COORDINATION COMPOUNDS

MONODENTATE LIGAND

Anionic
- X^- - Halido
- OH^- – Hydroxo
- NO_2^- - Nitrito
- SO_4^{2-} -Sulphato
- O^{2-} - Oxo(Oxido)
- S^{2-} - Sulphido

Neutral
- H_2O - Aqua
- NO - Nitrosyl
- NH_3 - Ammine
- CO -Carbonyl

Cationic
- NO_2^+ - Nitronium
- NO^+ - Nitrosonium

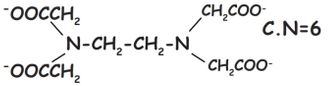
BIDENTATE LIGAND

1) Oxalato 

2) Ethane-1,2-diamine[en]
$H_2N-CH_2-CH_2-NH_2$

POLYDENTATE LIGAND

1) Trien,$N(CH_2CH_2NH_2)_3$ - Tetradentate
2) Ethylene Diamine Tetra Acetato [EDTA]



Donor - 4O Atoms
2N Atoms

AMBIDENTATE LIGAND

1) NO_2^- 2)SCN^-

CHELATE LIGAND

1) $EDTA^{4-}$, en, ox
2) greater Stability

WERNER'S THEORY

1) 1° Valency - O.N
2) 2° Valency - C.N

$[Pt(NH_3)_5Cl]Cl_3$

1) 1° Valency - O.N = 4
2) 2° Valency - C.N = 6
3) AgCl Formed per mole of complex ⟶ 3
4) Total ions per mole of complex - 4

GEOMETRICAL ISOMERISM

1) $[Ma_2b_2]$ - 2 (cis + trans)
2) $[Ma_2bc]$ - 2 (cis + trans)
3) [Mabcd] - 3
4) $[Ma_4b_2]$ / $[Ma_4bc]$ - 2 (cis + trans)
5) $[Ma_3b_3]$ - fac & mer
6) $[Ma_2b_2c_2]$ - 5
7) [Mabcdef] - 15
8) $[M(en)_2b_2]$ or $[M(en)_2bc]$-2

OPTICAL ISOMERISM

① $M(AA)_3$

2 Optical isomers (d cis + l cis)

② $M(AA)_2B_2$

Total 3 Stereoisomer (d cis + l cis + trans)

VBT

SPECTROCHEMICAL SERIES

$I^- < Br^- < SCN^- < Cl^- < F^- < C_2O_4^{2-} < H_2O < NCS^- < EDTA^{4-} < NH_3 < en < NO_2^- < CN^- < CO$

- $[ML_4]$: dsp^2 → Square planar; sp^3 → Tetrahedral
- $[ML_5]$: sp^3d, dsp^3 — Trigonal bipyramidal
- $[ML_6]$: sp^3d^2, d^2sp^3 — Octahedral

UNPAIRED ELECTRONS - PARAMAGNETIC
PAIRED ELECTRONS - DIAMAGNETIC

$\mu = \sqrt{n(n+2)}$

1=1.73 BM
2=2.84 BM
3=3.87 BM
4=4.90 BM
5=5.92 BM

$[NiCl_4]^{2-}$ - sp^3,Tetrahedral n=2
$[NiCO_4]$ - sp^3,Tetrahedral n=0
$[Ni(CN)_4]^{2-}$ - dsp^2,Sq. planar n=0

H_2O act as SFL with Co^{3+}

Cr^{3+} - ↑↑↑ □□ forms d^2sp^3

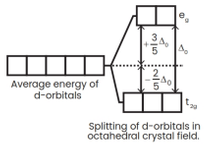
4d and 5d metals with all ligands act as SFL

$[Pt(CN)_4]^{2-}$, $[Pt(Cl)_4]^{2-}$, $[Pd(Cl)_4]^{2-}$ = dsp^2(diamagnetic)

$C_2O_4^{2-}$ act as SFL with Co^{3+}
F^- act as SFL with Ni^{4+}

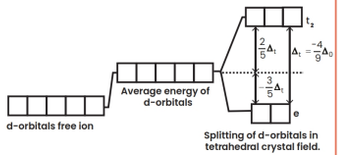
CFT

1) Octahedral - Ligand approaches along the axis ($e_g > t_{2g}$)



$CFSE = a_x(-0.4\ \Delta_o) + b_x(0.6\ \Delta_o) + np$

2) Tetrahedral -Ligand approaches b/w the axis ($t_2 > e$)



$CFSE = a_x - (0.6\Delta_t) + b_x(0.4\Delta_t) + np$

here a,b are number of electrons in low energy and high energy d-orbitals

HIGH SPIN COMPLEX	LOW SPIN COMLEX
$\Delta_o <$ Pairing Energy	$\Delta_o >$ Pairing Energy

For calculation of n, Crystal field stabilisation energy consider newly formed pairing only

CFSE

1) Stability ∝ CFSE
2) $\Delta_o > \Delta_t$, $\Delta_t = \frac{-4}{9}\Delta_o$
3) $[Fe(CN)_6]^{4-} < [Fe(CO)_6]$
4) Jahn Teller distortion by - d^4, d^7, d^9
5) Dissociation constant = $\frac{1}{\beta_n}$ (β_n = stability constant)
6) Color of d-d transition, $E \propto \frac{1}{\lambda}$

$[Co(en)_3]^{3+} < [Co(NH_3)_6]^{3+} < [Co(H_2O)_6]^{3+}$

E↑ λ↓ (E = energy of d-d transition) E↓ λ↑

OMC

1) σ bonded - RMgX(Grignard reagent)
- R_2SiCl_2

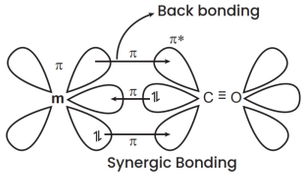
2) π bonded - Ferrocene

3) σ & π bonded- Metal Carbonyls
Mononuclear- $[Fe(CO)_6]$

$[Mn(CO)_6]^+ < [Cr(CO)_6] < [V(CO)_6]^-$

B.O.↑ B.L↓ B.O.↓ B.L↑

(w.r.to C-O bond)



APPLICATION OF ORGANO METALLIC COMPOUNDS

1) Ziegler Natta Catalyst is used in polymerisation of alkene
$TiCl_4 + AlEt_3$
2) Wilkinson's Catalyst is used in hydrogenation
$[\{(C_6H_5)_3P\}_3Rh]Cl$

APPLICATION OF COORDINATION COMPOUNDS

1) Cisplatin ($[Pt(NH_3)_2Cl_2]$) is used as an anticancerous agent
2) EDTA is used in Lead poisoning
3) Copper and iron poisoning- penicillamine & deferoxamine
4) Vitamin B-12 - Cobalt
5) Chlorophyll - Magnesium
6) Carboxy peptidase- Zinc