

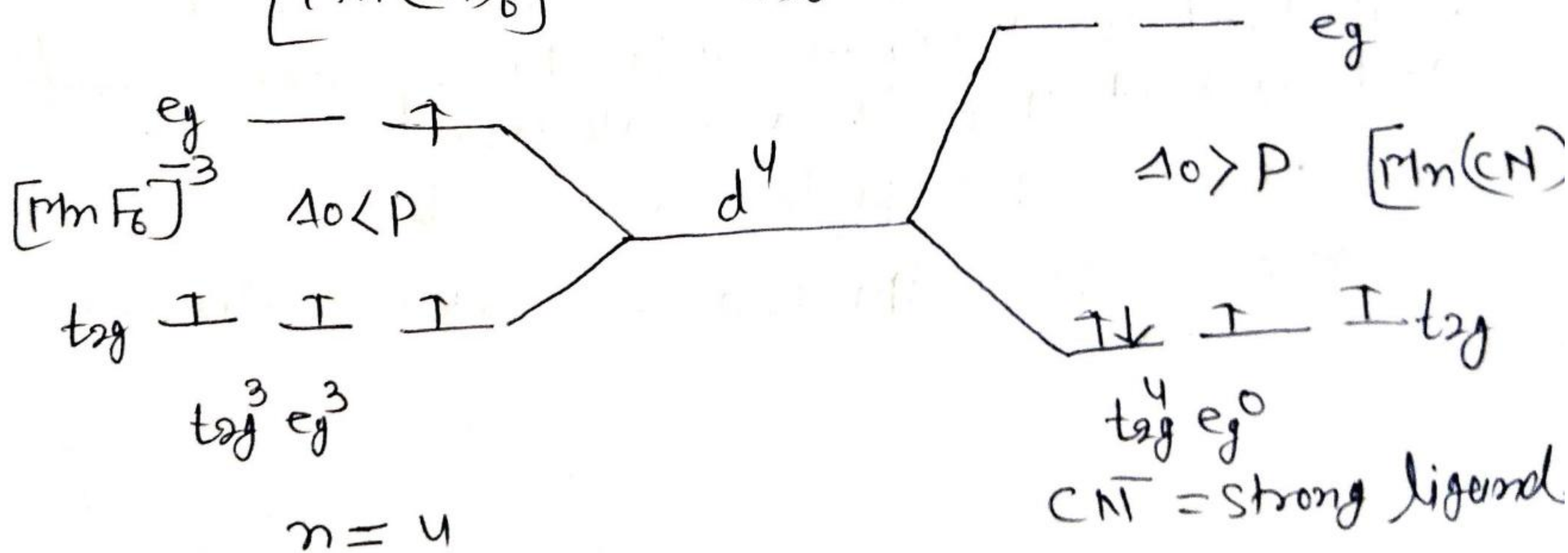
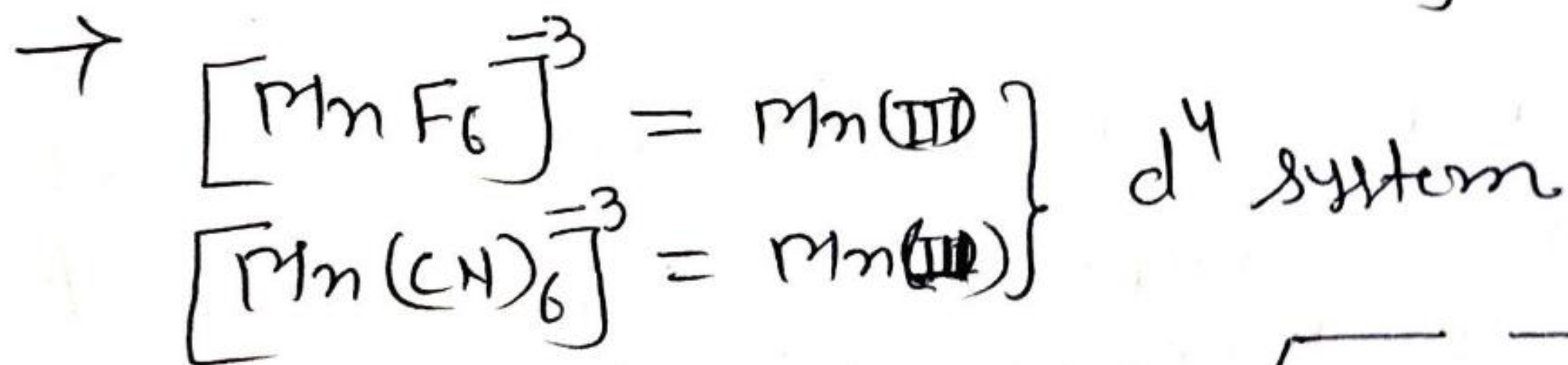
Strong Ligand :-

