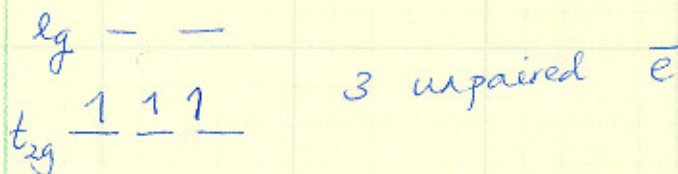
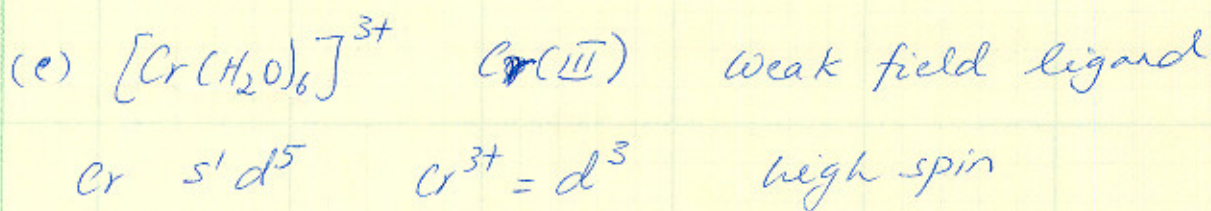
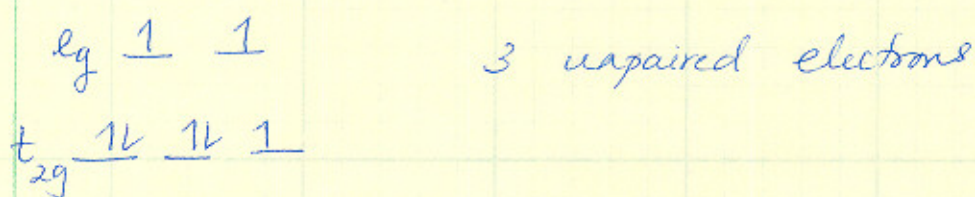
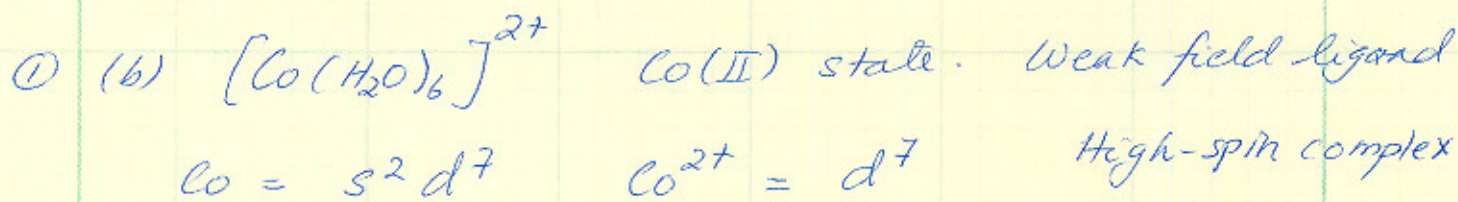


