**Problem Set on Chemical Equilibria**

1. Write the equilibrium constant expressions, Kc, for the following equilibria:

a. N2(g) + 2 H2(g) ⮀ N2H4(g)

b. PF5(g) ⮀ PF3(g) + F2(g)

c. SiCl4(g) + 2 H2O(g) ⮀ SiO2(s) + 2 Cl2(g)

d. Ba3(PO4)2 (s) ⮀ 3 Ba2+(aq) + 2 PO42-(aq)

Next write the Kp equilibrium constant expressions for the above equilibria, where applicable.

2. The following equilibrium has an equilibrium constant Kc = 1.7 x 10-3 at 2300 K and has a ΔH = 180.5 kJ/mol.

N2(g) + O2(g) ⮀ 2 NO(g)

a. Write the equilibrium constant expression in terms of concentrations and in terms of partial pressures.

b. Is this equilibrium reactant favored or product favored? Explain.

c. What is Kp for this reaction?

d. If [N2] = 0.10 M, [O2] = 3.2 M, and [NO] = 2.5 M are initially placed into the container, is the system at equilibrium? If not, which way will the reaction have to shift to reach equilibrium?

e. The following changes are introduced to the equilibrium. Explain why and which direction the reaction will shift in terms of LeChatelier’s Principle. You may assume the container is rigid. (1) N2 gas is removed from the container. (2) NO gas is removed from the container. (3) O2 gas is added to container. (4) Argon gas is added to the container. (5) The temperature of the system is decreased to 1000K. (6) The volume of the container is increased.

f. Which of the changes in problem (e) would alter the equilibrium constant value?

3. A sample of HI gas is placed into a rigid container at 700 K. At this temperature, Kc = 0.025. The equilibrium is shown below:

2 HI(g) ⮀ H2(g) + I2(g)

a. Find the equilibrium concentrations of HI, H2 and I2 if the initial concentration of HI is 0.20 M.

b. Find the equilibrium concentrations of HI, H2 and I2 if the initial concentration of H2 = 0.40 M and the initial concentration of I2 = 0.25 M.

c. What can be done to make the reaction product favored? Hint: Think LeChatelier’s Principle.

4. A sample of PCl5 gas is placed into a rigid 1.00 L container at 1500 K. At this temperature, Kc = 1.4 x 10-5. The equilibrium is shown below:

PF5(g) ⮀ PF3(g) + F2(g)

a. Find Kp at the same temperature.

b. If the initial concentration of PF5 is 0.30 M, what are the equilibrium concentration of all species in the container?

c. If 0.0010 moles of F2 is introduced into the container, what will be the new equilibrium concentrations of all species in the container?