When a ligand is strong it causes greater repulsion to d-electrons. Hence the extent of splitting of d-orbitals is comparatively larger. So in such cases $\Delta_o > P$ and so spin paired or low spin octahedral complexes are formed. Ex - CN^- , NO , CO etc

Weak Ligand :-

If a ligand is weak it does not cause greater repulsion to d-electrons hence the extent of splitting is small and so $\Delta_o < P$. In such cases spin free or high spin octahedral complexes are formed. Ex - Cl^- , F^- , Br^- , H_2O etc

Q. Predict the μ_s value of $[\text{MnF}_6]^{3-}$ and $[\text{Mn}(\text{CN})_6]^{3-}$



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

$$= \sqrt{4(4+2)} \text{ BM}$$

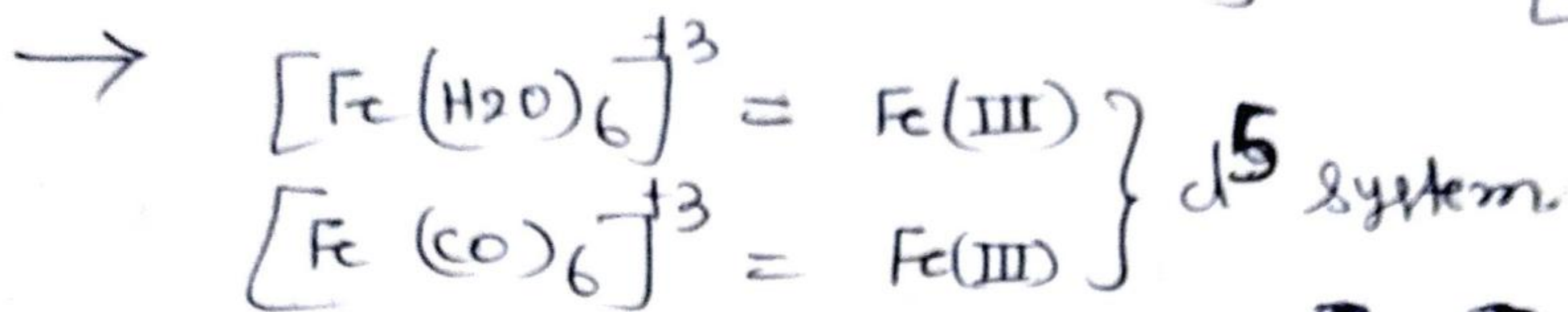
$$= \sqrt{24} = 2\sqrt{6} \text{ BM}$$

$$\mu_s = \sqrt{2(2+2)} \text{ BM}$$

