NAME:_____ SECTION:_____
STUDENT NUMBER:_____

CHM 1045, 2001
General Chemistry I. – Gelb

Homework #9 (due 11/13/2001) Total: 10 points.

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.) Write the Lewis symbols for the elements sodium through argon.

2. (1 point.) Use Lewis symbols to represent the formation of the following ionic compounds:

   (a) potassium iodide

   (b) magnesium oxide

   (c) aluminum chloride

   (d) chromium oxide

3. (1 point.)

   (a) It is known that the increase in atomic radius from Zr to Hf is smaller than the increase in radius from Y to La. Explain this observation.

   (b) Explain, in terms of electron configurations, why hydrogen exhibits chemical properties similar to those of both fluorine and lithium. Give examples to support your explanation.

4. (1 point.) Look up "valency" in the OED (`http://dictionary.oed.com`). Explain how the valency (number of valence electrons) of an atom can be equivalent to the number of hydrogens it displaces. Give an example to support your explanation.

5. (1 point.)

   (a) Does the lattice energy of an ionic solid increase or decrease as the charges on the ions increase?

   (b) The ionic substances KF, CaO and ScN are isoelectronic, and have lattice energies of 808 kJ/mol, 3414 kJ/mol and 7547 kJ/mol, respectively. Explain this trend by **calculating the ratios between these energies** and using **Coulomb's Law,** which gives the potential energy of two interacting charged particles.

6. (1.5 points.) The lattice energy of potassium bromide is 663 kJ/mol. Use the Born-Haber cycle, Hess's Law, and values for EA and I_1 from Chapter 8 and heats of formation (Appendix C) to calculate the heat of formation to potassium bromide. Write equations for all the reactions involved.

7. (1.5 points.) Use a Born-Haber cycle and values for EA and I_1 from Chapter 8 and heats of formation from the Appendix to calculate the lattice energy of sodium iodide. Write equations for all the reactions involved.

8. (2 points.)

(a) The density of Fe(s) (metallic iron) is 7.86 g/cc. Using the metallic radius of iron given in Figure 8.14 of the text, calculate the **fraction of empty space** in iron. *Hint: The volume of a sphere of radius r is $4\pi r^3/3$.* Start by calculating the volume per atom from the density.

(b) Niobium metal has the same "crystal structure" as iron, and therefore has this same fraction of empty space. If the density of Niobium is 8.57 g/cc, what is the metallic radius of a niobium atom?