**Chemistry 18.2**

**Reversible Reactions and Equilibrium**

**In the early 1900s, German chemists refined the process of making ammonia from elemental nitrogen and hydrogen.This process allows the manufacture of nitrogen fertilizers. You will learn how reaction conditions can influence the yield of a chemical reaction.**

**Reversible Reactions**

**How do the amounts of reactants and products change in a chemical system at equilibrium?**

**At chemical equilibrium, no net change occurs in the actual amounts of the components of the system.**

* + - If the rate of the shoppers going up the escalator is equal to the rate of the shoppers going down, then the number of shoppers on each floor remains constant, and there is an equilibrium.
    - A **reversible reaction** is one in which the conversion of reactants to products and the conversion of products to reactants occur simultaneously.
    - When the rates of the forward and reverse reactions are equal, the reaction has reached a state of balance called **chemical equilibrium**.
    - The relative concentrations of the reactants and products at equilibrium constitute the **equilibrium position** of a reaction.

**What three stresses can cause a change in the equilibrium position of a chemical system?**

**Factors Affecting Equilibrium:   
Le Châtelier’s Principle**

**Stresses that upset the equilibrium of a chemical system include changes in the concentration of reactants or products, changes in temperature, and changes in pressure.**

* + - The French chemist Le Châtelier proposed what has come to be called **Le Châtelier’s principle**: If a stress is applied to a system in dynamic equilibrium, the system changes in a way that relieves the stress.

**Factors Affecting Equilibrium:   
Le Châtelier’s Principle**

**Concentration**

* + - Rapid breathing during and after vigorous exercise helps reestablish the body’s correct CO2:H2CO3 equilibrium, keeping the acid concentration in the blood within a safe range.

**Temperature**

* + - Dinitrogen tetroxide is a colorless gas; nitrogen dioxide is a brown gas. The flask on the left is in a dish of hot water; the flask on the right is in ice.

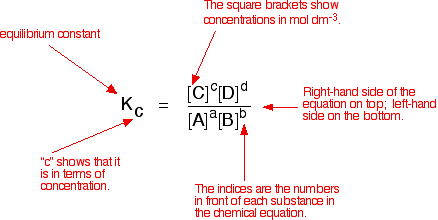
**Pressure**

* + - Pressure affects a mixture of nitrogen, hydrogen, and ammonia at equilibrium

**What does the value of *K*eq indicate about the equilibrium position of a reaction?**

* + - The **equilibrium constant** (*K*eq) is the ratio of product concentrations to reactant concentrations at equilibrium, with each concentration raised to a power equal to the number of moles of that substance in the balanced chemical equation.

**A value of Keq greater than 1 means that products are favored over reactants; a value of Keq less than 1 means that reactants are favored over products.**



**Chemistry 18.3**

**Solubility Equilibrium**

**Barium sulfate is ingested by a patient before X-ray images of the digestive tract are taken. Barium sulfate absorbs the X-rays, thereby producing light areas on the developed X-ray film. However, barium salts are usually toxic. You will learn why patients can ingest this poisonous substance without harm.**

**The Solubility Product Constant**

**What is the relationship between the solubility product constant and the solubility of a compound?**

The solubility product constant (*K*sp), equals the product of the concentrations of the ions, each raised to a power equal to the coefficient of the ion in the dissociation equation.

The smaller the numerical value of the solubility product constant, the lower the solubility of the compound.

MxAy(s) --> x My+(aq) + y Ax-(aq)

Ksp = [My+]x[Ax-]y

**The Solubility Product Constant**

**See Table 18.1 and 18.2**