Nishant Jindal

COORDINATION CHEMISTRY

Calculation of C.F.S.E

$$C.F.S.E = -0.4\Delta_o x + 0.6\Delta_o y + mP$$

x = no of e^- in t_{2g}

y = no of e^- in e_g

m = pairs of e^-

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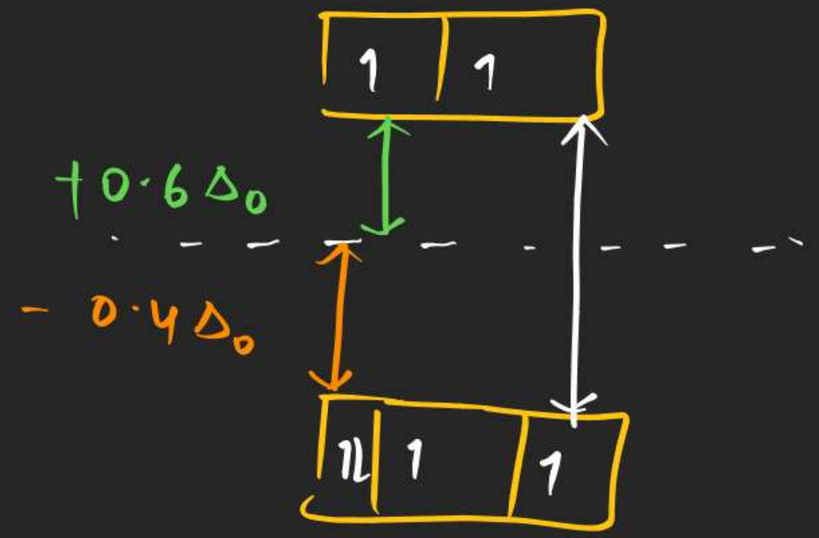
$[CoF_6]^{-3}$

Calculate C.F.S.E

$Co^{+3} = 3d^6$

$\Delta_0 = 10 D_q$



$= -0.4 \times 4\Delta_0 + 0.6 \times 2\Delta_0 + 1P$

$= -1.6\Delta_0 + 1.2\Delta_0 + 1P$

$= -0.4\Delta_0 + 1P$

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10 What is the hyb. of Brown Ring complex

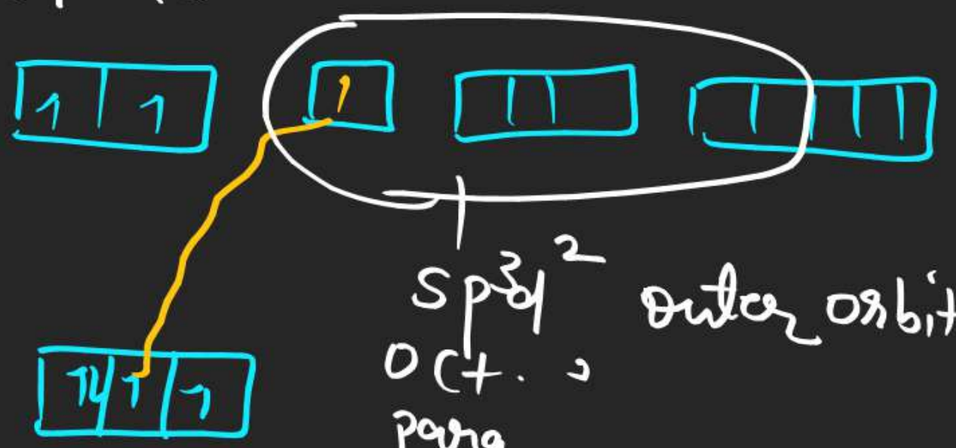
$$[\overset{+}{Fe}(H_2O)_5\overset{+1}{NO}]SO_4$$

NO acts as +ive ligand and it is decided by its magnetic moment in solid state

$\overset{+}{Fe} = 3d^6\ 4s^1$

$\overset{+}{Fe} = 3d^6\ 4s^1$

$\bar{Fe} = 3d^6$



sp^3d^2 Outer orbital

Oct. & para

$\mu = 3.87$ B.M

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Colour in complex Compound

- d^1 to d^9 ⟶ Colourful
- but $[FeF_6]^{-3}$ — Colourless
- d^0 and d^{10} ⇒ Colourless

