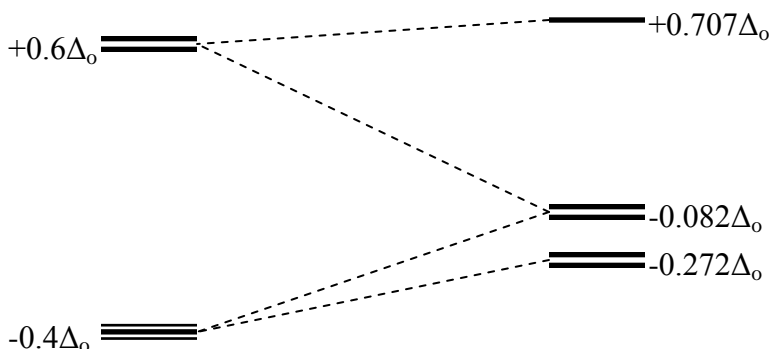
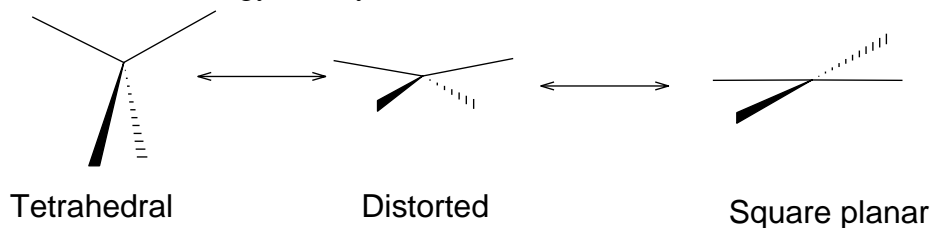


- You have synthesized the octahedral complexes $[\text{Co}(\text{CN})_6]^{3-}$ and $[\text{CoCl}_6]^{3-}$. Calculate the crystal field stabilization energy for each of these complexes and describe any differences you might expect to see in their physical properties. Explain any assumptions you make.
- What crystal field splitting pattern would you expect the f -orbitals to exhibit in an octahedral crystal field? (Orbital pictures are attached.) Explain your splitting assignments.
- Octahedral complexes can lose a ligand and undergo a rearrangement to form trigonal bipyramidal complexes. Explain the changes in crystal field splitting shown below for this transition including assignment of explicit orbitals. Are there any d -orbital counts that would favor loss of a ligand to form the 5-coordinate trigonal bipyramidal complex for weak-field ligands?



- Tetrahedral complexes can undergo a distortion that at its extreme results in a square planar complex as shown below. How do the d -orbital energies change throughout this transition. Explain all of your orbital energy assignments. Jahn-Teller distortions of octahedral complexes occur to lower the overall energy of some d -electron counts. Does this distortion result in lower overall energy for any d -electron counts?



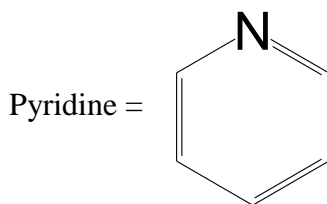
- Describe some technique, class of material, problem or solution addressed by one of the papers we discussed in class (*not your own paper!!*) that you found interesting and explain why.

NOTE: Only the first page of problems was used, those that follow this note are extras that I either used before or considered using. They can be cycled-in in the future.

NOTE: The back of the exam page showed the *f*-orbitals from page 404 in the Wulfsberg text. I will scan these at some point so I have an electronic copy of this figure.

##. Using explicit orbital arguments and calculations, explain why octahedral d^3 and d^6 complexes are often exchange inert.

3. You are attempting to synthesize some magnetic materials using either chromium, iron or nickel (Cr, Fe, Ni) and have available the ligands pyridine, iodide (I^-), carbon monoxide (CO) and hydroxide (OH^-). What complexes (oxidation states, geometries, etc.) might you expect to make good magnetic materials?



5. In mixed-ligand complexes, sterically demanding ligands can distort the “ideal” geometry one might expect for a complex. Assuming identical bond lengths, how would the crystal field splitting of a MF_5I complex differ from that of a MF_6 complex?