Mr. Bracken
AP Chemistry

Name ___________________________
Period ____

Equilibrium Worksheet #5

From the Internet October, 2003 (Revised 2010)

1. Suppose 1.000 mole CO and 3.000 moles H_2 are put into a 10.00 L vessel at 1200 Kelvin. If the equilibrium constant for the reaction shown below is 3.92, calculate the final composition of the mixture at equilibrium.

   $$CO_{(g)} + 3H_{2\,(g)} \leftrightarrows CH_{4\,(g)} + H_2O_{(g)}$$

   [CO] = 0.0613 M
   [H_2] = 0.1839 M
   [CH_4] = 0.0387 M
   [H_2O] = 0.0387 M

2. For the reaction represented by the equation:

   $$H_{2\,(g)} + CO_{2\,(g)} \leftrightarrows H_2O_{(g)} + CO_{(g)}$$

   the value of K is 0.771 at 750°C. If 0.0100 mole of $H_{2\,(g)}$ and 0.0100 mole of $CO_{2\,(g)}$ are mixed inside a 2.00 L vessel at 750°C, what are the concentrations of all substances at equilibrium?

   $$H_{2\,(g)} + CO_{2\,(g)} \leftrightarrows H_2O_{(g)} + CO_{(g)}$$

   [H_2] = 0.00266 M
   [CO_2] = 0.00266 M
   [H_2O] = 0.00234 M
   [CO] = 0.00234 M

3. Nitrogen monoxide is formed in automobile exhaust by the reaction of the N_2 and O_2 in the air. At 2127^oC, K=0.0125. Initially, a mixture contains 0.850 moles of N_2 and 0.850 moles of O_2 in a 15.0-Liter vessel. Calculate the concentration of all species when equilibrium is established at 2127^oC.

   $$N_2\,(g) + O_2\,(g) \leftrightarrows 2\,NO\,(g)$$

   [N_2] = 0.0537 M
   [O_2] = 0.0537 M
   [NO] = 0.00600 M

4. The equilibrium constant K is 115 at 60^{o}C for the reaction shown below. A 1.500 L flask contains 3.000 mole of each substance.

$$\mathbf{F_{2\,(g)} + H_{2\,(g)} \leftrightarrows 2HF_{(g)}}$$

A. Is the system at equilibrium? (Show work here)

B. If not, in which direction will the equilibrium shift?

C. What are the equilibrium concentrations for each substance?

$[H_2]$ = 0.472 M
$[F_2]$ = 0.472 M
[HF] = 5.056 M

5. The value of K for the HI equilibrium at 425°C is 54.8.

$$\mathbf{H_{2\,(g)} + I_{2\,(g)} \leftrightarrows 2HI_{(g)}}$$

A quantity of $HI_{(g)}$ is placed in a 1.00 L container and allowed to come to equilibrium at 425°C. At equilibrium, the concentration of $HI_{(g)}$ is found to be 0.50 M.

(a) What are the concentrations of $H_{2\,(g)}$ and $I_{2\,(g)}$ at equilibrium?
(b) What was the initial concentration of $HI_{(g)}$?

$$\mathbf{H_{2\,(g)} + I_{2\,(g)} \leftrightarrows 2HI_{(g)}}$$

$[H_2]$ = 0.068 M
$[I_2]$ = 0.068 M
[HI] = 0.64 M

6. Consider the system $A_{(g)} + B_{(g)} \leftrightarrows AB_{(g)}$ at equilibrium where $K_c = 500$.

At equilibrium, the concentrations of A, B, and AB are found to be 0.0300 M, 0.0100 M, and 0.150 M, respectively, in a 5.00 L container. An additional 0.0400 moles of B are added. What are the final equilibrium concentrations of A, B, and AB?

$$A_{(g)} + B_{(g)} \leftrightarrows AB_{(g)}$$

[A] = 0.0246 M
[B] = 0.0126 M
[AB] = 0.1554 M

7. A 2.50-mole quantity of NOCl was initially in a 1.50-L reaction chamber at 400°C where the following chemical reaction occurred.

$$2NOCl\ (g) \leftrightarrows 2\ NO\ (g) + Cl_2\ (g)$$

After equilibrium was established, it was found that 28.0% of the NOCl had decomposed. Calculate the equilibrium constant K_c for this reaction.

K = 0.0353