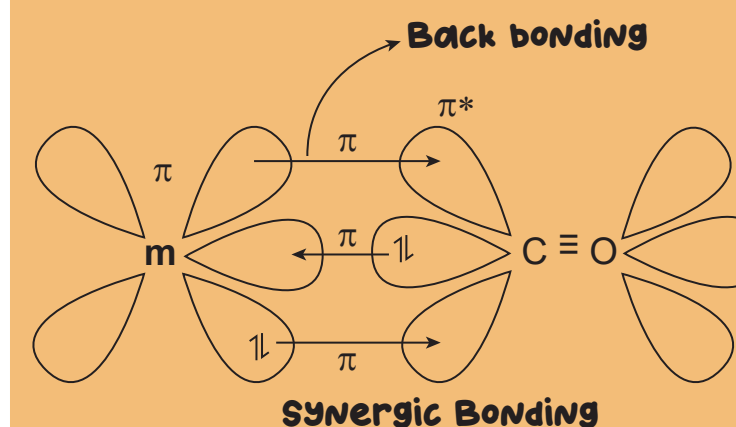


### AMBIDENTATE

$\text{M} \longleftarrow \text{SCN}^-$  Thiocyanate  
 $\text{M} \longleftarrow \text{NCS}^-$  Isothiocyanate

## METAL CARBONYL

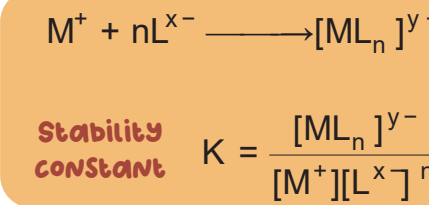
metal Carbonyl posses both  $\sigma$  and  $\pi$  bond.



EDTA is used in estimation of hardness of water

Hemoglobin is a coordination compound of Iron.

Coordination compounds are used in extraction of metals like gold.



## FACTOR AFFECTING STABILITY

Charge density on the central metal ion.  
Nature of ligands.

Shape	Coordination Number	Hybridisation	Example
Tetrahedral	4	$\text{sp}^3$	$[\text{CuCl}_4]^{2-}$
Square Planar	4	$\text{dsp}^2$	$[\text{Ni}(\text{CN})_4]^{2-}$
Trigonal Bipyramidal	5	$\text{sp}^3\text{d}$	$\text{PF}_5$
Square Pyramidal	5	$\text{sp}^3\text{d}^2$	$\text{BrF}_5$
Octahedral	6	$\text{sp}^3\text{d}^2$	$[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ $[\text{Co}(\text{NH}_3)_6]^{3+}$

## COLOUR IN COMPLEX

Caused by d-d transition. colour is complementary to wavelength absorbed.

## VALENCE BOND THEORY

## BONDING THEORY

## CRYSTAL FIELD THEORY

## SPECTRO CHEMICAL SERIES

$\text{I}^- < \text{Br}^- < \text{SCN}^- < \text{Cl}^- < \text{S}^{2-} < \text{F}^- < \text{C}_2\text{O}_4^{2-} < \text{H}_2\text{O} < \text{NCS}^- < \text{EDTA}^{4-} < \text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$

## STRUCTURAL ISOMERS

### Ionisation isomer

Different ions are produced in aqueous solution.

Ex:  $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]$

### Solvate isomer

Different in number of water molecules attached.

Ex:  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$  and  $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$

## WARNER'S THEORY

Central metal ion shows Primary and Secondary valences  
Primary valences are ionisable.  
Secondary valences are non-ionisable.  
Ions bonded to metal via secondary linkages have different spatial arrangement

Limitation  
Only certain elements form coordination complex  
Why coordination bonds have directional property couldn't explain magnetic and optical properties of complex.

## MAGNETIC PROPERTY

Magnetic moment =  $\sqrt{n(n+2)} \text{ BM}$

### PARAMAGNETIC

Ex-  $[\text{CoF}_6]^{3-}$   
One or more than one unpaired e- present  
Ex-  $[\text{CoF}_6]^{3-}$

### DIAMAGNETIC

No unpaired electron present  
Ex-  $[\text{Ni}(\text{CN})_4]^{2-}$

### HIGH SPIN COMPLEX

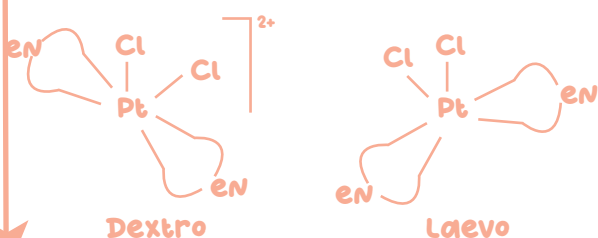
$\Delta_o < \text{Pairing Energy}$   
Ex:  $[\text{CrCl}_6]^{3-}$

