COORDINATION COMPOUNDS

COMPLEX SALT
DoeSN't diSSociate completely into the ion

- HOMOLEPTIC COMPLEX
- HETEROLEPTIC COMPLEX
- HOMONUCLEAR COMPLEX
- HETRONUCLEAR COMPLEX

NOMENCLATURE

Naming of MONONUCLEAR COMplex

Naming of MONONUCELAR complex
Cation iS named firSt
Naming of ligandS in alphabetical order
Anionic ligandS end in -O. Neutral and cationic are Same.
Prefixes MONO. di. tri. etc are uSed.
Followed by roman Numeral in parenthesiS.
Example: Triamminetriaqua chromium (III) chloride
[Cr(NH3)3(H20)3]Cl3

Formula of MONONUCLEAR Complex

Central atom iS liSted firSt.
LigandS iS alphabetical order.
Formula iS enCloSed in Square bracket.
No Space between ligand and metal.
Charge iS indicated outSide brackets.
Charge on cotton(S) balanCed by charge of anion(S)
Example:

ISOMERISM

STERIO ISOMERS

OPTICAL ISOMERS

Dextro — Laevo

GEOMETRICAL ISOMERS

(i) COORDINATION NUMBER 4

(CiS-PlatiN) (tran-PlatiN)

(ii) Coordination Number 6

(CiS-iSomer) (trANS-iSomer) (fac-iSomer) (mer-iSomer)

STRUCTURAL ISOMERS

IoNiSation iSomer
Different ioNS are produced in aqueouS Solution.
Ex: [CO(NH3)5(SO4)]

Solvate iSomer
Different in Number of water moleCuleS attached.
Ex: [Cr(H20)6)]Cl3 and [Cr(H20)5-Cl]Cl3.H20

LINKAGE ISOMR
OCCurS in ambidentate ligandS
Ex: $[CO(NH_3)_5(NO_2)]$ and $[CO(NH_3)_5(ONO)]$

Cordination enttiteS are different.
Ex: [CO(NH3)6][Cr(CN)6] and [CO(CN)6][Cr(NH3)6]

LIGAND

Counter ion — Central Metal Atom — Coordination Sphere

$K_4[Fe(CN)_6] \longrightarrow 4K^+ + [Fe(CN)_6]^{4-}$

MONODENTATE
CN^-, H^2O, NH^3, Cl^-, Br^- etc

OXALATE ION
O, O, C-C, -O, O-

POLYDENTATE
^-OOC, CH_2-COO^-, NH-(CH_2)-NH, ^-OOC, CH_2-COO^-

AMBIDENTATE
M ← SCN Thiocyanate
M ← NCS Isothiocyanate

STABILITY

$M^+ + NL^{x-} \longrightarrow (ML_N)^{y-}$

Stability constant $K = \frac{(ML_N)^{y-}}{(M^+)(L^{x-})^N}$

FACTOR AFFECTING STABILITY

Charge denSity on the central metal ion.
Nature of ligandS.

METAL CABONYL

Metal Carboxyl poSSeS both S and P bond.

Back bonding

M — C ≡ O

Synergic Bonding

EDTA is used in estimation of hardness of water

EDTA is used in estimation of hardness of water

EDTA is used in estimation of hardness of water

SPECTRO CHEMICAL SERIES

$I^* < BR^- < SCN^- < Cl^- < S^{2-} < F^- < C_2O_4^{2-} < H_2O < NCS^- < EDTA^{4-} < NH^3 < EN < CN^- < CO$

Shape	Coordination Number	HybridiSation	Example
Tetrahedral	4	SP^3	$(CuCl_4)^{2-}$
Square Planar	4	dSP^3	$(Ni(CN)_4)^{2-}$
Trigonal Bipyramidal	5	SP^3d	PF_5
Square Pyramidal	5	SP^3d^2	BrF_5
Octahedral	6	SP^3d^2 d^2SP^3	SF_4 $[Co(NH_3)_6]^{3+}$

VALENCE BOND THEORY

WARNERS THEORY

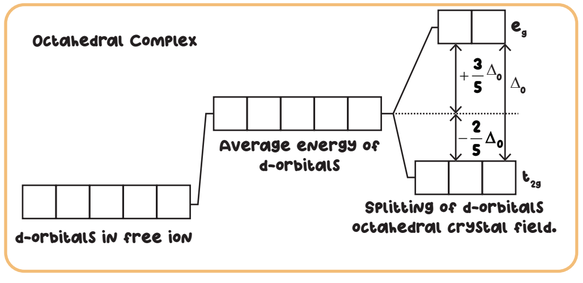
Central metal ion ShowS primary and Secondary valanCeS
Primary valanCeS are ioniSable.
Secondary valanCeS are non-ioniSable.
IonS bonded to metal via Secondary linkageS have different Spatial arrangement

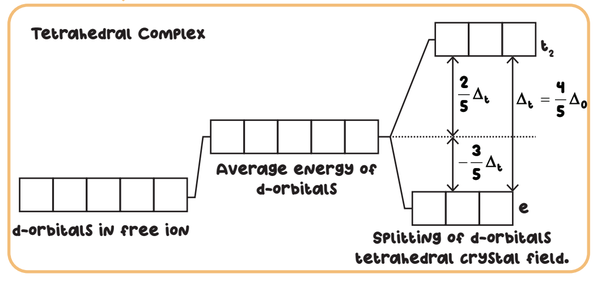
Limitation
Only certain elementS form coordination complex
Why coordination bondS have directional property couldn't explain magnetic and optical propertieS of complex.

BONDING THEORY

CRYSTAL FIELD THEORY

Square Planar — Trigonal tripyramidal — Tetrahedral — Octahedral





MAGNETIC PROPERTY

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

PARAMAGNETIC
Ex- $(CoF_6)^{-3}$
One or more than one unpaired e^- present
Ex- $(CoF6_6)^{3-}$

DIAMAGNETIC
No unpared electron present
Ex- $(Ni(CN)_4)^{2-}$

HIGH SPIN COMPLEX
Δ_0 < Pairing Energy
Ex: $(CrCl_6)^{3-}$

LOW SPIN COMLEX
Δ_0 < Pairing Energy
Ex: $(Cr(Cl)_6)^{3-}$

COLOUR IN COMPLEX

Caused by d-d tranSition. colour is complementary to wavelength abSorbed.