1) Stability of complexes

- Octahedral complexes are more stable & favourable than Tetrahedral complexes. It is because:-

(i) In O_h complexes, there are 6 bond energy terms involved, while in Td complexes, there are 4 bond energy terms

(ii) Larger CFSE is associated with O_h complexes than Td complexes

$$\Delta_t = \frac{4}{9}\Delta_o$$

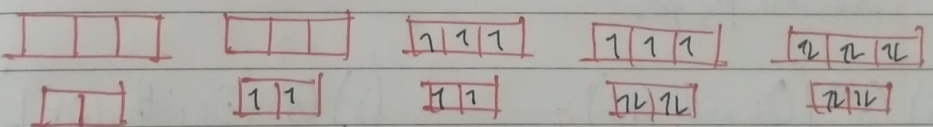
- Tetrahedral complexes are favoured:-

(i) When there are large & bulky ligands which could cause overcrowding in O_h complexes.

(ii) When there is attainment of regular/symmetric configuration

Eg:- d^0 , d^2 , d^5 , d^7 , d^{10}

Td



These orbitals ~~are~~ t_2 & e are either half / fully filled making them stable.

Example of Complexes:-

1) $TiCl_4$ → Ti^{4+} :- $3d^0$ (22)

2) MnO_4^- → Mn^{+7} :- $3d^0$ (25)

3) $FeCl_4^-$ → Fe^{3+} :- $3d^5$

⇓

Stable configurations

(iii) When there is a weak field ligands, the loss of CFSE is insignificant. In these cases, T_d complexes are favoured

(iv) When the CMP/ion is in lower oxidation state, the ligand is weak ∴ T_d complexes are favoured [Magnitude of Δ_t is less]

Magnetism

$\mu_s = \sqrt{n(n+2)}$ B.M → Bohr Magneton

↳ n → no. of unpaired e^-

Spin only magnetic moment

For $n=0$, $\mu_s = \sqrt{0(0+2)} = 0$ ⇒ Diamagnetic

For $n \neq 0$, $\mu_s \neq 0$ ⇒ Paramagnetic

- **Diamagnetic** :- 1) Has paired e^-
  2) No net spin ∴ Repelled by magnetic field
- **Paramagnetic** :- 1) Has unpaired e^-
  2) Net spin ∴ Attracted to magnetic field

Q. Calculate μ_s for :-

(i) Co^{2+} (O_h with SFL) :-

Co^{2+} :- d^7 → t_{2g} (↑↓ ↑↓ ↑) , e_g

(ii) Co^{2+} (O_h with WFL)

t_{2g} (↑ ↑ ↑) , e_g (↑ ↑)

* SFL → favours e^- pairing

WFL → does not favour e^- pairing

$n = 1$

$\mu_s = \sqrt{1(1+2)}$

$= \sqrt{3}$

$= 1.73$ B.M

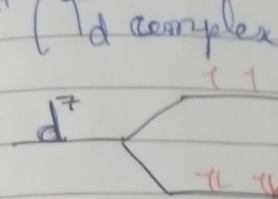
$n = 3$

$\mu_s = \sqrt{3(3+2)}$

$= \sqrt{15}$

$= 3.87$ B.M

(iii) Co^{2+} (T_d complex → All T_d complexes ligands treated as WFL)



$n = 3$

$M_S = \sqrt{3(3+2)} = \sqrt{15}$

$= 3.87$ B.M