AP CHEMISTRY

TOPIC 6: EQUILIBRIUM, PART C — EXAMPLES

Day 66:

- Heterogeneous Equilibria
- Calculating Equilibrium Pressures
- Applications of the Equilibrium Constant

Heterogeneous Equilbria:

Heterogeneous equilibria is an equilibrium reaction involving reactants and/or products in more than one phase.

Experimental results have shown that the position of heterogeneous equilibrium does not depend on the amounts of pure solids or pure liquids present. The fundamental reason for this behavior is that the concentrations of pure solids and liquids CANNOT change. Therefore, if pure solids and pure liquids are involved in a chemical reaction, their concentrations are NOT included in the equilibrium expression for the reaction.

Applications of the Equilibrium Constant:

Knowing the equilibrium constant for a reaction allows us to predict several important features of the reaction:

1. the tendency of the reaction to occur (but not the speed of the reaction),
2. whether or not a given set of concentrations represents an equilibrium condition,
3. the equilibrium position that will be achieved from a given set of initial concentrations.

The inherent tendency for a reaction to occur is indicated by the magnitude of the equilibrium constant. A "K" value much larger than one (1) means that at equilibrium the reaction system will consist of mostly products (the equilibrium lies to the right). This will have greater meaning when we discuss acids and bases.

It is important understand that the size of K and the TIME required to reach equilibrium are not directly related. The time required for the reaction to reach equilibrium deals with reaction rates and the nature of the reactants (we will discuss reaction rates later, Kinetics.)

Example:

Calculating Equilibrium Pressures (for an unknown pressure, and a known K)

Example:

N_2O_4 is placed into a flask and **allowed to reach equilibrium** at a temperature where $K_p = 0.133$ atm. At equilibrium, the pressure of N_2O_4 was found to be 2.71 atm. Calculate for the equilibrium pressure of NO_2 formed.

$$N_2O_{4\,(g)} \leftrightarrow 2\,NO_{2\,(g)}$$

$$K_p = \frac{(P_{NO_2})^2}{(P_{N_2O_4})^1} = 0.133 \text{ ATM} = \frac{(P_{NO_2})^2}{2.71 \text{ ATM}} = K_p$$

$$(P_{NO_2})^2 = (0.133 \text{ ATM})(2.71 \text{ ATM}) = 0.36043 \text{ ATM}^2$$

$$\sqrt{(P_{NO_2})^2} = \sqrt{0.36043 \text{ ATM}^2} = \boxed{0.600 \text{ ATM} = P_{NO_2}}$$