Chemistry 116 - Fall 2021

Dr. Audrey Dell Hammerich

Discussion Worksheet - Week 10

1. The reaction for the formation or breakdown of ammonia can be written

a) $N_2 + 3H_2$ <=> $2\ NH_3$

b) $1/2\ N_2 + 3/2\ H_2$ <=> NH_3

c) $1/3\ N_2 + H_2$ <=> $2/3\ NH_3$

d) NH_3 <=> $1/2\ N_2 + 3/2\ H_2$

e) Write the equilibrium constant expression for each of the above gas phase reactions.

f) Determine the numerical value of K for reaction a) if at 472°C and a total pressure of 10.0 atm the equilibrium mixture of gases consists of 24.58 mol percent N_2 and 73.76 mol percent H_2. [$K_P = 2.79 \times 10^{-5}$]

2. What is the value of K for the following reaction if an equilibrium mixture contains 1.0 mol Fe, 1.0×10^{-3} mol O_2, and 2.0 mol Fe_2O_3 in a 2.0-L container? [8.0×10^9]

$$4\ Fe(s)\ +\ 3O_2(g)\ \ <=>\ \ 2\ Fe_2O_3(s)$$

3. If the equilibrium mixture for the following reaction contains 0.500 atm CO, 0.500 atm H_2O, and 1.00 atm CO_2, what is the partial pressure of H_2 when $K_p = 1.845$? [0.461 atm]

$$CO(g)\ +\ H_2O(g)\ \ <=>\ \ CO_2(g)\ +\ H_2(g)$$

4. Determine the equilibrium concentration of HI for the following reaction when the equilibrium concentrations of H_2 and I_2 are both 0.0010 mol/L and $K = 55.6$. [0.0075 mol/L]

$$H_2(g)\ +\ I_2(g)\ \ <=>\ \ 2\ HI(g)$$

5. Determine the equilibrium pressure of NO_2 if the equilibrium pressure of N_2O_4 is 2.71 atm at a temperature where $K_p = 0.133$ for: [0.600 atm]

$$N_2O_4(g)\ \ <=>\ \ 2\ NO_2(g)$$

6. From the following 427°C equilibrium constants

1) $Na_2O(s)$ <=> $2\ Na(l)\ +\ ½\ O_2(g)$ $K_1 = 2 \times 10^{-25}$
2) $NaO(g)$ <=> $Na(l)\ +\ ½\ O_2(g)$ $K_2 = 2 \times 10^{-5}$
3) $Na_2O_2(s)$ <=> $2\ Na(l)\ +\ O_2(g)$ $K_3 = 5 \times 10^{-29}$
4) $NaO_2(s)$ <=> $Na(l)\ +\ O_2(g)$ $K_4 = 3 \times 10^{-14}$

determine the values of the equilibrium constants (K_p) for the following:

a) $Na_2O(s)\ +\ ½\ O_2(g)$ <=> $Na_2O_2(s)$ [4000]
b) $NaO(g)\ +\ Na_2O(s)$ <=> $Na_2O_2(s)\ +\ Na(l)$ [0.08]
c) $2\ NaO(g)$ <=> $Na_2O_2(s)$ [8×10^{18}]

7. Complete the following table of changes.

	$4\ NH_3(g)$	+	$7\ O_2(g)$	<=>	$4\ NO_2(g)$	+	$6\ H_2O(g)$
Initial	0.30 atm		0.70 atm		0		0
Change							
Equilibrium							

8. Solid molybdenum is placed in contact with gaseous CH_4 at a pressure of 0.68 atm in a sealed empty reaction vessel at 300 K. After equilibrium is reached the total pressure in the container is 1.13 atm.

$$2\ Mo(s) + CH_4(g) \text{ <=> } Mo_2C(s) + 2\ H_2(g)$$

a) What is the equilibrium pressure of H_2? [0.90 atm]

b) Write the expression for K_P.

c) Determine the numerical value of K_c. [0.14]

9. Determine K_p if the initial partial pressures are: $P_{NO} = 0.70$ and $P_{O_2} = 0.55$ atm and, when equilibrium has been reached, $P_{NO_2} = 0.20$ atm for: [0.36]

$$2\ NO(g) + O_2(g) \text{ <=> } 2\ NO_2(g)$$

10. The following reaction was run in a 3.00 L vessel at a temperature where $K = 115$:

$$H_2(g) + F_2(g) \text{ <=> } 2\ HF(g)$$

a) If 6.00 mol of all three components were initially added what are their equilibrium concentrations?

$[H_2] = [F_2] = 0.47$ M, $[HF] = 5.06$ M

b) If 3.00 mol of H_2 and 6.00 mol of F_2 were initially added what are all the equilibrium concentrations?

$[H_2] = 0.03$ M, $[F_2] = 1.03$ M, $[HF] = 1.94$ M