* d^n and d^{10-n} ⇒ Same Colour

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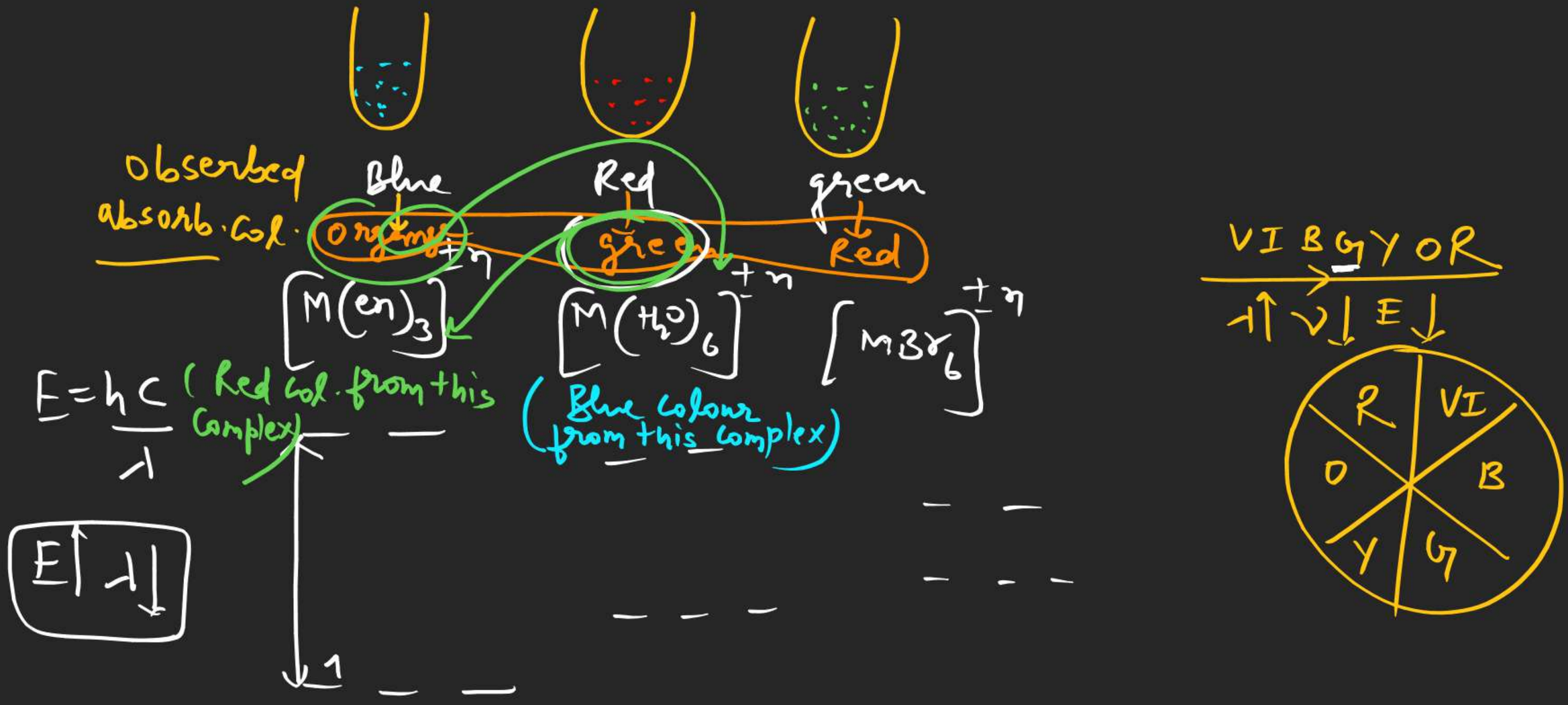

