CH302 Spring 2009 Worksheet 1 Answer Key: A Little Thermo Review

1. What two processes (a.k.a. path functions) can transfer internal energy between a system and its surroundings? What symbols are used for these variables?
Heat and work. *q* for heat and *w* for work.

2. Write a good definition for a state function.
A state function is a property of a system which is dependent exclusively on the state of the system and not the processes leading to that state.

3. Name some state functions.
Temperature, Volume, Pressure, Number of Moles, Gibb's Free Energy, Entropy, Enthalpy, Internal Energy, etc.

4. The first law states that the value of which state function is conserved in an isolated system? What **two** symbols are used for this state function?
Internal energy (E or U).

5. What is an isolated system? Name the most obvious example of an isolated system (hint: big).
A closed system is one that exchanges neither matter nor energy with its surroundings. The universe is the most obvious example because it has no surroundings.

6. What **inequality** is often associated with the second law of thermodynamics? What does it mean in plain English?
$\Delta G_{univ} > 0$. This means that the entropy of the universe is always increasing.

7. What **equality** is often associated with the second law of thermodynamics? What does it mean in plain English?
$\Delta G_{univ} = \Delta G_{system} + \Delta G_{surroundings}$. This means that the universe's change in entropy is the sum of the system's and surrounding's change in entropy

8. What does the third law of thermodynamics state?
It states that the entropy of a perfect crystal will approach zero as its temperature approaches zero.

9. How many translational, rotational and vibrational modes, respectively, does C_2H_4 have?
It has 3 translational, 2 rotational, and 13 vibrational modes.

10. What would be the total internal energy associated with the vibrational motion of 1 molecule of C_2H_4? What about 1 mole of C_2H_4?
since E = 0.5kT for each mode, one molecule would have 6.5kT and one mole 6.5RT.

11. In the list of elements below, mark (circle, underline, etc.) all of the elements that are not shown in their standard state.
$C_{diamond}$(s) Ca(s) **B_2(s)** Na(s) Fe(s) **Hg(s)**
Br_2(l) Mo(s) **H(g)** He(g) Xe(g) **Rb_2(s)**
Cd(l) As(s) **N_2(l)** **O_2(l)** **Si_{60}(s)** F_2(g)

12. Write the standard formation reactions for the following chemical species
NH_3(g)
$1/2N_2(g) + 3/2H_2(g) \rightarrow NH_3(g)$
Fe_2O_3(s)
$2Fe(s) + 3/2O_2(g) \rightarrow Fe_2O_3(s)$
O_2(l)