

**Chem 155 Homework #9** Due at the start of class on **Mon. Mar. 9**

Reading: Chapter 6, begin Chapter 20 (yes, back to 20!)

Note 1: It is easy to be overwhelmed by chapter 20. I recommend reading the homework problems FIRST, then reading the chapter to focus on the sections needed to answer the homework (and those covered in lecture).

*Note 2: You'll hopefully find this homework easier than average. This is your hint to start your lab 5 write up before Monday night.*

**Chapter 6 Problems:**

**6.8**

**6.9**

**6.17**

**6.20**

**6.28**

**6.33**

**Chapter 20 Problems:**

**20.31**

**20.35**

**20.39**

**Additional Problems:**

- 1) Discuss the experimental evidence supporting the existence of molecular orbitals. Explain how a chemist might measure the energy of an electron in a particular molecular orbital.
- 2) When we breath in air,  $O_2$  is taken up in the blood by the protein hemoglobin, which contains  $Fe^{2+}$  ions bound to a heme group [(heme) $Fe^{2+}$ ]. The iron-heme reversibly binds  $O_2$ , picking it up and releasing it in the other tissues (see Oxtoby, pp. 284-286). In the bound form (oxygenated heme), one electron is transferred from the iron to the  $O_2$  so that this species can be described as [(heme) $Fe^{3+}(O_2^-)$ ]. Is the oxygen-oxygen bond length in heme longer or shorter than the bond in  $O_2$ . Explain.
- 3) Find a paper with a molecular orbital measurement that shows an experimental measurement of a molecular wavefunction (e.g. via STM, angle resolved UPS, or otherwise). Include a printout on your homework and the citation.
- 4) Draw, and label the hybridization, and bond angles of each carbon atom in:
  - a) toluene
  - b) butane
  - c) acetic acid
  - d) methyl cyanate