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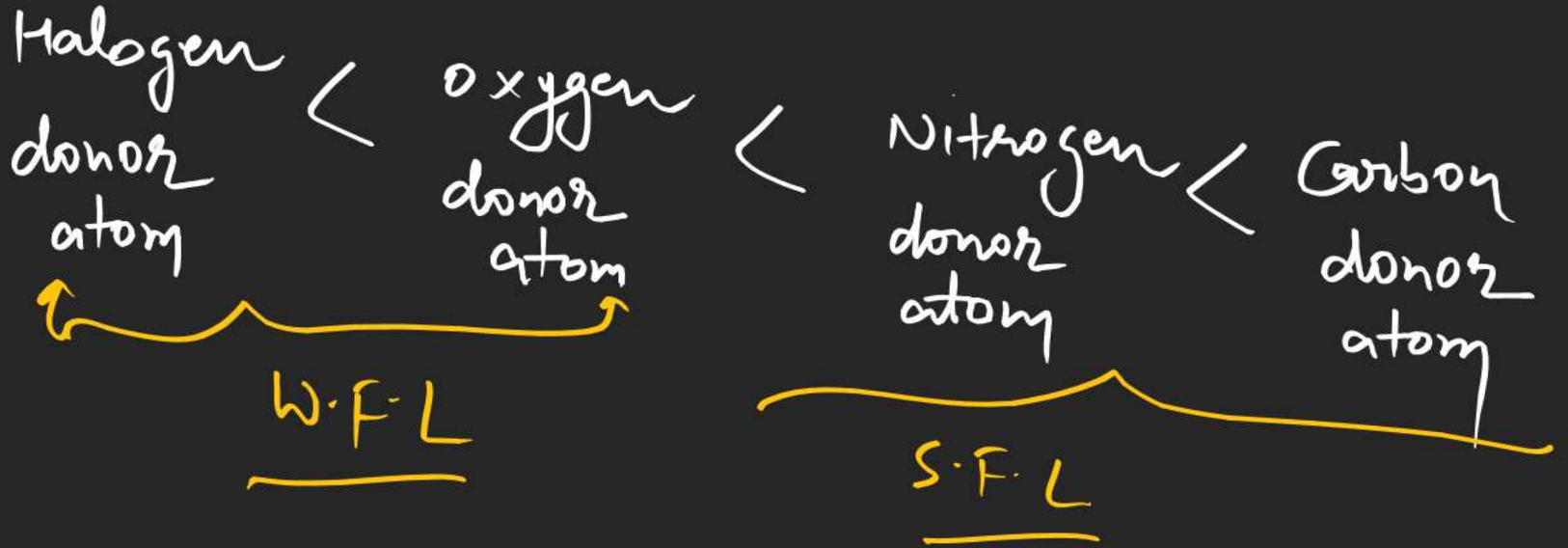
Keypoint



Key point

S.F.L ↑ ↓

order of S.F.L nature

$$L_1 > L_2 > L_3 > L_4$$

order of absorption of I

$$L_1 < L_2 < L_3 < L_4$$

Ques $CuSO_4 \cdot 5H_2O$ is Blue

Which of the following Colour absorbed by this complex.

JEE advanced

1. green
2. ~~orange~~ - Red
3. violet
4. Blue

Ques Colour of aq. $CrCl_3$ is green. Which of the following colour absorbed by this complex.

Ans = Red

MnO_4^- CrO_4^{-2} $Cr_2O_7^{-2}$ CrO_2Cl_2 VO_4^{-3} → Colours

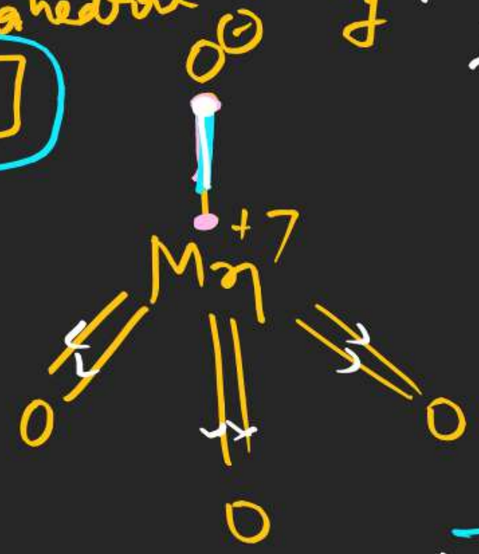
d^3s, tet.