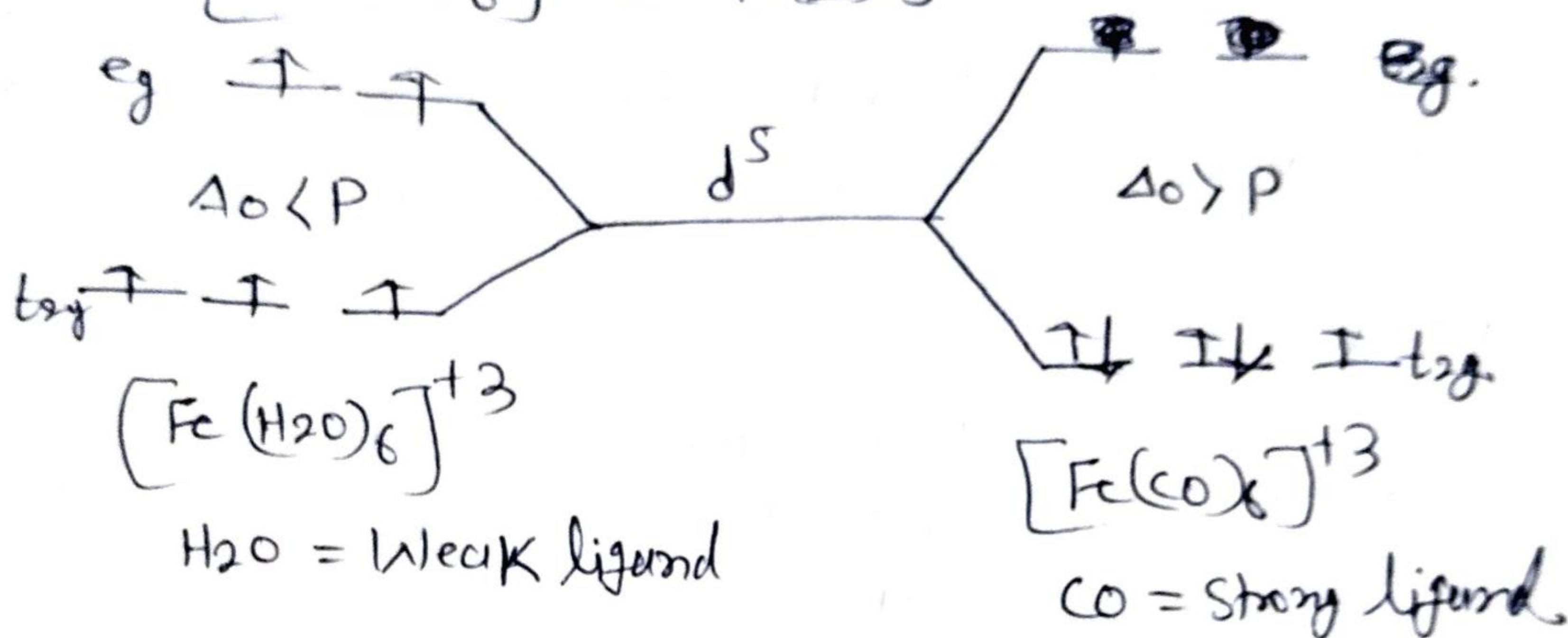
$$= \sqrt{8} \text{ BM}$$

$$= 2.828 \text{ BM}$$

Q Predict μ_s value of $[\text{Fe}(\text{H}_2\text{O})_6]^{+3}$ and $[\text{Fe}(\text{CO})_6]^{+3}$.



} d^5 system.



$$\mu_s = \sqrt{5(5+2)} \text{ BM}$$

$$= \sqrt{35} \text{ BM}$$

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

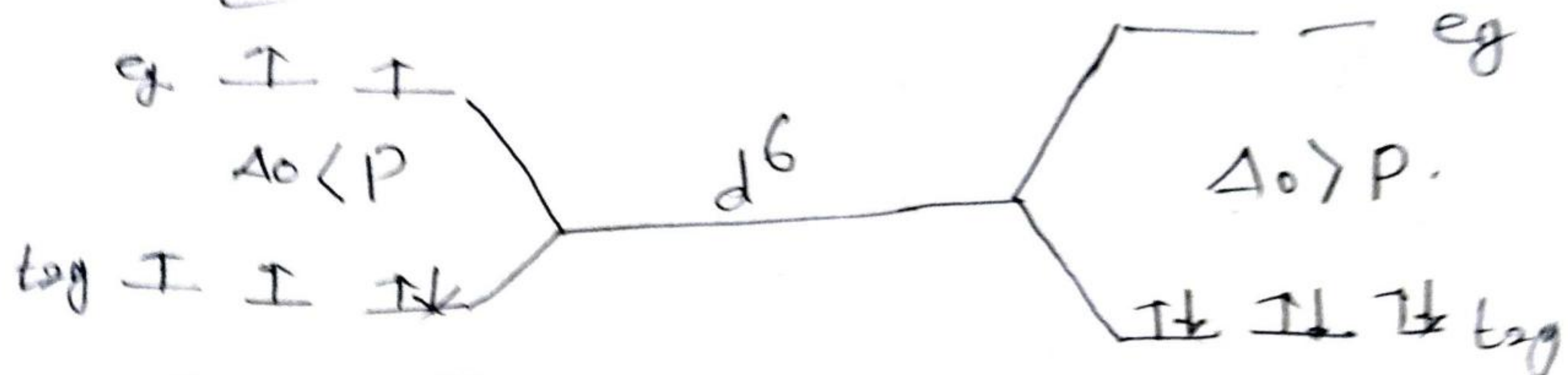
$$= 1.732 \text{ BM}$$

$$\mu_s [\text{Fe}(\text{H}_2\text{O})_6]^{+3} > \mu_s [\text{Fe}(\text{CO})_6]^{+3}$$

As CO is a strong ligand $\Delta_o > P$, so it is low spin octahedral complex or spin paired octahedral complex, in which there is one unpaired electron but H_2O is a weak ligand for which $\Delta_o < P$, so it is high spin or spin free octahedral complex, in which there are 5 unpaired electrons.

