Chem 1105-2015 Summer Problem Set #4

1. Write the expression for K_c for each of the following equilibrium:
a) $2NO_2(g) \leftrightharpoons 2NO(g) + O_2(g)$
b) $SrCO_3(s) \leftrightharpoons SrO(s) + CO_2(g)$
c) $2HBr(g) \leftrightharpoons H_2(g) + Br_2(l)$
d) $P_4(g) + 3O_2(g) \leftrightharpoons P_4O_6(s)$

2. Given the equilibrium constants for the following reactions at a particular temperature:

$$3H_2(g) + N_2(g) \leftrightharpoons 2NH_3(g) \qquad K_c = 1.7\times10^{-4}$$

calculate the value for the equilibrium constant, K_c, for the following reaction

$$3/2H_2(g) + 1/2N_2(g) \leftrightharpoons NH_3(g) \qquad K_c = ?$$

at the same temperature.

3. Initially, 0.84 moles of $PCl_5(g)$ and 0.18 moles of $PCl_3(g)$ are mixed in a 1.0 L container. It is later found that only 0.72 moles of PCl_5 are pressent when the system has reached equilibrium. Calculate the value of K_c for the reaction

$$PCl_5(g) \leftrightharpoons PCl_3(g) + Cl_2$$

4. When 4.0 moles of HI(g) are placed in a 2.0 L container at 25°C and allowed to dissociate according to the equation

$$2HI(g) \leftrightharpoons H_2(g) + I_2(g)$$

it is found that 20.% of the HI has dissociated at equilibrium. Calculate K_c and K_p.

5. Nitrosyl bromide, NOBr(g), decomposes according to the equation

$$NOBr(g) \leftrightharpoons NO(g) + 1/2Br_2(g) \qquad K_p = 0.15 \text{ at } 350°C.$$

If 1.0 atm of NOBr, 0.8 atm of NO, and 0.4 atm of Br_2 are mixed at 350°C, will any net reaction occur? If a net reaction is observed, will NO be formed or consumed?

6. Consider the following reaction

$$ZnS(s) \leftrightharpoons Zn^{2+}(aq) + S^{2-}(aq) \qquad K_c = 1.1\times10^{-21}$$

If a small amount of ZnS(s) is placed in water what is the equilibrium concentrations of Zn^{2+}.

7. At 633°C, 3.60 moles of ammonia are placed in a 2.00 L vessel and allowed to decompose to the elements.

$$2NH_3(g) \leftrightharpoons N_2(g) + 3H_2(g) \qquad K_c = 6.56\times10^{-3} \text{ at } 633°C$$

Calculate the equilibrium concentration of each reagent

8. Consider the following equilibrium

$$2NOBr(g) \leftrightharpoons 2NO(g) + Br_2(g) \qquad \Delta H = -344 \text{ kJ}$$

Using LeChatelier's Principle predict the effect of the following changes on the position of the equilibrium. a) Addition of more Br_2. b) Removal of some NOBr. c) Increse in container volume. d) Decrease in temperature. e) Addition of a catalyst.

Answer Set for Chem 1105-2015 Summer Problem Set #4

1.

a) $K_c = \frac{[NO(g)]^2[O_2(g)]}{[NO_2(g)]^2}$ b) $K_c = [CO_2(g)]$

c) $K_c = \frac{[H_2(g)]}{[HBr(g)]^2}$ d) $K_c = \frac{1}{[P_4(g)][O_2(g)]^3}$

2. $K_c = 1.3\times10^{-2}$

3. $K_c = 0.050$

4. $K_p = K_c = 0.0156$

5. $Q = 0.5 > K_p$. Therefore, NO and and Br_2 are consumed and produce more NOBr.

6. $[Zn^{2+}] = 3.3\times10^{-11}$ M

7. $[NH_3(g)] = 1.49$ M, $[H_2(g)] = 0.459$ M, $[N_2(g)] = 0.153$ M

8.a) Equilibrium will shift to the left. b) Equilibrium will shift to the left. c) Equilibrium will shift to the right. d) Equilibrium will shift to the right. e) No affect on the position of the equilibrium. System will obtain equilibrium faster.