48pts

Name:_____ Date:_____

Chapter 13 Review

1. write the equilibrium expression for each of the following

a. $2NO\ (g) + O_2(g) \leftrightarrow 2NO_2\ (g)$ (2)

$$\frac{[NO_2]^2}{[NO]^2[O_2]}$$

b. $Ag^+(aq) + F(aq) \leftrightarrow AgI\ (s)$ (2)

$$\frac{1}{[Ag^+][I^-]}$$

c. $Fe^{3+}(aq) + 3OH^-(aq) \leftrightarrow Fe(OH)_3\ (S)$ (2)

$$\frac{1}{[Fe^{3+}][OH^-]^3}$$

2. Calculate the equilibrium constant K at 25°C for the reaction

$2NO\ (g) + O_2(g) \leftrightarrow 2NO_2\ (g)$

If the equilibrium concentrations are NO = 6.5×10^{-5} atm $O_2 = 4.5 \times 10^{-5}$ atm $NO_2 = 0.55$ atm (4)

$$K = \frac{[NO_2]^2}{[NO]^2[O_2]} = \frac{[.055]^2}{[6.5\times10^{-5}]^2[4.5\times10^{-5}]} = 1.6\times10^{12}$$

3. Of the equilibrium constant at 444°C for $2HI\ (g) \leftrightarrow H_2(g) + I_2(g)$ is 1.39×10^{-2}, find the equilibrium constant for the reverse reaction at 444°C. (4)

$$\frac{[I][H]}{[HI]^2} = K \quad \therefore \frac{1}{K} = \frac{1}{1.39\times10^{-2}} = 71.9$$

reverse

4. For each value of K predict the effect on the reaction.

K = 1 K = 10^{10} K = 10^{-10} (6)

K = 1 (9) = Lib

K = 10^{10}. Far right / Forward

K = 10^{-10} = Far left / Reverse

20

5. The dissociation of acetic acid, CH_3COOH, has an equilibrium constant at 25°C of 1.8×10^{-5}. The reaction is

$$CH_3COOH\,(aq) \leftrightarrow CH_3COO^-(aq) + H^+(aq)$$

If the equilibrium concentration of CH_3COOH = 0.46 moles in 0.500 L of water and the concentration of CH_3COO^- is 8.1×10^{-3} moles in the same 0.500L calculate the concentration of H^+ for the reaction.

(4)

$$\frac{\frac{8.1\times10^{-3}}{.5}[x]}{\frac{.46}{.5}} = 1.8\times10^{-5}$$

$x = [H^+] = 0.001\,M$

6. Indicate which has an effect on A. the speed of the reaction or B. the position of the equilibrium. (m)ark the appropriate lines(s)

(8)

	1. Catalyst	2. Pressure	3. Temperature	4. Concentration
A	↑	↑	↑	↑
B	N/A	↑ P ↓V shift to fewer n.	↑ shift ↑ K	shift ← Lib

speed = liq

7. at 700K, the measured values of for the partial pressures of ammonia, hydrogen, and nitrogen are 0.400 atm , 7.20 atm, and 2.40 atm respectively. Calculate the K_p and K_c at 700K for the synthesis of ammonia:

(4)

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3\,(g)$$

$K_p = K_c(RT)^{\Delta n}$

$K_p = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{.4^2}{2.4 \cdot 7.2^3}$

$K_p = 1.78\times10^{-4}$

$1.78\times10^{-4} = K_c(.0821 \cdot 700)^{-2}$

$2 - 4 = -2$; $\Delta n = -2$

$K_c = 0.588$

8. (Likely to see on AP) For the following process at700°C, what is the partial pressure of each gas at equilibrium if the total pressure is 0.750 atm? Hint: use X to solve

(4)

$$C(s) + CO_2\,(g) \leftrightarrow 2CO \qquad K_p = 1.50$$

$$K = \frac{[CO]^2}{[CO_2]} = \frac{[x]^2}{[.75 - x]} = 1.50$$

$P_T = .75$

$P_{CO} = .549$ atm

$P_{CO_2} = .201$ atm

(20)

9. Given the reaction of methane and water below

$CH_4 + H_2O \leftrightarrow CO\ (l) + 3H_2\ (g)$ $\quad K = 5.67$

predict what direction the system will shift in order to reach equilibrium given the following initial values of Q.

a. $Q = 11.85$ $\quad Q > K$ Reverse/Left

b. $Q = 3.8 \times 10^{-4}$ $\quad Q < K$ Forward/Right

(3)

c. $Q = 5.67$ $\quad Q = K$ $\quad Q = Lib$

10. The reaction of carbon disulfide with chloride is as follows

$CS_2(g) + 3Cl_2(g) \leftrightarrow CCl_4(g) + S_2Cl_2\ (g) + Heat$ $\quad \Delta H = -238$ kJ Exo

Predict the effect of the following change to the system on the direction of the equilibrium.

a. The pressure on the system is doubled by halving the volume

Forward / Right

(3)

b. CCl_4 is removed as it is generated

Forward / Right

c. Heat is added to the system

Reverse/Left

11. Given the following reaction at equilibrium,

$Cl_2\ (g) + 3F_2(g) \leftrightarrow 2ClF_3\ (g)$

a. Predict the effect if the pressure were reduced at a constant temperature.

(2)

↓P ↑V Shift Left (favor more moles)

b. Predict the effect if the volume were reduced by increasing the pressure at a constant temperature.

↑P ↓V Shift Right

(8)