**HOMEWORK PROBLEMS SET 9**

All problems must go in your homework notebook, dated and numbered sequentially. You must show the formulas used, the work and the answers where appropriate. Explanations and justifications need to be concise but thorough.

**Day 20**



1. The potential energy of a system of 2 atoms as a function of their internuclear distance is shown in the diagram above. Which of the following is true regarding the forces between the atoms when their internuclear distance is *x*.
2. The attractive and repulsive forces are balanced, so the atoms will maintain an average internuclear distance x.
3. There is a net repulsive force pushing the atoms apart, so the atoms will move further apart.
4. There is a net attractive force pulling the atoms together, so the atoms will move closer together.
5. It cannot be determined whether the forces between atoms are balanced, attractive, or repulsive, because the diagram only shows potential energy.
6. Using average bond energies (found in your textbook), calculate the enthalpy change (∆ H) for the following reactions:
7. N2H4 (g) → N2(g) + 2H2
8. C2H2(g) + 5O2(g) → 4 CO2(g) + 2 H2O(g)
9. C2H5Cl(g) + Cl2(g) → C2H4Cl2(g) + HCl(g)
10. Draw Lewis (electron dot) structures for the following sulfur and oxygen compounds:
11. SO2 b. SO3 c. SO32- SO42-
12. For which of the structures should resonance structures be shown?
13. Calculate the formal charges for each of the atoms in all of the structures above.
14. Describe the bond length between sulfur and oxygen in each of the structures above.

**Day 21**

1. For problem 3 (day 20) give the molecular geometries and bond angles for all of the substances.
2. Which substances would be polar and which would be non-polar?
3. The characteristic odor of pineapple is due to ethyl butyrate, a compound containing carbon, hydrogen, and oxygen. Combustion of 2.78 mg of ethyl butyrate produces 6.32 mg of CO2 and 2.58 mg of H2O. What is the empirical formula of ethyl butyrate?
4. Nicotine, a component of tobacco, is composed of C, H, and N. A 5.250-mg sample of nicotine was combusted, producing 14.242 mg of CO2 and 4.083 mg of H2O.
	1. What is the empirical formula of nicotine?
	2. If the substance has a molar mass of approximately 160 g, what is its molecular formula?
5. Washing soda, a compound used to prepare hard water for washing laundry, is a hydrate. Its formula can be written as Na2CO3● X H2O, where X is the number of moles of H2O per mole of Na2CO3. When a 2.558 g sample of washing soda is heated at 125 ⁰C, all the water of hydration is lost, leaving 0.948 g of Na2CO3. What is the value of X?