Q. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is diamagnetic but $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$ is paramagnetic. Explain.

→ $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3 = \text{Co(III)}$
 $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3 = \text{Co(III)}$ } d^6 system.



$[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$
 Spin free/High spin
 $n = 4$

Paramagnetic
 $\mu_s = \sqrt{4(4+2)} \text{ BM}$
 $= 2\sqrt{6} \text{ BM}$

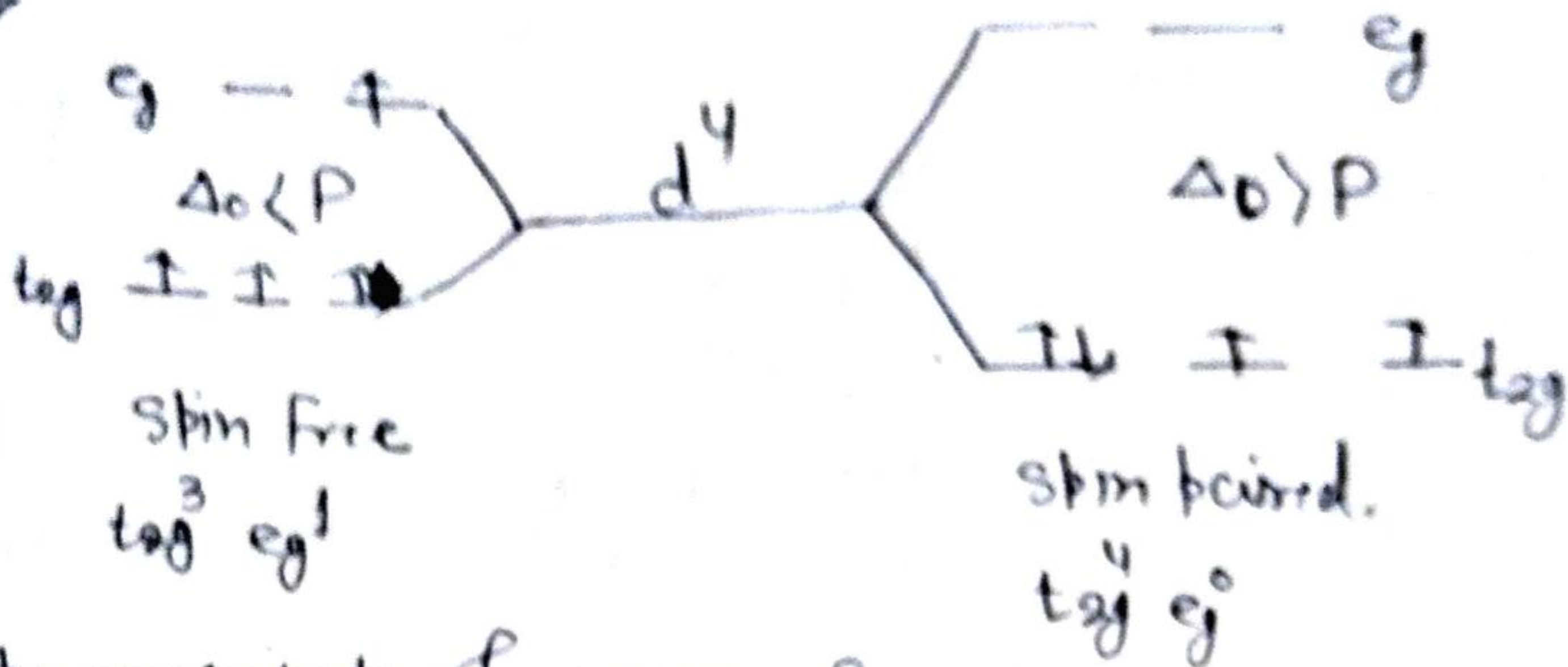
$[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
 Spin paired/Low spin,
 $n = 0$

Diamagnetic
 $\mu_s = 0$

NH_3 is a strong ligand it causes large extent of ~~orbital~~ splitting in the d-orbitals and hence $\Delta_0 > P$. That's why electrons are forced to pair up and is called spin paired or low spin oh. complex.

Whereas H_2O is a very weak ligand causes small splitting hence $\Delta_0 < P$. That's why electrons are unpaired and this is referred to as spin free or high spin oh. complex.

