Chapter 15 Big Ideas-

There is nothing that is not important in chapter 15. You should be able to work through all sample exercises in the book as well as the examples below. The first free response question on the AP test will be an equilibrium question. Chapters 15-17 cover the concepts of equilibrium.

You should be able to-

Qualitatively describe the condition of equilibrium.

Write the equilibrium constant expression (Kc and Kp) of a reaction and solve for the numeric value.

Relate Kc to Kp both qualitatively and quantitatively.

Solve for the equilibrium constant given equilibrium, initial, or the change in concentrations.

Evaluate the affect on equilibrium concentrations/pressure that certain stresses have. (Le Chatelier's principle)

Identify what side a reaction is favored at equilibrium by interpreting the value of Kc or Kp.

Determine the direction a reaction will proceed to achieve equilibrium using Q.

$$NH_4HS(s) \leftrightarrow NH_3(g) + H_2S(g) \qquad \Delta H^o = +93 \text{ kilojoules}$$

The equilibrium above is established by placing solid NH_4HS in an evacuated container at 25ºC. At equilibrium, some solid NH_4HS remains in the container. Predict and explain each of the following.

(a) The effect on the equilibrium partial pressure of NH_3 gas when additional solid NH_4HS is introduced into the container
(b) The effect on the equilibrium partial pressure of NH_3 gas when additional solid H_2S is introduced into the container
(c) The effect on the mass of solid NH_4HS present when the volume of the container is decreased
(d) The effect on the mass of solid NH_4HS present when the temperature is increased.

$$2\ NaHCO_3(s) \leftrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

Solid sodium hydrogen carbonate, $NaHCO_3$, decomposes on heating according to the equation above.

(a) A sample of 100. grams of solid $NaHCO_3$ was placed in a previously evacuated rigid 5.00-liter container and heated to 160ºC. Some of the original solid remained and the total pressure in the container was 7.76 atmospheres when equilibrium was reached. Calculate the number of moles of $H_2O(g)$ present at equilibrium.
(b) How many grams of the original solid remain in the container under the conditions described in (a)?
(c) Write the equilibrium expression for the equilibrium constant, K_P, and calculate its value for the reaction under the conditions in (a).
(d) If 110. grams of solid $NaHCO_3$ had been placed in the 5.00-liter container and heated to 160ºC, what would the total pressure have been at equilibrium? Explain.

$$2SO_3(g) \leftrightarrow 2\ SO_2(g) + O_2(g)$$

Sulfur trioxide decomposes at high temperatures according to the above equation. Initially the vessel is charged at 1000 K with SO_3 (g) at a partial pressure of 0.500 atm. At equilibrium the SO_3(g) partial pressure is 0.200 atm. Calculate the value of Kp at 1000 k.