ATOMS, MOLECULES AND RESEARCH

COORDINATION CHEMISTRY - SPRING - WEEK 4

Chapter 10



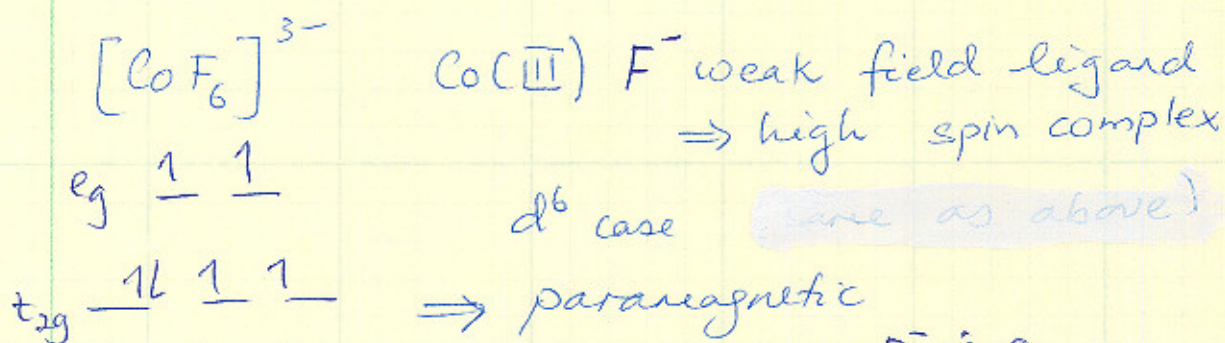
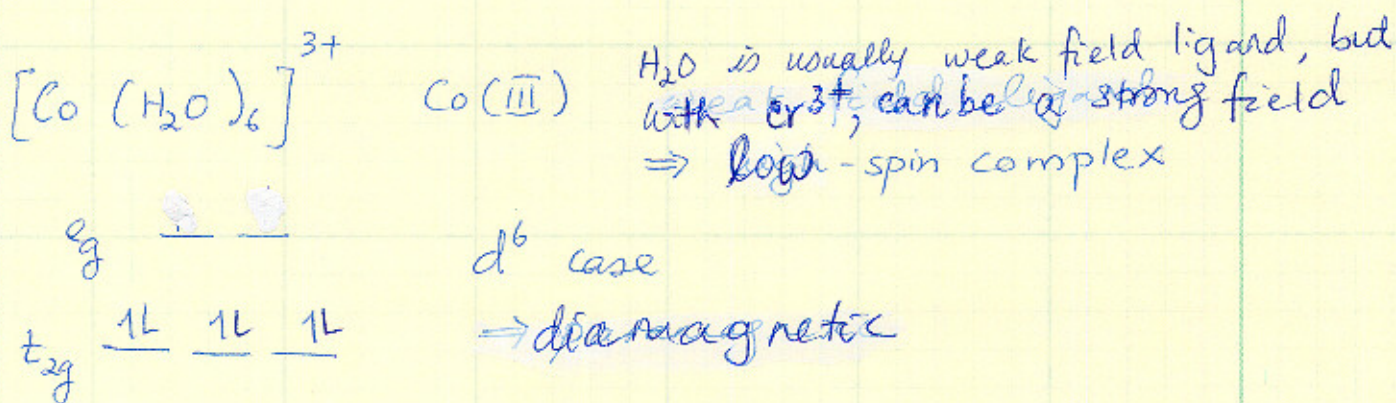
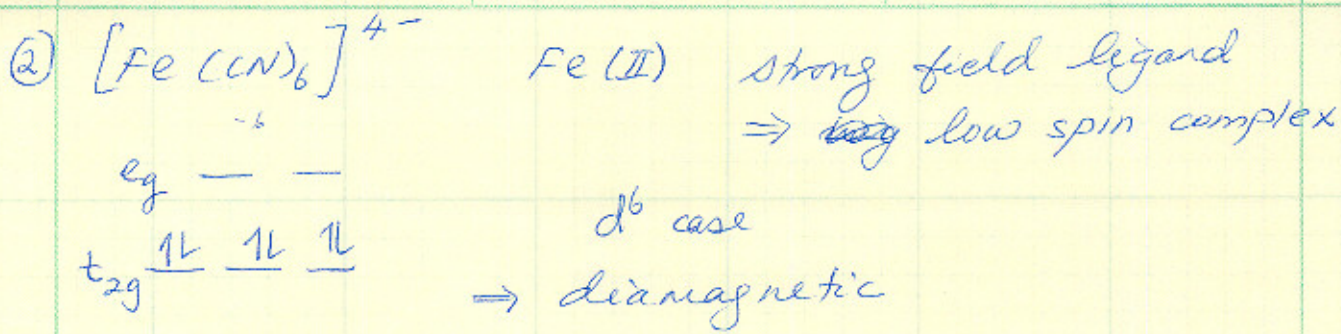
(e) $\mu_s = 5.1 \text{ BM} = \sqrt{n(n+2)} \mu_B$

