1. For complexes $[Fe(CN)6]^{3-}$ or $[Fe(CN)6]^{4-}$answer the following questions:

   (a) Which complex will show the higher value for Δo, give a brief reason for your answer?

   Ans: Higher the charge on the metal ion higher will be Δo

   In $[Fe(CN)_6]^{4-}$ the iron is in +2 oxidation state while in $[Fe(CN)_6]^{3-}$ iron is in +3 oxidation state thus $[Fe(CN)_6]_3^-$ will show higher Δo value.

   (b) Calculate the wavelength most intensely absorbed light for $[Fe(CN)_6]^{4-}$ complex (Δo = 392 kJ/mol) [Avogadro's no. = 6.02214×10^{23} mol^{-1}]

   Ans: Δo = 392 kJ/mol

   $\Delta o = [(392 \text{ kJ/mol} \times 1000 \text{ J})/1 \text{ kJ}] / 6.02214 \times 10^{23} = 6.5093 \times 10^{-19}$ J

   $\Delta o = h\nu$

   As $\nu = c/\lambda$

   So, $\Delta o = hc/\lambda$

   $\lambda = hc/\Delta o = [6.6261 \times 10^{-34} \text{ Js} \times 2.9979 \times 10^{8} \text{ m/s}]/ 6.5093 \times 10^{-19}$ J

   $\lambda = 305.17 \times 10^{-9}$ m = **305 nm**

   (c) What will be the color of a dilute aqueous solution of $[Fe(CN)_6]^{4-}$?

   Ans: Almost colorless as it absorbs in the UV region. Refer to the artist's wheel.

2. The material $NiFe_2O_4$ will prefer spinel or inverse spinel structure? Use the crystal field theory to explain.

   Ans. Ni(II) prefers octahedral geometry over tetrahedral due to stabilization through LFSE.

   Octahedral (t2g 6 eg 2): LFSE: -1.2 Δo

   Tetrahedral (e4 t2 4): LFSE: -0.8 Δt

   Fe(III) is similar for both octahedral and tetrahedral (LFSE = 0 units)

   So $NiFe_2O_4$ will be an inverse spinel.

3. If we add two equivalents of KCN into a solution containing $[Cu(NH_3)_4(H_2O)]^{2+}$ complex sample, it produces $[Cu(NH_3)_4(CN)_2]$. Based on the crystal field theory, predict the Cu *d*-orbital splitting and coordination geometry for both the complexes?

Ans.