Worksheet #8 Equilibrium Calculations

Solve each problem and show all of your work.

1. $SO_{3(g)}$ + $H_2O_{(g)}$ ⇄ $H_2SO_{4(l)}$ **Do not count the liquid!!**

At equilibrium $[SO_3]$ = 0.400M $[H_2O]$ = 0.480M $[H_2SO_4]$ = 0.600M

Calculate the value of the equilibrium constant.

$$K_{eq} = \frac{1}{[SO_3]\,[H_2O]}$$

$$K_{eq} = \frac{1}{[0.400]\,[0.480]}$$

Keq = 5.21

2. At equilibrium at 100°C, a 2.0L flask contains:

0.075 mol of PCl_5 0.050 mol of H_2O 0.750 mol 0f HCl 0.500 mol of $POCl_3$

Calculate the Keq for the reaction:

PCl_5 (s) + H_2O (g) ⇄ 2HCl (g) + $POCl_3$ (g)

Keq = 1.4

3. Keq= 798 at 25°C for the reaction: **$2SO_2$ (g) + O_2 (g) ⇄ $2SO_3$ (g).**

In a particular mixture at equilibrium, $[SO_2]$= 4.20 M and $[SO_3]$=11.0M. Calculate the equilibrium $[O_2]$ in this mixture at 25°C.

$[O_2]$ = 0.00860M

4. Consider the following equilibrium:

$2SO_2$ (g) + O_2 (g) ⇄ $2SO_3$ (g)

0.600 moles of SO_2 and 0.600 moles of O_2 are present in a 4.00 L flask at equilibrium at 100°C. If the Keq = 680, calculate the SO_3 concentration at 100°C.

Keq = $\frac{[SO_3]^2}{[SO_2]^2[O_2]}$

680 = $\frac{[SO_3]^2}{[0.150]^{2l}0.150]}$

$[SO_3]^2 = (0.150)(0.150)^2(680)$

$[SO_3] = 1.51$ M

5. Consider the following equilibrium:

$2\ NO_{2(g)} \rightleftarrows N_2O_{4(g)}$

2.00 moles of NO_2 and1.60 moles of N_2O_4 are present in a 4.00 L flask at equilibrium at 20°C. Calculate the Keq at 20°C .

Keq = 1.60

6. **$2\ SO_{3(g)} \rightleftarrows 2\ SO_{2(g)} + O_{2(g)}$**

4.00 moles of SO_2 and 5.00 moles O_2 are present in a 2.00 L container at 100°C and are at equilibrium. Calculate the equilibrium concentration of SO_3 and the number of moles SO_3 present if the Keq = 1.47×10^{-3}.

$[SO_3] = 82.5$ M **165 moles SO_3**

7. If at equilibrium $[H_2] = 0.200$M and $[I_2] = 0.200$M and Keq=55.6 at 250°C, calculate the equilibrium concentration of HI.

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

[HI] = 1.49 M

8. 1.60 moles CO, 1.60 moles H_2O, 4.00 moles CO_2, 4.00moles H_2 are found in a 8.00L container at 690°C at equilibrium.

$CO\ (g) + H_2O\ (g) \rightleftarrows CO_2\ (g) + H_2\ (g)$

Calculate the value of the equilibrium constant.

Keq = 6.25