Colourful due to charge transfer

$Mn^{+7} = 3d^0$

4 oxygen (W.F.L) hence tetrahedral splitting

tet: Dia d^3s



C.T.L-M ✓

C.T.M.L ✗

Charge transfer L → M

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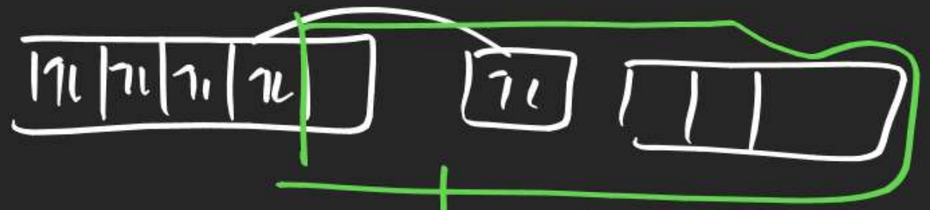
$Fe(CO)_5 \quad [MnCl_5]^{-3} \quad [Ni(CN)_5]^{-3}$

$Fe = 3d^6 4s^2$

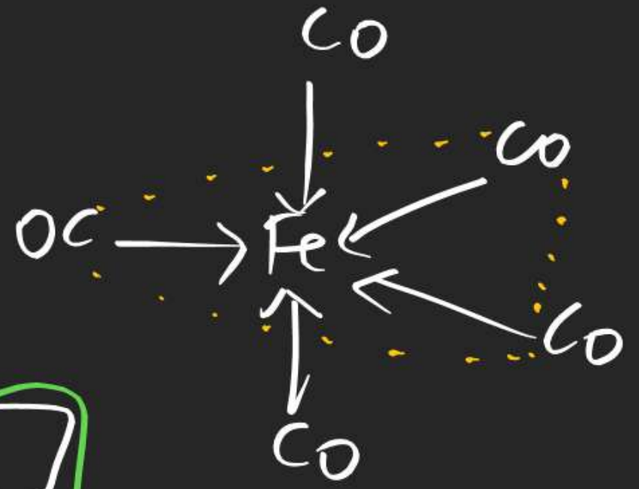
CO is S.F.L hence
it will pair up u.p.e



$dsp^3(dz^2)$

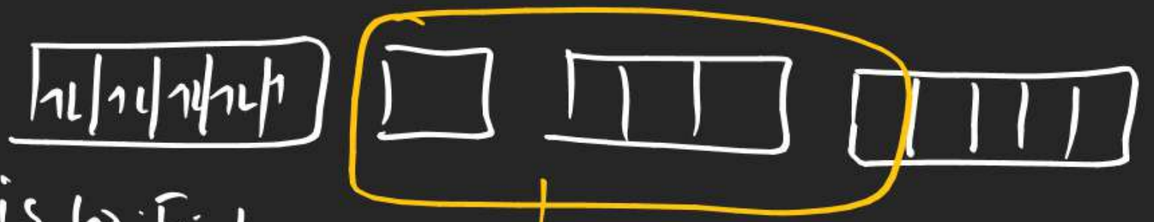
T.B.P

Dia, low spin



$[CuCl_5]^{-3}$

$Cu^{+2} = 3d^9$



Cl^- is W.F.L

$sp^3d(d_{z^2})$

T.B.P (Trigonal bipyramidal)

