Unit 7: Equilibrium

Reversible Reactions

- Chemical reactions are reversible in the molecular level in any directions
- Dynamic Chemical equilibrium is when a reaction and its reverse are happening at the same rate
- Le Chatelier's Principle
    - When a system at equilibrium is stressed by a change in conditions, the system will adapt itself to counteract the change and come back to equilibrium
    - $aA + bB \leftrightarrow cC + dD$
    - $K_c = (C)^c(D)^d / (A)^a(B)^b$
        - K_c is the equilibrium constant
    - $Q = (C)^c(D)^d / (A)^a(B)^b$
        - The reaction quotient is similar but used for problems where the reaction measure is not at equilibrium
    - Q and K can be compared to find out which direction a chemical reaction will go
        - If K > Q, the reaction will go forward
        - If K < Q, the reaction will proceed in the reverse direction
        - When K = Q, the reaction is at equilibrium
    - Only reactants that can change concentration or pressure help with the calculation of K or Q
    - Solid and liquid reagents are not included in the equilibrium constant calculation
    - Changing pressure can affect chemical equilibrium; higher pressure means fewer particles
    - Changing temperature can affect equilibrium constants depending on whether the reaction is endothermic or exothermic
    - Sometimes catalysts are added to a reaction to increase the rate of reaction

Solubility Equilibria

- Solubility is the ratio of the maximum amount of solute to the volume of the solvent in which solute can dissolve. This is expressed in grams of solute per 100g of water or moles of solute per liter of solution
- Equilibrium is associated with dissolving solids in H2O that form aqueous solutions
- Each of the molecular solids dissolves to give an individual aqueous molecule
    - Ionic Solids break apart to give their positive and negative ions
    - Ionic solids can carry an electric current
    - Molecular solids don't break apart in water to give ions, so no electrical current is present
- **Solubility Product Constant**
    - $M_yX_z(s) \longleftrightarrow yM^{z+}(aq) + zX^{y-}(aq)$
    - $K_{sp} = (M^{z+})^Y(X^{y-})^Z$
        - K_{sp} is the Solubility Product Constant
        - $(M^{z+})^Y(X^{y-})^Z$ is the molar solubility of ions