

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

- 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.
- 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.
- Name some state functions.  
Temperature, Volume, Pressure, Number of Moles, Gibb's Free Energy, Entropy, Enthalpy, Internal Energy, etc.
- 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  $U$ ).
- 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.
- What **inequality** is often associated with the second law of thermodynamics? What does it mean in plain English?  
 $\Delta G_{\text{univ}} > 0$ . This means that the entropy of the universe is always increasing.
- What **equality** is often associated with the second law of thermodynamics? What does it mean in plain English?  
 $\Delta G_{\text{univ}} = \Delta G_{\text{system}} + \Delta G_{\text{surroundings}}$ . This means that the universe's change in entropy is the sum of the system's and surrounding's change in entropy.
- 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.
- How many translational, rotational and vibrational modes, respectively, does  $\text{C}_2\text{H}_4$  have?  
It has 3 translational, 2 rotational, and 13 vibrational modes.
- What would be the total internal energy associated with the vibrational motion of 1 molecule of  $\text{C}_2\text{H}_4$ ? What about 1 mole of  $\text{C}_2\text{H}_4$ ?  
since  $E = 0.5kT$  for each mode, one molecule would have  $6.5kT$  and one mole  $6.5RT$ .
- In the list of elements below, mark (circle, underline, etc.) all of the elements that are not shown in their standard state.  

<b>Cdiamond(s)</b>	Ca(s)	<b>B<sub>2</sub>(s)</b>	Na(s)	Fe(s)	<b>Hg(s)</b>
Br <sub>2</sub> (l)	Mo(s)	<b>H(g)</b>	He(g)	Xe(g)	<b>Rb<sub>2</sub>(s)</b>
<b>Cd(l)</b>	As(s)	<b>N<sub>2</sub>(l)</b>	<b>O<sub>2</sub>(l)</b>	<b>Si60(s)</b>	F <sub>2</sub> (g)
- Write the standard formation reactions for the following chemical species  
 $\text{NH}_3(\text{g})$   
 $\frac{1}{2}\text{N}_2(\text{g}) + \frac{3}{2}\text{H}_2(\text{g}) \rightarrow \text{NH}_3(\text{g})$   
 $\text{Fe}_2\text{O}_3(\text{s})$   
 $2\text{Fe}(\text{s}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{Fe}_2\text{O}_3(\text{s})$   
 $\text{O}_2(\text{l})$