1. Predict whether following complexes will show any Jahn-Teller distortion:
(i) $[Co(NH_3)_6]^{2+}$ (ii) $[CoF_6]^{3-}$ (iii) $[MnF_6]^{3-}$ (iv) $[FeCl_4]^{2-}$

2. Infrared spectrum of $[Mn(DMSO)_6](ClO_4)_3$ (DMSO = dimethyl sulfoxide) shows two S-O stretching frequencies at 915 cm^{-1} and 960 cm^{-1}. The intensity of the 915 cm^{-1} band double than that of 960 cm^{-1} band. From these observation, find out the position (orbital) of the 4^{th} electron of manganese.

3. The stepwise stability constants in aqueous solution at 25 ^{0}C , K_1, K_2, and K_3, for successive reactions of ethylenediamine with Cu^{2+} are follows:

$[Cu(H_2O)_6]^{2+}$ + en $\rightarrow$ $[M(H_2O)_4(en)]^{2+}$ + $2H_2O$ ---- $\log K_1 = 10.72$

$[Cu(H_2O)_4(en)]^{2+}$ + en $\rightarrow$ $[M(H_2O)_2(en)_2]^{2+}$ + $2H_2O$ ----$\log K_2 = 9.31$

$[Cu(H_2O)_2(en)_2]^{2+}$ + en $\rightarrow$ $[M(en)_3]^{2+}$ + $2H_2O$ ----- $\log K_3 = -1.0$

Explain why there is striking difference in K_3.

4. Determine the nature of following spinel structures from CFSE? Show your calculation.
(i) Fe_3O_4 (ii) $ZnFe_2O_4$

5. Dark green colored and paramagnetic $[NiBr_2(PEtPh_2)_2]$ complex on cooling to -78 ^{0}C becomes brown colored and diamagnetic in nature. Explain this unique observation.

6. (a) When dil HCl is added to a pale pink coloured aqueous solution of cobaltous nitrate, the color changed to dark blue.

(i) Write down the equilibrium reaction. Identify the complex species in solution and explain this observation.

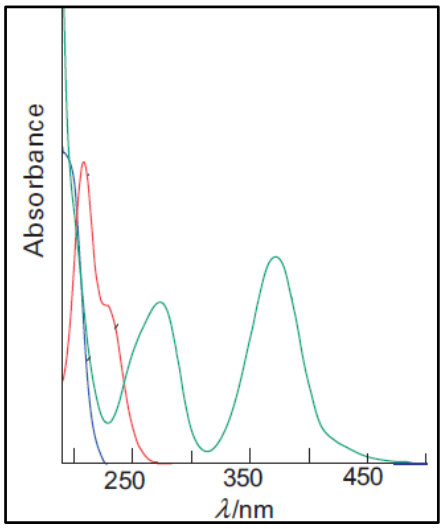
(ii) Check whether there will be any difference in observed magnetic moments in the starting material and products formed in the above reaction.

7. Account for the following observation in electronic spectra of listed transition metal complexes:

Compound	**ε_{max} ($M^{-1}cm^{-1}$)**	**Reason**
$[Mn(H_2O)_6]^{2+}$	0.1	
$[Ti(H_2O)_6]^{3+}$	10	
$[CoCl_4]^{2-}$	500	
$[TiCl_6]^{2-}$	10,000	

8. Potassium dichromate is having bright orange colour whereas $[Cu(MeCN)_4](BF_4)$ is colourless. Give a proper reason.

9. Absorption spectra for CrO_4^{2-}, WO_4^{2-} and MoO_4^{2-} are shown below. Identify the species corresponding to respective spectra. Mention the origin of the spectra.



10. $[Et_4N]_2[NiBr_4]$ paramagnetic, but $K_2[PdBr_4]$ is diamagnetic. Rationalize these observations.

11. Calculate the spin only ($\mu_{S.O.}$) and total effective magnetic moment (μ_{L+S}) for Cr(III)