$\therefore n(n+2) = 5.1^2 = 26.01$

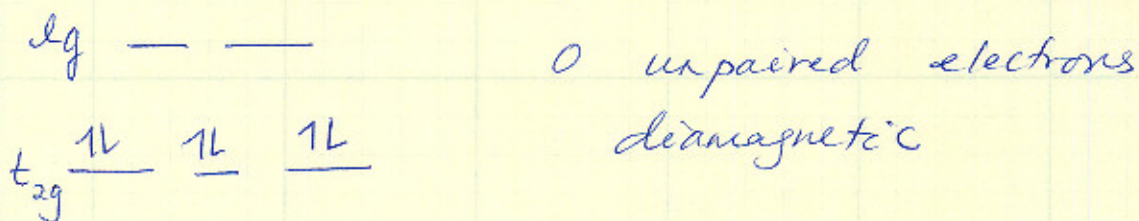
$n^2 + 2n - 26.01 = 0$

$n = \frac{-2 \pm \sqrt{4 + 4(26.01)}}{2} \approx 4$

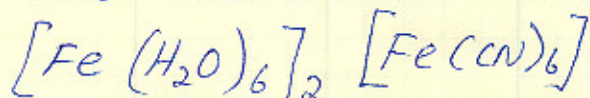
of unpaired electrons = 4



But Rh(III) tends to form low-spin (high field cpxes)
 because it is in the second transition series



③ The two octahedral complexes are



↑
+ve ion -ve ion

Fe is in +2 oxidation state in the +ve and -ve ions.

ratio of Fe : H₂O : CN⁻ = 3 : 12 : 6 = 1 : 4 : 2

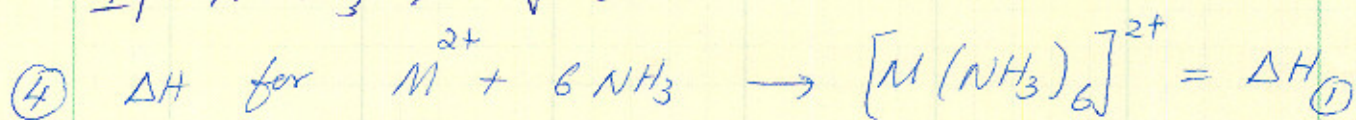
[Fe(H₂O)₆]²⁺ is a high-spin (low field) cpx with 6 unpaired e⁻

[Fe(CN)₆]⁴⁻ is a low-spin (high-field) cpx with 0 unpaired e⁻

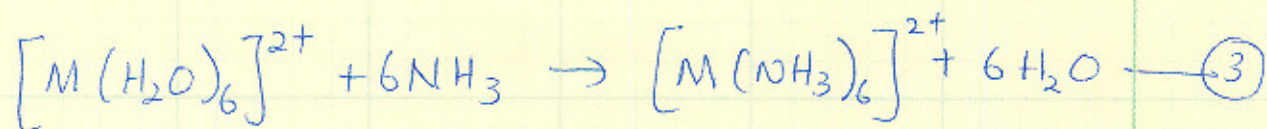
For [Fe(H₂O)₆]²⁺; $\mu = 4.9 \text{ B.M.}$ for [Fe(CN)₆]⁴⁻, $\mu = 0$

$$\therefore \mu_{\text{average}} = \frac{2(4.9) + 0}{3} = 3.3 \text{ B.M.}$$

$$\text{If } n = 2\frac{2}{3} \quad \mu = \sqrt{n(n+2)} \text{ B.M.} = 3.53 \text{ B.M.} \quad \left. \begin{array}{l} \text{close} \\ \text{enough!} \end{array} \right\}$$

