Tutorial 2

Q1. The magnetic moment of an octahedral Co(II) complex is 4.0 μ_B. What is its electron configuration?

Q2. What is the magnetic moment of $[CoF_6]^{3-}$, assuming that the spin-only formula will apply.

Q3. Two different complexes, one red-orange (**A**) and the other green (**B**), can be isolated from an aqueous solution of Co^{3+} containing excess HCl and ethylene diamine (en). The red-orange complex **A** has the empirical formula $CoCl_3(en)_3$ while the green complex **B** has the empirical formula $CoCl_3(en)_2$. Addition of excess $AgNO_3$ (aq) to an aqueous solution of **A** or **B** produces a white precipitate but **A** produces 3 times as much precipitate as **B** on a molar basis. The red-orange complex **A** can be resolved into a pair of enantiomers while the green complex **B** is not chiral. ***Assume Co^{3+} has the same coordination number in both complexes***. Propose reasonable structures for both complexes **A** and **B** consistent with these observations and the behaviour of chelate ligands.

Q4. The crystal field splitting energy of a complex is 2.9×10^{-19} J. What wavelength of light (in nm) would be absorbed for a d-d electronic transition corresponding to this splitting?

Q5. $[Ni(NH_3)_4]^{+2}$ is paramagnetic while isoelectronic $[Pd(NH_3)_4]^{+2}$ is diamagnetic. Explain in a few words how this could be so.

Q6. The value of Δ_o in $[Mn(OH_2)_6]^{3+}$ is 15,800 cm^{-1} while the mean pairing energy (P) in this complex is 28,000 cm^{-1}. Do you expect this ion to be high or low spin?

Q7. For the following complexes, give the crystal field stabilization energy (in terms of Dq), the spin-only magnetic moment (in Bohr-Magnetons), and predict if the complex will be Jahn-Teller active. If the complex is Jahn-Teller active, indicate the likely nature of the distortion.

a. $[CoF_6]^{3-}$

b. $[V(H_2O)_6]^{3+}$

c. $[Mn(CN)_6]^{3-}$

d. $[Cr(H_2O)_3(CN)_3]^{-}$