NAME:_____ SECTION:_____
STUDENT NUMBER:_____

CHM 1045, 2001
General Chemistry I. – Gelb

Homework #12. Total: 10 points.

Turn this homework in to either Dr. Gelb's mailbox in Dittmer, or your TA's mailbox in HTL, **by 2:00 PM, Monday, December 10th.**

Read the questions carefully! You must **show your work** and use the correct number of significant figures in order to receive full credit for numerical problems. Remember to also put your name, number and recitation section on it! Attach additional sheets if necessary.

1. (1 point.)

   (a) The ionization energy of molecular hydrogen (H_2) is greater than that of atomic hydrogen. Explain why.

   (b) The ionization energy of molecular oxygen (O_2) is less than that of atomic oxygen. Explain why.

   (c) Does molecular fluorine has a higher or lower ionization energy than atomic fluorine?

   (d) Does O_2^{2-} have a higher or lower ionization energy than F_2?

2. (1 point.) Arrange the following substances in order of increasing melting point: NaOH, CH_3OH, LiOH, C_6H_5OH. Give reasons to support your answer.

3. (3 points.)

(a) Use average bond energies (Table 9.1) to calculate ΔH for the atomization (dissociation into atoms) of ethylene, C_2H_4.

$$C_2H_4(g) \longrightarrow 2C(g) + 4H(g)$$

(b) Calculate the ΔH for ethylene atomization using ΔH_f° data in the Appendix and Hess's Law. Compare your result with that from (a).

(c) Use average bond energies to calculate ΔH for the atomization (dissociation into atoms) of benzene, C_6H_6. Use a Kekulé structure for this calculation.

$$C_6H_6(g) \longrightarrow 6C(g) + 6H(g)$$

(d) Calculate the ΔH for benzene atomization using ΔH_f° data in the Appendix and Hess's Law. Compare your result with that from (c); calculate the difference between the two, which is called the *delocalization energy*.

4. (2 points.) A compound composed of 2.1% H, 29.8% N, and 68.1% O has a molar mass of approximately 50 g/mol.

   (a) What is the molecular formula of the compound?

   (b) What is its Lewis structure, if H is bonded to O?

   (c) Draw the geometry of the molecule. Label the hybridization of each atom.

   (d) How many σ and π bonds are in the molecule?

5. (1 point.) What is the strongest kind of attractive force that must be overcome to

   (a) Boil water?

   (b) melt sodium chloride?

   (c) Boil liquid bromine?

   (d) boil methanol?

6. (2 points.) Sketch the formation (*à la* Figure 10.26) of each of the following bonds. Label the signs of the "lobes" of the orbitals, as done in class. Label the *nodal planes* if there are any.

   (a) A σ-bond between an s orbital on one atom and a sp^3 orbital on a second atom.

   (b) A π-bond between two p orbitals.

   (c) A σ-antibonding orbital made from two p orbitals.

   (d) A π-bond between two d_{xy} orbitals.

   (e) A σ-bond between two d_{z^2} orbitals.

   (f) A π-antibonding orbital made from two p orbitals.