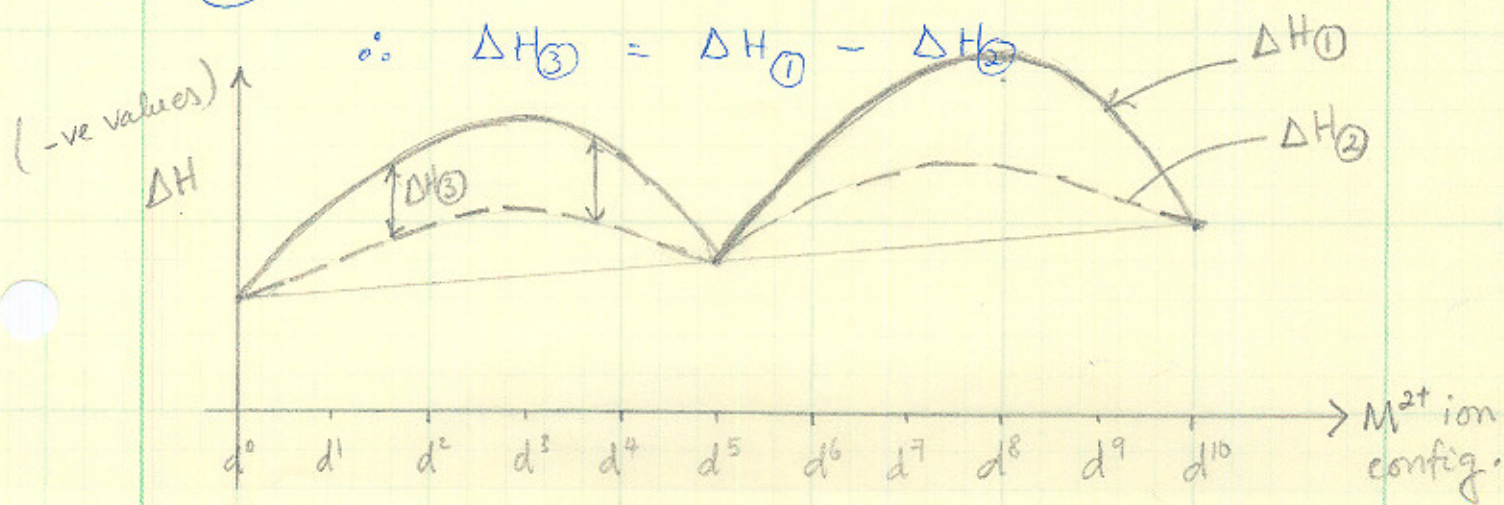


$\Delta H_1 > \Delta H_2$ since NH₃ binds more strongly to the metal than H₂O.



$$\text{③} = \text{①} - \text{②}$$

$$\therefore \Delta H_3 = \Delta H_1 - \Delta H_2$$



(13) CN^- has the highest Δ_0 . This is because CN^- has vacant π^* orbitals that participate in π -back bonding ($M \rightarrow L$ π -bonding)

Next is en (ethylenediamine) which is a bidentate ligand, and hence forms a stronger bond with the ~~ligand~~^{metal} than the unidentate NH_3 . en does not have π -bonding abilities.

The others are all monodentate, weak field ligands. Of these Cl^- is the most ~~to~~ weak field. Since it has filled p orbitals that π -bond to the metal, there is $L \rightarrow M$ π -bonding which lowers Δ_0 .

F^- acts very similar to Cl^- but F^- is a stronger ligand than Cl^- because F^- has less π -donor ability than Cl^-

Comparing NH_3 & H_2O : These are both monodentate ligands. H_2O has a small π -donor ability (one of the lone pairs on H_2O). NH_3 has no π donor (or acceptor) ability because its orbitals do not have the right symmetry for π bonding). $\therefore \text{NH}_3$ is a stronger ligand than H_2O

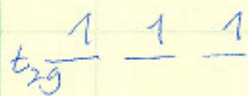
(17)

NH_3 is a stronger Lewis base than H_2O (i.e. NH_3 is the better σ -donor). Water has one lone pair that can act as a π donor. $\therefore \text{H}_2\text{O}$ is a weaker ligand than NH_3 , despite O being more electronegative than N.

For the halides, all of them have the same electron structure. Therefore the stronger Lewis base ~~is~~ (which is F^-) is the stronger ligand. More electronegative F^- is therefore the stronger ligand compared to less electronegative Cl^- .

(21) (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ Cr^{2+} d^4 case weak field ligand

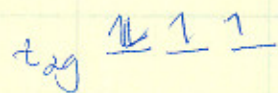
$e_g \uparrow \quad \text{---}$ $n=4$ $\mu_s = \sqrt{n(n+2)} \mu_B = \underline{\underline{4.9 \text{ B.M.}}}$



(b) $[\text{Cr}(\text{CN})_6]^{4-}$ Cr^{2+} d^4 case strong field ligand.

$e_g \text{---} \text{---}$ $n=2$ $\mu_s = \underline{\underline{2.8 \text{ B.M.}}}$

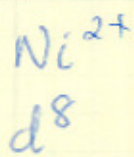
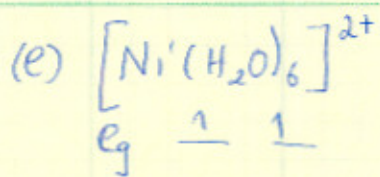
$d^6 s^2$



(d) $[\text{Fe}(\text{CN})_6]^{3-}$ Fe^{3+} strong field ligand

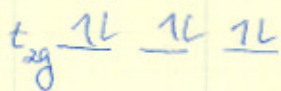
$e_g \text{---} \text{---}$ d^5 case

$t_{2g} \uparrow \uparrow \uparrow$ $n=1$ $\mu_s = \underline{\underline{1.7 \text{ B.M.}}}$



weak field ligand

$n = 2$



$\mu_S = \underline{\underline{2.8 \text{ B.M.}}}$