### LOW SPIN COMPLEX

$\Delta_o > \text{Pairing Energy}$   
Ex:  $[\text{Cr}(\text{Cl})_6]^{3-}$

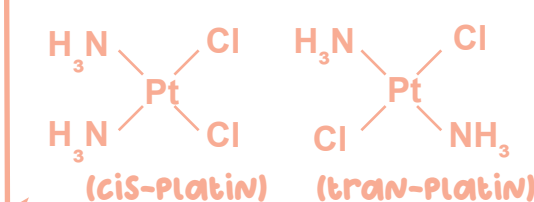
## STEREO ISOMERS

### OPTICAL ISOMERS

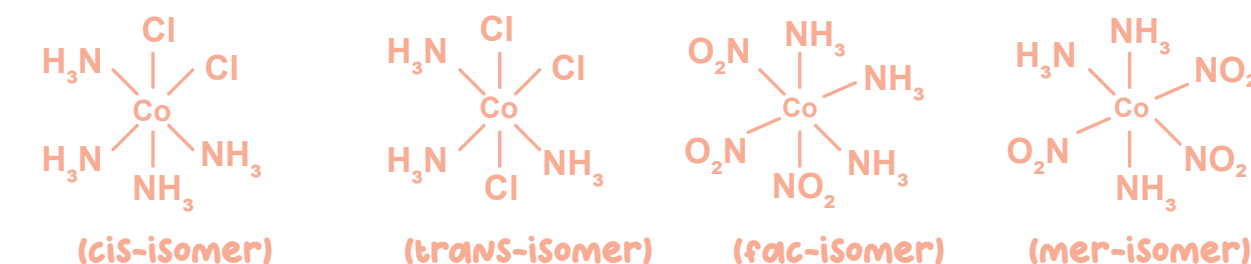


### GEOMETRICAL ISOMERS

#### (i) COORDINATION NUMBER 4



#### (ii) Coordination Number 6



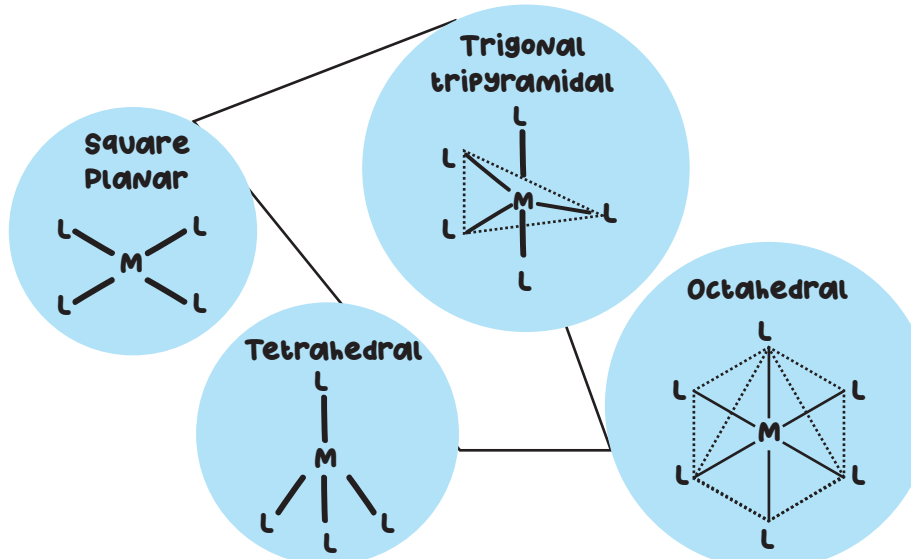
## ISOMERISM

### LINKAGE ISOMER

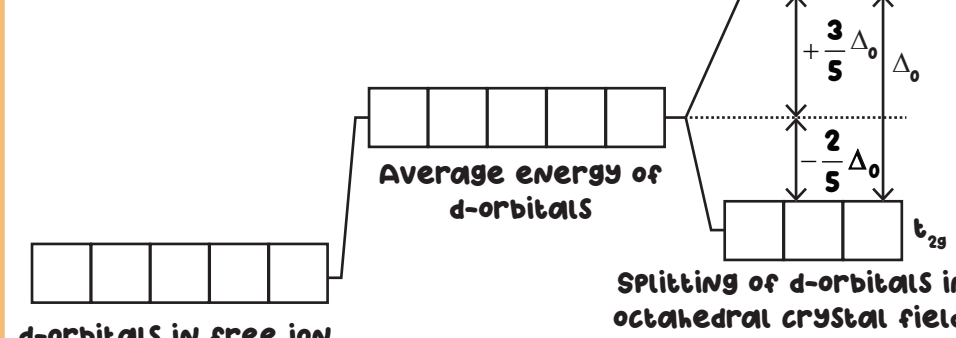
Occurs in ambidentate ligands

Ex:  $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]$  and  $[\text{Co}(\text{NH}_3)_5(\text{ONO})]$

Coordination entities are different.  
Ex:  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$  and  $[\text{Co}(\text{CN})_6][\text{Cr}(\text{NH}_3)_6]$



### Octahedral Complex



### Tetrahedral Complex

