Equilibrium 2a

Name: Key
Period:

$$SO_2F_{2(g)} \rightleftharpoons SO_{2(g)} + F_{2(g)}$$

1) A 10.55 gram sample of $SO_2F_2$ liquid is placed in a sealed 1.50L container. The container is heated to 450K and the liquid first boils and then begins to break down according to the retain given above.

a) If no decomposition had occurred what would be the pressure of the $SO_2F_2$ gas?

$10.55\text{g } SO_2F_2 \cdot \frac{1 \text{ mol}}{102.06 \text{ g}} = 0.10337 \text{ mol}$

$P = \frac{0.1034 \cdot 0.0821 \cdot 450}{1.50\text{L}} = 2.55 \text{ atm}$

b) The equilibrium constant for the decomposition at 450K, $K_p$, is $7.65 \bullet 10^{-6}$. Write the equilibrium expression for the reaction.

$K_P = \frac{P_{SO_2} \cdot P_{F_2}}{P_{SO_2F_2}}$

c) Once the system reaches equilibrium what will be the partial pressure of $SO_2F_2$ remaking in the container?

| | $SO_2F_2$ | $\rightleftharpoons$ | $SO_2$ | + $F_2$ |
|---|---|---|---|---|
| I | 2.55 | | 0 | 0 |
| C | $-x$ | | $+x$ | $+x$ |
| E | $2.55-x$ | | $+x$ | $+x$ |

$7.65 \cdot 10^{-6} = \frac{(x)(x)}{(2.55-x)}$

$7.65 \cdot 10^{-6} = \frac{x^2}{2.55}$

$P_{SO_2F_2} = 2.545$ or $2.55$

$x = 4.42 \cdot 10^{-3}$ atm

d) What will be the total pressure in the container at equilibrium?

$P_T = P_{SO_2F_2} + P_{SO_2} + F_2 = 2.545 + 4.42 \cdot 10^{-3} + 4.42 \cdot 10^{-3}$

$P_T = 2.55$

$Ba^{2+}_{(aq)} + EDTA^{4-}_{(aq)} <==> Ba(EDTA)^{2-}_{(aq)}$ $K = 7.7 \times 10^{7}$

2) Barium ions will react with the EDTA ion to for a complex according the the reaction given above. A student mixes a solution with an initial concentration of Ba(EDTA)2- of 0.0237M.

A) Write the equilibrium expression for the reaction.

$$K = \frac{[Ba(EDTA^{-2})]}{[Ba^{2+}][EDTA^{4-}]}$$

B) What will be the concentration of the barium ions in the solution at equilibrium? assume x is small

| | $Ba^{2+}$ | + $EDTA^{4-}$ | ⇌ $Ba(EDTA)^{2-}$ |
|---|---|---|---|
| I | 0 | 0 | 0.0237 |
| C | +x | +x | -x |
| E | x | x | 0.0237-x |

$$7.7 \cdot 10^{7} = \frac{(0.0237-x)}{(x)(x)}$$

$$7.7 \cdot 10^{7} = \frac{0.0237}{x^2}$$

$$x^2 = \frac{0.0237}{7.7 \cdot 10^{7}}$$

$$x = 1.75 \cdot 10^{-5}$$

$[Ba^{2+}] = 1.75 \cdot 10^{-5} M$

$2NH_{3(g)} + 2O_{2(g)} <==> N_2O_{(g)} + 3\,H_2O_{(g)}$

3) Ammonia($NH_3$) will react with oxygen to form dinitrogen monoxide($N_2O$) and water as shown above. Researchers fill a 2.50L reaction vessel with ammonia to a pressure of 1.50 atm and oxygen gas to a pressure of 1.00 atm at 25°C. After the reaction comes to equilibrium they measure the pressure of the $N_2O$ to be 0.0385 atm.

A) Write the equilibrium express for $K_p$.

$$K_p = \frac{P_{N_2O}\, P_{H_2O}^{3}}{P_{NH_3}^{2}\, P_{O_2}^{2}}$$

B) Calculate the value of the equilibrium constant, $K_p$, at 25°C.

| | $2NH_3$ | + $2O_2$ | ⇌ $N_2O$ | + $3H_2O$ |
|---|---|---|---|---|
| I | 1.50 | 1.00 | 0 | 0 |
| C | -2·.0385 | -2·.0385 | +0.0385 | +3·0.0385 |
| E | 1.423 | 0.923 | 0.0385 | 0.1155 |

$$K_p = \frac{(0.0385)(0.1155)^3}{(1.423)^2\,(0.923)^2}$$

$$K_p = 3.44 \cdot 10^{-5}$$