

THERMOCHEMISTRY SYLLABUS

THERMOCHEMISTRY: The study of the energetics of reactions, bonds and phase changes.

I. Major Topics:

- A. Different types of energy and other definitions
- B. Endothermic/ Exothermic Reactions and Energy Diagrams
- C. Thermochemistry Stoichiometry
- D. Constant-volume Calorimetry (Bomb Calorimeters)
- E. Constant-pressure Calorimetry
- F. Standard Enthalpy of Formation and Reaction
- G. Hess's Law
- H. Heat of solution
- I. Foods and Fuels

II. Objectives/Guidelines:

1. Familiarize yourself with the different types of energy important to chemistry {Thermal, Chemical, Potential and Kinetic}. Be able to categorize the different types as either a type of potential or kinetic energy.
2. Be able to define heat and distinguish it from thermal energy.
3. Understand the difference between a temperature measurement and an amount of energy. In other words, a bucket of water and a cup of water might have the same temperature but which one has more energy?
4. Understand the difference between a closed system, open system and insulated system. Through which systems is heat transfer is permitted?
5. Know the difference between an exothermic and endothermic reaction. Be able to illustrate any reaction on an energy diagram. If it's exothermic, are the products or the reactants more stable?
6. Define enthalpy.
7. Be able to perform thermochemistry stoichiometry. What is the ΔH of a reaction (given off -, or absorbed +) per mole of substance? Per gram? How much energy will be exchanged if 50 moles are reacted?
8. Understand the purpose of calorimetry and the premise that it is based on $q_{\text{released}} = - q_{\text{absorbed}}$
9. Understand the differences and similarities between bomb calorimetry (constant-volume) and constant-pressure calorimetry. Remember, calorimeters don't necessarily have to contain water. If the heat capacity of the calorimeter is reasonably large, the calorimeter itself is sufficient.
10. Practice calorimetry problems.
11. Be able to calculate and compare/contrast the heat capacity and specific heat of a substance. Which one is an intensive property and which one is an extensive property? Make sure to pay attention to UNITS.
12. What does ΔH°_f refer to? The heat given off (absorbed) to make 1mole of a certain compound from it's most stable elements.
13. Be able to write formation reactions. Why are ΔH°_f values often negative values? Explain in terms of bond breaking vs. bond making. Going from an unstable situation to a stable situation always liberates energy
14. What substances always have zero heat of formation values (ΔH°_f)?
15. Using Hess's Law and ΔH°_f for different substances, be able to determine ΔH_{rxn} .
16. Using Hess's Law, be able to determine $\Delta H^{\circ}_{\text{rxn}}$ from a series of intermediate reactions. Be careful with your book keeping.
17. What are the two steps that occur when an ionic substance is dissolved in water? Explain why each of the two steps is either exothermic or endothermic. Remember that hydration is a stabilizing effect. How do you calculate the total $\Delta H^{\circ}_{\text{soln}}$ of an aqueous ionic solid? Add up the three ΔH values! $\{\Delta H_1(\text{break solute/ionic bond}) + \Delta H_2(\text{break solvent/IMF}) + \Delta H_3(\text{ionic solute/solvent interaction, attractive forces}) = \Delta H^{\circ}_{\text{soln}}\}$
18. What is the first law of thermodynamics? Remember, some of the total energy in a system is frequently lost to do work (heat/friction, etc).

Complete the following problems from your Brown, LeMay & Bursten chemistry text. Show all of your work! (No Work = No Credit). The answers to the odd numbered problems are in the back of your text. It is your responsibility to get yourself in an academic position to answer ALL of these problems. If needed – PLEASE ASK ME FOR HELP!

Problem Set #5: problems 5.1, 5.3, 5.8, 5.11, 5.17, 5.20, 5.22, 5.27, 5.30.

Due Date: _____

Problem Set #6: problems 5.38, 5.50, 5.51, 5.57, 5.60, 5.67, 5.68. In addition to the book problems, also complete the handout, *ADDITIONAL CALORIMETRY PROBLEMS*. Work all problems on a separate sheet. Do NOT just scribble in the margins of the handout.

Due Date: _____