Chemistry 1105 Lab: Equilibrium

Experiment introduces and investigates the concept of

1. **chemical equilibrium and**
2. **Le Chatelier's Principle**

Equilibrium

An equilibrium is a chemical system that occurs both in the forward direction and reverse direction. Reversible reaction.

Consider the following reaction,

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

The reverse reaction also occurs,

$$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$$

Equilibrium

Both reactions occur until the rate of the forward reaction equals the rate of the reverse reaction. System obtains equilibrium.

Equilibrium system written as,

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Equilibrium Position

When a system is at equilibrium the amount of reactants and products appear to be constant.

The reactant and product concentration is not equal. Equilibrium tends to favor the reactants on the left or the products on the right.

Equilibrium Position

Consider the following equilibrium

Reactants ⇋ Products

Red Blue

Equilibrium favors products: BLUE.

Equilibrium favors reactants: RED.

Heterogeneous Equilibria:

Equilibria between substances in two or more phases. Example solid and aqueous.

Ex: $AgCl(s) \rightleftharpoons Ag^{+}(aq) + Cl^{-}(aq)$

Equilibrium favors products: no solid.
Equilibrium favors reactants: solid.

Le Chatelier's Principle:

When an equilibrium is disturbed it will cause the equilibrium to shift in a direction that minimizes the effect and establish a new equilibrium.

- **Concentration Changes**
- **Pressure Changes**
- **Temperature Changes**

Concentration Changes

Ex: $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$

Increase $[Cl^-(aq)]$. Equilibrium shifts to the Left or Reactant side.
Observation: more solid.

Decrease $[Ag^+(aq)]$. Equilibrium shifts to the Right or Product side.
Observation: less solid.

Temperature Changes

Exothermic/endothermic equilibria can have position altered by temperature changes.

Consider the following ENDOTHERMIC (+ΔH) equilibria:

Reactants + heat ⇋ Products

Temp decreases: Shifts to Left or Reactants.
Temp increases: Shifts to Right or Products.