LECTURE 28

1. For each of the following ions, **(i) draw** an crystal field splitting diagrams to show orbital occupancies in both weak and strong octahedral fields, and **(ii)** indicate the number of unpaired electrons in each case. **Label** the diagrams (**iii**) weak or strong field, (**iv**) high spin or low spin (as appropriate), (**v**) with the names of the d-orbitals, and (**vi**) with the appropriate orbital sets e_g and t_{2g} designators.
   (a) Fe^{2+}
   (b) Cr^{3+}
   (c) Cd^{2+}

2. For each of the above ions in problem one, **(i)** Write the expected d^n electron configuration and **(ii)** calculate the CFSE (both the high and low spin states, as appropriate, and indicate pairing energies PE if electrons are paired).

3. For $[CoCl_6]^{3-}$
   (a) Determine the coordination number of the cobalt
   (b) Determine the oxidation number of the cobalt
   (c) Predict whether this compound is high or low spin. Briefly explain your answer.
   (d) Estimate the octahedral crystal field splitting energy (Δ_o) in joules/mol if the wavelength most intensely absorbed is 740nm.

4. Octahedral platinum(IV) complexes are used in protein crystallography to help determine three-dimensional protein structures. If the octahedral crystal field splitting energy (Δ_o) is large for these complexes,
   (a) Predict whether they are diamagnetic or paramagnetic
   (b) Write the expected d^n electron configuration

5. For the following, consider a field that has a z-axis that is vertical, a y-axis that is horizontal, and x-axis that is coming out of page.

   (a) Draw pictures of the $d_{x^2-y^2}$ and d_{z^2} orbitals
   (b) Predict the relative energy of $d_{x^2-y^2}$ in an octahedral crystal field compared to a linear crystal field that is along the y-axis
   (c) Predict the relative energy of d_{z^2} in an octahedral crystal field compared to a linear crystal field that is along the y-axis
   (d) Predict the relative energies of $d_{x^2-y^2}$ to d_{z^2} to each other in a(n)
      (i) octahedral field
      (ii) linear field along the y-axis.

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