Homework V: Intermolecular Forces and Transition Metal Chemistry

Name: _______________________________         Due: Tuesday, November 13, 2001

1. Derive the crystal field splitting diagram for a transition metal complex with a molecular geometry that is square planar. Explain the order of the orbitals that you obtain. [4 points]
2. For the following coordination compounds, draw the sets of isomers that can be created for each compound. Label each isomer as cis or trans, fac or mer, or chiral. [8 points]

a) PtCl₂(NH₃)₂ [this molecule has square planar molecular geometry]

b) Fe(CO)₃Br₃

c) [Cu(EDTA)]⁴⁻ ← The EDTA loses an H on each of the acid sites (-C(O)OH) before it binds. Also, you may draw this as a "cartoon", as we did for [Co(en)₃]²⁺ in lecture.

d) Fe(NH₃)₂(CO)₂Br₂
3. Predict which molecule will have a higher boiling point, and support your answer with a reason. [4 points] Hint: building a model might help!

Which of these two molecules will have the higher boiling point? Why?

4. Soaps work by forming micelles (round aggregates of molecules) around non-polar "dirt" molecules and making them soluble in water. If the following is a typical soap molecule, what part interacts with water? What type of intermolecular forces occur between soap and water? What part of the molecule interacts with the non-polar dirt? What type of interactions occur between soap and dirt? [4 points] Hint: the sodium ion floats away in water.

Soap scum forms when soap is in contact with Ca$^{2+}$ or Mg$^{2+}$ ions in hard water. Why is soap scum insoluble in water? [2 points]

5. Using the appropriate d-orbital splitting diagram, determine the number of unpaired electrons in each of the following inorganic compounds. (3 points)

$[\text{Co(CO)}_6]^{2+}$
Na₂[NiCl₄]

Number of unpaired electrons: ______________

[Mo(H₂O)₆]²⁺

Number of unpaired electrons: ______________

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