AP Chemistry - Unit 7 - Equilibrium

Wkst: Equilibrium

1. Briefly describe the following ideas or phenomena
    a. Dynamic equilibrium

    b. The difference between Q and K

    c. Effect of a catalyst on equilibrium

2. Nitrogen and acetylene gases react to form hydrogen cyanide according to the reaction
    $N_{2(g)} + C_2H_{2(g)} \leftrightarrow 2HCN_{(g)}$ $K_c = 2.3 \times 10^{-4}$ at 300 °C

    a. Write out the equilibrium constant expression for K_c for this reaction as shown

    b. The value of K_p for this reaction at 300 °C is also 2.3×10^{-4}. Why are the values of K_p and K_c the same for this reaction?

    c. Write a balanced equation and calculate the value of equilibrium constant K_c for the formation of 1.0 mole of hydrogen cyanide gas from nitrogen and acetylene gas.

d. What is the equilibrium concentration of $HCN_{(g)}$ if nitrogen and acetylene are mixed so that both are starting concentrations of 1.0 M ?

3. Consider the following equilibrium reaction.
   $4HCl_{(g)} + O_{2(g)} \leftrightarrow 2H_2O_{(g)} + 2Cl_{2(g)}$ $K_c = 885$ at 500°C

   a. If 0.030 mole HCl, 0.020 mole O_2, 0.090 mol H_2O and 0.085 mole Cl_2 are mixed in a 1.0 L container at 500°C, in what direction will the reaction proceed?

   b. What is the value of K_p for the reaction at 500°C ?

4. Suppose a 1.0 L flask is filled with 0.30 atm $Br_{2(g)}$ and 0.30 atm $Cl_{2(g)}$ at 400 K.

   $Br_{2(g)} + Cl_{2(g)} \leftrightarrow 2BrCl_{(g)}$ at 400K $K_p = 7.0$

   a. Find the pressures of all three gases at equilibrium

5. For the reaction below, which change would cause the equilibrium to shift to the right?

   $CH_{4(g)} + 2H_2S_{(g)} \leftrightarrow CS_{2(g)} + 4H_{2(g)}$

   a. Decrease the concentration of dihydrogen sulfide.

   b. Increase the pressure on the system.

   c. Increase the temperature of the system.

   d. Increase the concentration of carbon disulfide.

   e. Decrease the concentration of methane.

6. What would happen to the position of the equilibrium when the following changes are made to the equilibrium system below?

$$2SO_{3(g)} \leftrightarrow 2SO_{2(g)} + O_{2(g)}$$

   a. Sulfur dioxide is added to the system.

   b. Sulfur trioxide is removed from the system.

   c. Oxygen is added to the system.

7. What would happen to the position of the equilibrium when the following changes are made to the reaction below?

$$2HgO_{(s)} \leftrightarrow Hg_{(l)} + O_{2(g)}$$

   a. HgO is added to the system.

   b. The pressure on the system increases.

8. When the volume of the following mixture of gases is increased, what will be the effect on the equilibrium position?

$$4HCl_{(g)} + O_{2(g)} \leftrightarrow 2H_2O_{(g)} + 2Cl_{2(g)}$$

9. Predict the effect of decreasing the volume of the container for each equilibrium.

   a. $2H_2O_{(g)} + N_{2(g)} \leftrightarrow 2H_{2(g)} + 2NO_{(g)}$

   b. $SiO_{2(s)} + 4HF_{(g)} \leftrightarrow SiF_{4(g)} + 2H_2O_{(g)}$

   c. $CO_{(g)} + H_{2(g)} \leftrightarrow C_{(s)} + H_2O_{(g)}$

10. Predict the effect of decreasing the temperature on the position of the following equilibria.

   a. $H_{2(g)} + Cl_{2(g)} \leftrightarrow 2HCl_{(g)} + 49.7\ kJ$

   b. $2NH_{3(g)} \leftrightarrow N_{2(g)} + 3H_{2(g)} \qquad \Delta H = 37.2\ kJ$

   c. $CO_{(g)} + H_2O_{(g)} \leftrightarrow CO_{2(g)} + H_{2(g)} \qquad \Delta H = -27.6\ kJ$