September 16, 2003

(Example on board.) Notes:

- Exam 1 is next Tuesday and covers: Chapter 15; 60% -- M. C. & 40% -- Free Response. *Look at some of my old tests to know how you will be able to answer the questions.*
- CSB due next Friday 5 pm. 8, 21 (don’t need to do all of it this time). *For 1 point, show me that you are working on it… At the end of the semester I will check for work done. Even with only doing one section now, you can earn the 1-point.*
- BOP’s due next Thursday by 5 pm, for full credit. (Will collect in class) *purpose of these is to help you for the exams.*
- Laboratory review Thursday 7 pm. *Thursday will keep it fresh in your mind.*
- Exam review is on Sunday At 2 pm, here. *At this time there is a turf war on who is getting what room, so we should be okay for being here.*
Teacher: **standard state condition**

*What does this mean by standard state?* You need to know what the thermodynamic state is of a substance. Thermodynamic standard state of a substance is its most standard stable state under standard pressure and at some $T$, usually $25^\circ C$; this is not the STP. You need to know the elements in their standard state: you need to know the formula and state.

Elements in their standard state (Example on board.):
- Hydrogen $H_2$ g
- Helium $He$ g
- Chlorine $Cl_2$ g
- Bromine $Br_2$ l
- Iodine $I_2$ s

*(See additional notes for other elements)*

Look in App. K (thermo quantities). (Example on board.) This is meaning at 1 atmosphere, this means we are at the specific temperature. The amount of heat absorbed in a rxn where 1 mol of solution is a specific state is formed from elements in their standard state. This del H in a very defined rxn. That is the number.

Lets look at that rxn.
(Example on board.). We are working with water as a liquid; we are making 1 mol of water as a liquid. We want to balance the equation and keep the 1 in front. Water is made of H2O, which means \( \text{H}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \). Now, how do you keep the 1? You add a \( \frac{1}{2} \), so you get this equation: \( \text{H}_2 (\text{g}) + \frac{1}{2} \text{O}_2 (\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \)

So, how much heat is released when 2 moles of \( \text{H}_2\text{O} \) are formed from elements in standard state? Is the answer – 2(285.8) kJ or +2(285.8) kJ? It’s the +2, but you used the words, so you don’t need the sign \(-/+\) in front. When you use delta, you have to put the sign, but when using the words, you can just stick with the positive value. How much heat is released when 5 g of \( \text{O}_2 \) reacted with excess \( \text{H}_2 \) in this rxn?

\[
\text{Heat} = \frac{5 \text{ g O}_2 \times 1 \text{ mol O}_2}{320 \text{ g O}_2}
\]

Now, notice the del H for any element on a compound in its standard state is 0. If you don’t know the elements SS, then you can look in the table and see the element with 0, is linked to its SS.
Hess’ Law of heat summation

Del H is a state function and is independent of path. Does not matter how the reactant gets to the product, as long as the del H is the same no matter which path. (Example on board.) The del H must be the same, regardless of the path taken.

Suppose we want the del H for A \rightarrow D. We know some paths (Example on board.) so all we have to do is add up the del H and that then becomes 25 kJ. Let me show you another way… (Example on board.).

There are 2 applications so lets do one of them now.

1) N2o (g) + no2 (g) \rightarrow 3no(g)
   delHrxn = ? delH formation = delH reaction

You have 3 equations and you must algebraically manipulate the equations and their delH rxn to get the rxn we want. (Example on board.).

When you flip the equation, remember to change the sign…
Hess’ Law of heat summation, cont’d…

Hess’ law – type 2 problem is another way to find the del H and write it mathematically as this: the symbol is the sum; n is mole for stoichi coeff. Etc.

Calculate del Ho298, rxn for combustion of 16.8 (g) of propane (MW 44.02 g/mol), which we got from App K. You wont get the App so I will give you the information you need. (Example on board.)

C3H8 (g) …

It is always products minus reactants. Then you plug in the numbers and do the math. Remember you are subtracting and watch your signs. The neat thing about summation is that it works for all of the equations.

Anyway, del = -2219.9 kJ/mol rxn. Is this it? No go back to the equation and we want to know the delH of the rxn (Example on board.). You must make sure to have the same units by changing g to mols. In this, you end with delH = – 848 kJ.
Entropy, written as $S$, is the drive for more disorder. Entropy is the thermodynamic measure of disorder. **Second law of thermodynamics:** in a spontaneous rxn, the entropy (disorder) of universe – (not necessarily the system) – increases. This is the nature of things and entropy is the measure of this. You can measure the absolute standard molar entropy, not the change, of this disorder and it is always positive. (Example on board.), you would expect a gas to be more disordered than a solid. We use the numbers to calculate the change of entropy of a system. In general for a substance, the $S$(naught) of formation solid < liquid < gas.

**Third law of Thermodynamics** shows the entropy of a perfect, pure crystalline substance at $0K = zero$.  
$\Delta S$ + disorder increasing (order decreasing)  
$\Delta S$ – disorder decreasing (order increasing)  

**Quiz 4** – take out paper!

(Example on board.)… Writing 3 equations… From this information, find the $\Delta H$ of this reaction. You will get one on your exam! These are our normal quizzes… Find your friends, check your answers, help your neighbors, and get help from your neighbor… We want this to be a kinder friendlier time.
I need to see your work. On your exam, if you just give me the answer, you won’t get credit. Always explain what you do! I want to see you write down the equations and see what you do to each of these equations. The process is more important than the answer.

Anyone lost? Okay let me walk you through this… You are looking for the reactants that only occur one time. Start with Na2O… Using (3), you divide that by 2 to get this. Next you look for SO3, which occurs in (2). Make sure you cancel through and show me all your work.

It can get confusing, so make sure you write down your transformed equations, so you can see how they cancel.

The words del Ho (naught) is that little circle.