

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 C_2H_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 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 $6.5RT$.
- In the list of elements below, mark (circle, underline, etc.) all of the elements that are not shown in their standard state.

Cdiamond(s)	Ca(s)	B₂(s)	Na(s)	Fe(s)	Hg(s)
Br ₂ (l)	Mo(s)	H(g)	He(g)	Xe(g)	Rb₂(s)
Cd(l)	As(s)	N₂(l)	O₂(l)	Si60(s)	F ₂ (g)
- Write the standard formation reactions for the following chemical species
 $\text{NH}_3(\text{g})$
 $\frac{1}{2}\text{N}_2(\text{g}) + \frac{3}{2}\text{H}_2(\text{g}) \rightarrow \text{NH}_3(\text{g})$
 $\text{Fe}_2\text{O}_3(\text{s})$
 $2\text{Fe}(\text{s}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{Fe}_2\text{O}_3(\text{s})$
 $\text{O}_2(\text{l})$