Chemistry Notes 11/15/13

- Solid → Gas: Sublimation
  - Endothermic reaction (ΔH_{sub})
- How much energy is required to convert 100mL of water at its boiling point from liquid to vapor? (ΔH_{vap} = 40.7 kJ/mol)
  - Density = 1g/mL
  - 100mL H_2O = 100g H_2O
  - H_2O = 18.02amu
  - 100/18.02 = 5.55 mol
  - 40.7*5.55 = 226kJ

Heat Capacity

- Temperature required to raise the temperature of a substance

Specific Heat

- Heat required to raise the temperature of one gram of a substance by one degree Celsius/Kelvin

1. How much heat is required to heat 100g of water from 25 degrees Celsius to 100 degrees Celsius? (Specific heat = 4.184 J/gC)
   a. 4.184*100g*75 C = $3.14x10^4$J = 31.4kJ

- (heat) = (mass)(specific heat)(change in temperature)

2. What is the specific heat of iron if it requires 13kCal of heat to raise temperature of 755g from 23 degrees to 175 degrees Celsius?
   a. C_p = 0.11 Cal/gC

Calorimetry

- Measurement of heat flow in or out
  - Measured by calorimeter
- $q_{rxn} = -q_{solution}$
  - Heat of the system = negative heat of the surroundings

1. A student mixes 50.0mL of 1.0M HCl and 50.0mL of NaOH in a calorimeter. The T of the resulting solution increases from 21.0 degrees Celsius to 27.5 degrees Celsius. Calculate ΔH_{rxn} (Assuming the calorimeter loses negligible heat)
   a. $q_{solution}$ = (100)(4.184)(6.5) = 2700J
   b. $q_{rxn} = -(q_{sol})$ = -2700J for 100g
   c. What is the <u>molar</u> heat of reaction?
      i. HCl + NaOH → H_2O + NaCl
      ii. 0.050L * 1.0mol/L = 0.050mol HCl
      iii. ΔH_{rxn} = -2700/0.050 = -54000J/mol = -54kJ/mol

How to find ΔH other than direct measurement

- Use bond dissociation energies
    - The amount of energy needed to break a covalent bond
    - Represented by the letter D and will be provided on a table for the test
- Ex. Cl_2 has a bond dissociation energy D = 243kJ/mol
- ΔH_{rxn} is dependent on the amount of energy required to break bonds versus the amount of energy released when new bonds form

1. What is ΔH_{rxn} using bond dissociation energies for: $H_2 + Cl_2 \rightarrow 2HCl$
    a. H – H + Cl – Cl → 2(H – Cl)
        i. Line represents a single bond
    b. D_{H-H} = 436 kJ/mol
    c. D_{Cl-Cl} = 243 kJ/mol
    d. 436+243 = +679 kJ/mol
    e. D_{H-Cl} = 432 kJ/mol
    f. 432*2 = -864kJ/mol
    g. 679 – 864 = -185kJ (exothermic reaction)