Teacher Bullet Notes: Thermochemistry and Thermodynamics

Thermochemistry

- Sensible/latent heat processes

Calorimetry

- Sign convention for q
- Coffee cup calorimeter/Heats of solution
- Bomb

Thermochemical Reactions

- Exothermic/endothermic
- Laws of Hess
- Heat of reaction
  - Formation reactions/heats of formation
  - Chemical bond energy calculations

Thermodynamics

- General contextual stuff
  - Thermodynamics tells us if a reaction will spontaneously occur and if so, the extent to which it will occur. This is the second half of the chemical reaction picture, the first half kinetics told us how quickly a reaction would happen.
  - Energy can exist in many different forms. By and large thermodynamics looks at energy in the forms of heat and work.
  - Naturally occurring processes are a balance between nature's desire to minimize energy and maximize randomness.

Thermodynamic Laws

First Law $\Delta u = q - w$ or $\Delta u = q + w$ (depends on how you define w)

- Convention for the sign of q
- Convention for the sign of w
- State functions and what they mean. (U, H, S)

Second Law of Thermodynamics

- Spontaneous natural processes are accompanied by an increase in the entropy of the universe.
  - $\Delta S > 0$ more disorder
  - $\Delta S < 0$ less disorder

Third Law of Thermodynamics

- Entropy = 0 at 0K

Mechanics of calculating changes in enthalpy, ΔH, and entropy, ΔS

- Standard state condition notations
  - ΔH°_{298}, ΔS°_{298} –--> 298K 1 atm, unit activities (pure substances)
  - ΔH°, ΔS° –--> unit activities
  - ΔH, ΔS –--> no restrictions
- ΔH°_{298} –--> from heats of formation
- ΔS°_{298} –--> from S°_{298} tables
  - Elemental reactants/products have values.

Gibbs-Helmholtz equation—Gibbs Free Energy

- $\Delta G = \Delta H - T\Delta S$ <-- greatest equation in chemistry
- Determination of spontaneity, ΔH, T, ΔS influences.
- ΔG°_{298} from tables of Gibbs free energy
- ΔG°_{298} from entropy, enthalpy data.
- Nonstandard state ΔG values
  - $\Delta G = \Delta G^\circ + RT \ln Q$ (nonequilibrium)
  - $\Delta G^\circ = -RT \ln K$
    - Equilibrium from thermodynamics