Q. Spin paired oh. complexes are more stable than spin free oh. complexes. Explain.

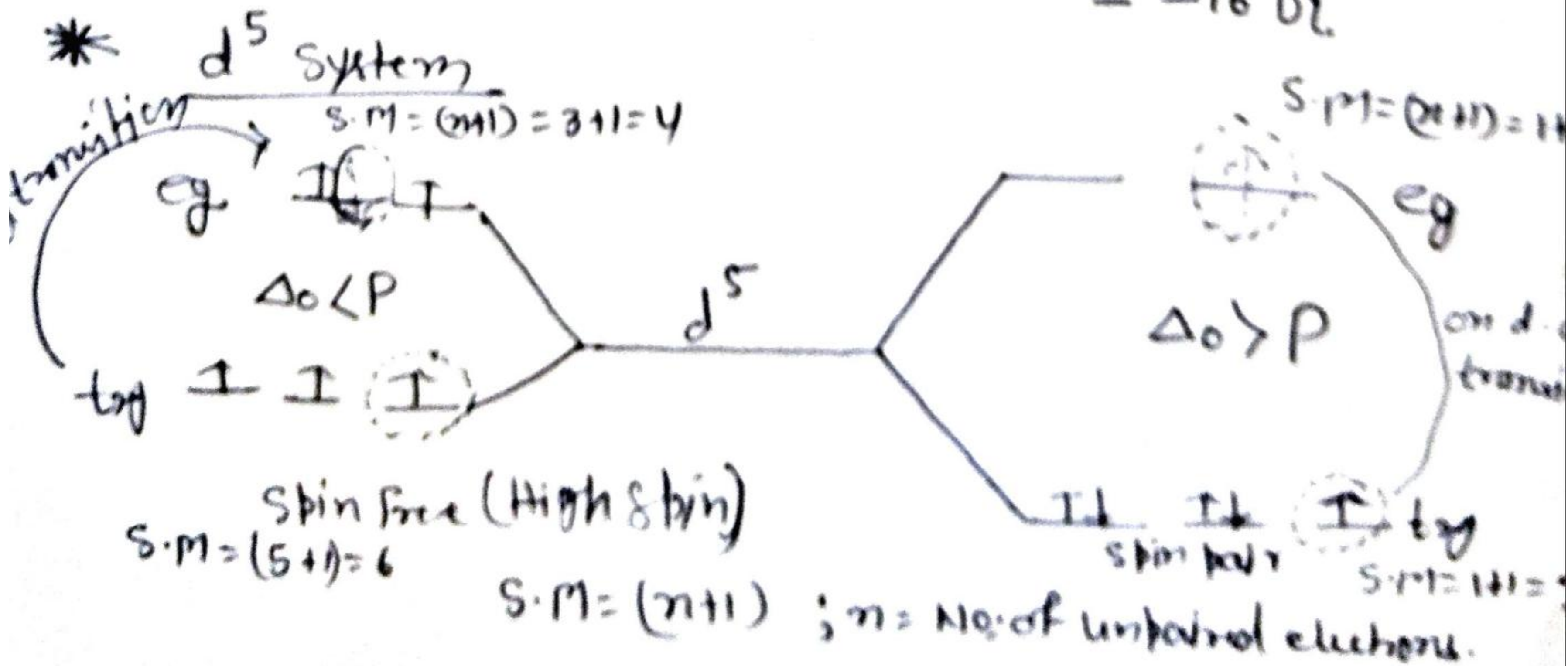


The magnitude of CFSE of O.C. (octahedral complexes) is greater than that of spin

The magnitude of CFSE of spin paired octahedral complex (O.C) is greater than that of spin free O.C. that's why spin paired O.C are more stable than spin free O.C.

$$\begin{aligned}
 \text{C.F.S.E} &= 3 \times -4Dq + 6 \times -1Dq \\
 &= -12Dq + 6Dq \\
 &= -6Dq
 \end{aligned}$$

$$\begin{aligned}
 \text{C.F.S.E} &= \\
 &4 \times -4Dq + 0 \times 6Dq \\
 &= -16Dq
 \end{aligned}$$



High spin o.c of d^5 system is not coloured due to d-d transition because it is spin forbidden transition since, s.p changes in case of $\Delta_0 < P$ hence this transition is not allowed. But in $\Delta_0 > P$ transition is allowed because there is no change in spin multiplicity.

So, d^5 is not coloured due to d-d transition but coloured due to charge transfer from ligand.

