

Chapter 6 Thermochemistry -homework sets form pages 254 – 263 (Chang)- **Set 1:** 16, 20, 26, 28, 34; **Set 2:** 38, 52, 54, 62, 74; **Set 3:** 80, 88, 98, 100, 108; **Set 4:** 113, 118, 122.

I. Energy

- a. The _____ . _____ – directed energy change resulting from a process.
- b. _____ – energy of motion $E_k = \frac{1}{2} mv^2$ (m=mass,kg; v=velocity, meters/sec)
- c. _____ – energy of position
- d. _____ – solar ; energy from the sun
- e. _____ – energy from the random motion of atoms or molecules
- f. _____ - energy stored in chemical structures, from reactions
- g. _____ – energy from the atom
- h. Law of Conservation of Energy – _____

II. Energy in Chemical reactions

- a. _____ – transfer of thermal energy from high heat to low heat
- b. _____ – study of heat change in chemical reactions
- c. _____ – the part of the universe we are concerned about
- d. _____ - the part of the universe outside of the system
 - i. _____ – can exchange mass and energy between system and surroundings
 - ii. _____ – can only exchange energy not mass between system and surroundings
 - iii. _____ – no exchange of energy or mass between system and surroundings
- e. _____ – energy given off; energy given to surroundings by the system; products of reaction have less energy than reactants
- f. _____ – energy taken in; energy given to the system by surroundings; products of reaction have more energy than reactants.

III. Thermodynamics

- a. The study of the _____ of heat and other kinds of energy
- b. _____ functions – _____, _____, _____ and _____; properties determined by the state of the system not how the state was achieved. Example – skiing down a mountain
- c. First Law – _____
 - i. The energy change of _____ + the energy change of _____ = _____.
 - ii. $\Delta E = q + w$; the _____ (ΔE) of a system is the sum of the _____ exchange (q) between the system and the surroundings and the _____ done (w) on (or by) the system.
 1. $q = _$ when _____ – heat absorbed by system from surrounding

2. $q = \underline{\hspace{2cm}}$ when $\underline{\hspace{2cm}}$ - heat given to surroundings by the system
 3. $w = \underline{\hspace{2cm}}$ when work is done $\underline{\hspace{2cm}}$ the system $\underline{\hspace{2cm}}$ surroundings
 4. $w = \underline{\hspace{2cm}}$ when work is done $\underline{\hspace{2cm}}$ the surroundings $\underline{\hspace{2cm}}$ the system
- d. Work is defined as $\underline{\hspace{2cm}}$ times $\underline{\hspace{2cm}}$; $w = f \times d$ which can be changed into pressure and volume. Pressure = $\underline{\hspace{2cm}} / \underline{\hspace{2cm}}$ ($\underline{\hspace{2cm}}$) and $\underline{\hspace{2cm}} = (\underline{\hspace{2cm}})$ so if we multiply pressure \times volume = force / $d^2 \times d^3 = f \times d$ so work is now $w = -P\Delta V$ which has units of $L \cdot atm$ and = 101.3 J. Work is $\underline{\hspace{2cm}}$ a state function.
- e. Heat is $\underline{\hspace{2cm}}$ a state function.

IV. Enthalpy of Chemical Reactions

- a. $\underline{\hspace{2cm}}$ (H) is basically the energy of a system plus the pressure times the volume of that system. $\underline{\hspace{2cm}}$ and since all are state functions then we can find changes $\underline{\hspace{2cm}}$, no change in pressure is common.
- b. Enthalpy of a reaction, $\Delta H = \underline{\hspace{2cm}} - \underline{\hspace{2cm}}$. If ΔH is $\underline{\hspace{2cm}}$ then $\underline{\hspace{2cm}}$ since the products have more enthalpy than reactants which means the reaction absorbed energy. If ΔH is $\underline{\hspace{2cm}}$ then $\underline{\hspace{2cm}}$ since the products have less enthalpy than reactants which means the reaction gave off energy.
- c. For our reality $\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$, $\Delta H = \Delta E$.

V. Calorimetry

- a. $\underline{\hspace{2cm}}$ - energy needed to raise the temperature of a substance one Celsius degree. (J / C^0)
- b. $\underline{\hspace{2cm}}$ (C_p) Chang -(s) - energy needed to raise the temperature of one gram of a substance one Celsius degree. (J / gC^0)
- c. $q = ms\Delta T$ Energy = $\underline{\hspace{2cm}}$
- d. $\underline{\hspace{2cm}}$ - a special insulated container that does not allow for heat exchange from system to surroundings.
- e. PRACTICE PROBLEMS!!!!!!

VI. Enthalpy of Formation (ΔH^0_f)

- a. This is the heat change that results when I $\underline{\hspace{2cm}}$ of a substance is $\underline{\hspace{2cm}}$ from its $\underline{\hspace{2cm}}$ at 1 atm.
- b. ΔH^0_f of elements, in most stable form, is equal to $\underline{\hspace{2cm}}$
- c. These can be used to determine the Enthalpy of reaction ΔH^0_{rxn}
 - i. $\Delta H^0_{rxn} = \Sigma \Delta H^0_f(\text{products}) - \Sigma \Delta H^0_f(\text{reactants})$
 1. use this for direct method
- d. Can use $\underline{\hspace{2cm}}$ Law to determine ΔH^0_f

- i. The overall Enthalpy of reaction is equal to the sum of its parts the parts being other reaction pathways to get to the final destination. This is possible since ΔH^0_f is a state function.
- ii. Using a series of reactions, reversing them as needed, reactions are added, reactants and products are added and subtracted as needed. When reactions are reversed the ΔH^0_{rxn} signs are also reversed and if they are multiplied then ΔH^0_{rxn} are also multiplied.
- iii. PRACTICE PROBLEMS!!!!!!!!!!

VII. e. The more negative the ΔH^0_f the more stable the compound
Heat of solution and dilution

- a. Δ _____
- b. $U =$ _____
- c. Δ _____
- d. Heat of Dilution is energy associated when more solvent is added to a solution.