**Problem Set #10 Review, Q, & Size of Keq**

1. Consider the chemical equilibrium system shown below:

2 CrO4-2 (aq) + 2 H+ (aq)  ⇄ Cr2O7-2 (aq) + H2O (l)

Calculate the Keq if the following amounts were found at equilibrium in 2.0 L of solution.

CrO4-2 = 0.030 mol, H+ = 0 .020 mol, Cr2O7-2 = 0.32 mol, H2O = 110 mol

2. Consider the chemical equilibrium system shown below:

PCl5 (s) + H2O (g) ⇄ 2 HCl (g) + POCl3 (g) ; Keq= 11

At equilibrium, the 4.0L flask contains the indicated amounts of the three chemical species.

PCl5 = 0.012 mol; H2O = 0.016 mol; HCl = 0.120 mol

Calculate the equilibrium [POCl3].

\*3. Consider the chemical equilibrium system shown below:

2 H2S (g) ⇄ 2 H2 (g) + S2 (g)

6.0 moles of H2S are placed in a 2.0 L container. At equilibrium, 5.0 moles H2 are present. Calculate the Keq for the equilibrium system.

4. Consider the chemical equilibrium system shown below:

H2 (g) + Br2 (g) ⇄ 2HBr (g)

  4.0 moles H2 and 2.0 moles Br2 are placed in a 1.0L container at 180oC. If the equilibrium [HBr] = 3.0M, calculate Keq.

5. At 2000 0C, Keq = 11.6 for the following chemical system at equilibrium:

2 NO (g) ⇄ N2 (g) + O2 (g).

If some NO was placed in a 2.0 L vessel, and the equilibrium [N2] = 0.120 M, calculate the equilibrium concentrations of all other chemical species.

6. At 800oC, Keq = 0.279 for the chemical system below:

CO2 (g) + H2 (g) ⇄ CO (g) + H2O (g).

If 2.00 moles CO(g) and 2.00 moles H2O (g) are placed in a 500.0 mL container, calculate the equilibrium concentrations of all chemical species.

7. CO (g) + H2O (g) ⇄ CO2 (g) + H2 (g) ; Keq = 10.0 at 690oC.

At a certain time, [CO] = 0.80 M, [H2O] = 0.050 M, [CO2] = 0.50 M and [H2] = 0.40 M. Is the reaction at equilibrium? If not, how will it shift in order to get to reach equilibrium?

 8. Consider the chemical system shown below:

CO (g) + H2O (g) ⇄ CO2 (g) + H2 (g) ; Keq = 10.0 at 690 oC.

Some time after the reactants were placed in the vessel, the following concentrations were observed.

[CO] = 2.0 M, [H2] = 1.0 M, [CO2] = 2.0 M, [H2O] = 0.10 M.

Is the reaction at equilibrium? If not, how will it shift in order to reach equilibrium?

 9. Consider the chemical system shown below:

CO (g) + H2O (g) ⇄ CO2 (g) + H2 (g); Keq = 10.0 at 690oC

Some time after the reactants were placed in the vessel, the following concentrations were observed.

[CO] = 1.5 M, [H2] = 1.2 M, [CO2] = 1.0 M, [H2O] = 0.10 M.

Is the reaction at equilibrium? If not, how will it shift in order to reach equilibrium?

10. At a certain temperature the Keq for the reaction below is 75.

2 O3 (g) ⇄ 3 O2 (g)

Predict the direction in which the equilibrium will proceed, if any, when the following amounts are introduced to a 10.0 L vessel.

a) 0.60 mole of O3 and 3.0 mol of O2 b) 0.050 mole of O3 and 7.0 mol of O2

c) 1.5 mole of O3 and no O2

11) Consider the following equilibrium:

a) 2 NO2 (g) ⇄ N2O4 (g) Keq = 2.2

b) Cu2+(aq) + 2 Ag(s) ⇄ Cu(s) + 2 Ag+ (aq) Keq = 1 x 10-15

c) Pb2+ (aq) + 2 Cl- (aq) ⇄ PbCl2 (s) Keq = 6.3 x 104

d) SO2 (g) + O2 (g) ⇄ SO3 (g) Keq = 110

i) Which equilibrium favors products to the greatest extent? \_\_\_\_\_\_

ii) Which equilibrium favors reactants to the greatest extent? \_\_\_\_\_\_

12. What is the *only* factor that affects the value of the Keq?

13. Consider the fictional chemical equilibrium system shown below.

A + B ⇄ C + D + 100 kJ,

What will happen to the value of Keq if we increase the temperature? Explain.

14. If the value of Keq decreases when we decrease the temperature, is the reaction exothermic or endothermic? Explain.

15. Consider the fictional chemical equilibrium system shown below.

W + X + 100kJ ⇄ Y + Z,

What happens to the value of Keq if we increase the [X]? Explain your answer.

16. If the value of Keq increases when we decrease the temperature, is the reaction exothermic or endothermic?

17. Predict whether reactants of products are favored in the following equilibrium systems

(a) CH3COOH (aq) ⇄ H+(aq) + CH3COO-(aq)  ; Keq = 1.8 x 10-5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) H2O2 (aq) ⇄ H+(aq) + HO2 -(aq) ; Keq = 2.6 x 10-12 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) CuSO4 (aq) + Zn (s) ⇄ Cu (s) + ZnSO4 (aq) ; Keq = 1037 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

18. What effect will each of the following have ***on the value of Keq*** of the reaction shown below?

2 NO2 (g) + heat ⇄ N2O4 (g) ; Keq = 2.2

(a) adding a catalyst

(b) increasing the concentration of a reactant

(c) increasing the concentration of a product

(d) decreasing the volume

(e) decreasing the pressure

(f) increasing the temperature

(g) decreasing the temperature