Para

$\mu = 1.73$

$[Ni(CN)_5]^{-3}$

$Ni^{+2} = 3d^8\ 4s^0$

CN^- is S.F.L hence it will pair up e.p.e

$dsp^3[dx^2-y^2]$

Square pyramidal

one

O_2

$\pi^* \quad 1 \quad 1$

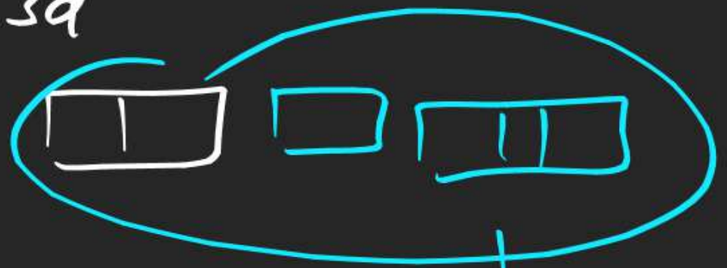
$\pi \quad \pi \quad \pi$

$\sigma \quad 1$

(O_2)

$K_4[\overset{+3}{Fe}(CN)_5(\overset{-2}{O_2})]$

$Fe^{+2} \Rightarrow 3d^6$



d^2sp^3

oct.

Paramag

$\mu = 1.73$

$\pi \quad \pi \quad \pi$

$O_2^{-2} \Rightarrow$ Peroxide

$O_2^{-} =$ Superoxide

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$K_2[NiF_6]$

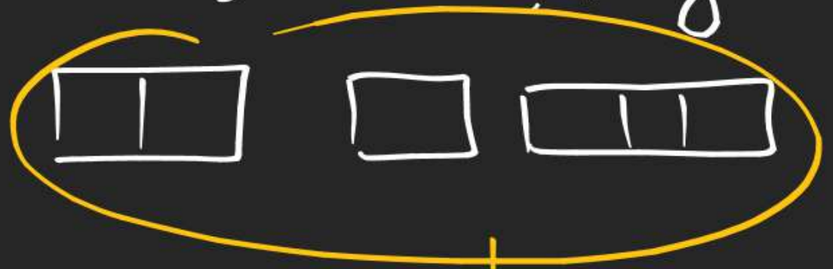
$Ni^{+4} = 3d^6$

$Ni^{+4} = 3d^8\ 4s^2$

$= 3d^4$

due to higher charge on Ni, large splitting

$\Delta_0 > P$



d^2sp^3

oct.

Dia magnetic

$[Sc(H_2O)_6]^{+3}$ $[Ti(H_2O)_6]^{+3}$ $[V(H_2O)_6]^{+3}$ $[V(H_2O)_6]^{+2}$ $[Cr(H_2O)_6]^{+3}$

$\Delta_o > P$

d^1 to d^3 $\Rightarrow$ always large splitting

irr. to nature of ligand

$\Rightarrow$ o hybridisation always d^2sp^3

$[Co(H_2O)_6]^{+3}$

$[Co(ox)_3]^{-3}$

$\Delta_o > P$

d^2sp^3

OCT

Dia

$\mu = 0$

low spin

inner orbital

$[Cr(NH_3)_6]^{+2}$

$[Mn(NH_3)_6]^{+2}$

$[Fe(NH_3)_6]^{+2}$

$[Co(NH_3)_6]^{+2}$

$\Delta_o < P$

sp^3d^2

outer

high spin

$Fe(CO)_5$ follow 18 e⁻ Rule

$Fe(CO)_5$

Fe = $3d^6 4s^2$ → 8

Co = 2 × 5 = 10

8 + 10 = 18

(Spin only mag. moment

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

n = 4.p.e

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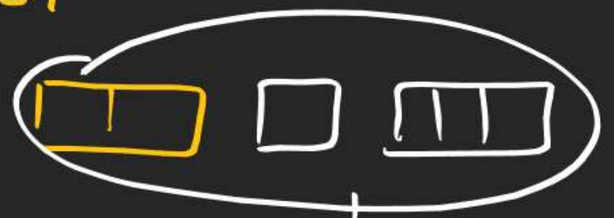
What is the Hyb. of Sodium nitroprusside

$Na_2[Fe^{+2}(CN)_5(N^{+1}O)]$

$Fe^{+3} = 3d^5$



d^2sp^3

Oct.

Dia

$\mu = 0$

Inner orbital

low spin