CHEM 150 Chemistry for Engineers, Fall 2013
Homework Assignment #4
Due in class Friday, October 4, 2013

Instructions: Your solutions to these problems should be complete (that is, don't just write down the answer – show the process!), neat, well organized, well written (that is, using grammatically correct complete sentences!). You may discuss the problems and problem solving strategies with other students, but the work you turn in must be your own.

You should include your name, laboratory section time and TA name on the upper right hand corner of your homework. In addition, the pages of your homework assignment should be stapled together – PRIOR TO BRINGING TO CLASS! On the due date, please turn in your assignment in class to the folder corresponding to your lab section.

Problems from Text:

***Chapter 7*:** 7.34, 7.39, 7.42, 7.48, 7.50, 7.52, 7.92, 7.94

***Chapter 8*:** 8.22, 8.26, 8.29, 8.31, 8.32, 8,35, 8.38

Additional Problems:

1. Explain the difference between solids, liquids and gases in terms of their intermolecular forces
2. Explain why molecular chlorineCl_2 is a gas while molecular bromine, Br_2 is a liquid.
3. How many nodes are in a σ_s molecular orbital? In a σ_s* orbital? In a σ_p orbital? In a σ_p* orbital? In a π orbital? In a π* orbital? Arrange these orbitals according to the number of nodes. Based on nodes, arrange the orbitals in terms of their energy.
4. What is the bond order of the dimer Na_2? Justify your answer with a molecular orbital energy diagram.
5. Molecular and ionic oxygen species play a role in atmospheric, biological, and oxide semiconductor catalyzed processes. These species include molecular oxygen, O_2, the peroxide ion O_2^{2-}, and the superoxide ion O_2^{-}-. Evaluate the stability of these species by drawing the molecular-orbital diagram, filling in the electrons for each oxygen species, and predict the order of stability for these diatomic species. Identify which are paramagnetic and which are diamagnetic.
6. Sketch the bonding orbital for a combination of an *s* orbital on one atom and a *p* orbital on another. Sketch the anti-bonding combination. Do you expect the bonding combination to higher or lower in energy than a similar *s*–*s* combination? Why?
7. Sketch the molecular-orbital diagram of C_2^{2-} and compare it with that of N_2. Predict how the two compare in terms of bond order and bond length.
8. Use molecular orbital energy diagrams to predict the bond order and magnetism of each of the following molecules: (a) Ne_2 ; (b) P_2
9. What are the relationships between bond order, bond energy, and bond length? Which of these quantities can be measured?
10. Which of the following are predicted to be stable? Justify your answers (include molecular orbital diagrams): (a) H_2^{+}, H_2, H_2^{-}, H_2^{2-}; (b) Be_2, B_2, Li_2