EQUILIBRIUM PROBLEMS II

Once the value of the equilibrium constant is known, the equilibrium constant expression can be used to calculate concentrations of reactants or products at equilibrium.

EXAMPLE:

Given the reaction:

$$H_{2(g)} + I_{2(g)} \text{ <===> } 2HI_{(g)}$$

Suppose a system in equilibrium at 25°C is found to contain 0.81 mol/L $H_{2(g)}$ and 0.035 mol/L $I_{2(g)}$. The value of K_{eq} for this reaction is 7.1×10^2 found in a table of equilibrium constants, What must be the concentration of $HI_{(g)}$ for this system?

SOLUTION:

The expression for K_{eq} is:

$$K_{eq} = \frac{[HI]^2}{[H_2][I_2]}$$

Solving for [HI] gives:

$$[HI] = \sqrt{K_{eq}[H_2][I_2]}$$

Substituting the values gives:

$$[HI] = \sqrt{7.1x10^2[0.81][0.035]}$$

Solving gives:

$$[HI] = 4.49$$

STUDENT PRACTICE

1. An equilibrium mixture at a specific temperature is found to consist of 1.2×10^{-3} mol/L HCl, 3.8×10^{-4} mol/L O_2, 5.8×10^{-2}mol/L H_2O, and 5.8×10^{-2}mol/L Cl_2 according to the following reaction:

$$4\ HCl_{(g)} + O_{2(g)} \text{ <===> } 2H_2O_{(g)} + 2\ Cl_{2(g)}$$

Determine the value of the equilibrium constant for this reaction.

2. At 450°C the value of the equilibrium constant for the following system is 6.59×10^{-3}. If

$[NH3] = 1.23 \times 10^{-4}$ mol/L
$[H_2] = 2.75 \times 10^{-6}$ mol/L

at equilibrium, determine the concentration of N_2 at that point. The reaction is:

$$N_{2(g)} + 3\ H_{2(g)} \text{ <===> } 2\ NH_{3(g)}$$

Ans:

1. 1.4×10^{10}

2. 1.10×10^{11} mol/L