Chapter 5: Thermochemistry

1. Distinguish between heat, energy, and work.
2. Distinguish between exothermic and endothermic reactions
3. Use the thermochemical equation to calculate the heat evolved or absorbed when a given amount of reactant is converted to products
4. Interpret a thermochemical equation in terms of sign conventions for ΔH and amounts of reactants consumed
5. Use specific heat to determine temperature changes and quantities of heat. ($q = sm\Delta T$)
6. Inter convert joules and calories.
7. Explain how to use a Styrofoam coffee cup calorimeter and interpret the data obtained.
8. Calculate the heat of a reaction at constant volume, using bomb calorimetry data
9. Apply Hess law of constant heat summation.
10. State the definitions of "standard state" and "standard formation reaction" and write the standard formation reaction for any substance.
11. Calculate the $\Delta H°_{rxn}$ for any reaction using the table of $\Delta H°_f$
12. Define the heat of solution and the heat of dilution
13. Describe the energy changes that occur during the solution process and apply Hess law to calculate the enthalpy of solution
14. State the meaning of the concept "state function," especially as demonstrated by enthalpy.
15. Calculate the work done when a gas expands
16. Write the equation for the first law of thermodynamics and give the sign conventions of q and w
17. Relate ΔE and ΔH
18. Describe vaporization, including its enthalpy change, ΔH_{vap}, using the latter in calculations.

Energy	energy is the capacity to do work
Heat flow	Heat flows from regions of higher temperature to regions of lower temperature
KE units	$1\ J = 1\ kg{\bullet}m^2/s^2$
First law of thermodynamics	The law of conservation of energy; energy is conserved; the total energy of the universe is constant;
systems vs surroundings	the contents of the vessel are the system; everything else is the surroundings
signs on q	A positive sign means heat added to the system; a negative value means heat removed from the system.
signs on w	a positive sign means work is done by the surroundings on the system; a negative sign means work is done by the system on the surroundings
meanings	$\Delta E = q + w$, when $q>0$, heat is transferred to the system. $w>0$, the surroundings do work on the system.
Exothermic vs. endothermic	reactions and processes that evolve heat are exothermic; reactions and processes that consume heat are endothermic. For an endothermic reaction, the reactants have lower enthalpies than do the products (ΔH is positive). For an exothermic reaction, the reactants have higher enthalpies than the products (ΔH is negative)
state functions	State functions do not depend on the pathway; they depend on the state or the condition of the system. The initial and final states of the system become very important when discussing state functions. He at 25°C is at a different energy state than He at 27°C.
ΔH	the heat exchange at constant pressure is enthalpy. Many chemical reactions are done at constant pressure.
enthalpy changes	The physical states of the reactants and products need to be considered when calculating ΔH.
molar heat capacity	heat capacity expressed on a per mole basis
specific heat	Heat capacity expressed on a per gram basis; if the specific heat is given for a substance, the mass is also required. If the total heat capacity is given, the mass is not needed.
heat magnitude	heat is gained or lost on the same magnitude but different signs
Hess's Law	If a reaction is carried out in a series of steps, ΔH for the reaction will be equal to the sum of the enthalpy of the changes for the individual steps. Hess's law is a direct consequence of the fact that enthalpy is a state function.
ΔHf ΔH°_f	the enthalpy of formation; the enthalpy for the reaction forming the substance from the pure elements. At standard conditions (0.987 atm, 1000 Pa, 298K) this is called the standard enthalpy

	of formation. For the most stable form of an element at standard conditions, ΔH_f° is zero
ΔH_{rxn}°	$\Delta H_{rxn}^\circ = \sum n\Delta H_f^\circ(\text{products}) + \sum n\Delta H_f^\circ(\text{reactants})$ The sums must be completed before subtracting
Enthalpy	Is not stored as heat. Heat is the manner in which the energy is transferred between the system and the surroundings. The enthalpy is a measure of the capacity of the system to supply energy as heat when a certain change occurs.