Key

Equilibrium Review #2

1. At a particular temperature, $K = 2.0 \times 10^{-6}$ for the reaction:

$$2CO_2(g) \leftrightarrow 2CO(g) + O_2(g)$$

initial 2 mol / 5L = .4 M; 0; 0

@ eq. .4 − 2x; 2x; x

If 2.0 mol CO_2 is initially placed into a 5.0 L vessel, calculate the equilibrium concentrations of all species.

$2 \times 10^{-6} = \frac{(2x)^2(x)}{(.4-2x)^2}$

$2 \times 10^{-6} = \frac{4x^3}{.16}$

$x = .0043$ M

$[CO_2] = .4 - 2(.0043) =$ .39 M CO_2

$[CO] = 2(.0043) =$ .0086 M CO

$[O_2] =$ .0043 M O_2

2. At 35°C, $K = 1.6 \times 10^{-5}$ for the reaction below.

$$2NOCl(g) \leftrightarrow 2NO(g) + Cl_2(g)$$

initial 1 M; 0; 0

@ eq 1 − 2x; 1 + 2x; x

Calculate the concentration of all species at equilibrium when 1.0 mol NOCl and 1.0 mol NO is initially put in a 1 L flask.

$1.6 \times 10^{-5} = \frac{(1+2x)^2(x)}{(1-2x)^2}$

$x = 1.6 \times 10^{-5}$

$[NOCl] = 1 - 2(1.6 \times 10^{-5}) =$ 1 M NOCl

$[NO] =$ 1 M NO

$[Cl_2] =$ 1.6×10^{-5} M Cl_2

3. At a particular temperature, the reaction below is at equilibrium when the concentrations of SO_2 and NO_2 are both 1.28 M and the concentrations of SO_3 and NO are both 2.47 M in a 6.3 L container. What will be the new concentrations of all gases at equilibrium if 2.5 mols of SO_3 is added into the reaction.

$$SO_2(g) + NO_2(g) \leftrightarrow SO_3(g) + NO(g)$$

@ eq. 1.28 M; 1.28 M; 2.47 M; 2.47 M

+2.5 mols = .4 M

initial 1.28 M; 1.28 M; 2.87 M; 2.47 M

@ eq. 1.28 + x; 1.28 + x; 2.87 − x; 2.47 − x

$K = \frac{(2.47)^2}{(1.28)^2} = 3.72$

$3.72 = \frac{(2.87-x)(2.47-x)}{(1.28+x)(1.28+x)}$

$3.72 = \frac{7.0889 - 5.34x + x^2}{1.6384 + 2.56x + x^2}$

$6.0948 + 9.523x + 3.72x^2 = 7.0889 - 5.34x + x^2$

$2.72x^2 + 14.8632x - .994 = 0$

$x = .066$

$[SO_2] =$ 1.346 M SO_2

$[NO_2] =$ 1.346 M NO_2

$[SO_3] =$ 2.804 M SO_3

$[NO] =$ 2.404 M NO

4. The reaction below was analyzed at equilibrium and found to have concentrations of N_2 and H_2 were both 3 M. What is the concentration of NH_3 if the K value for this reaction is 0.016.

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

@ eq. 3 M; 3 M; ?

$.016 = \frac{(x)^2}{3^3(3)}$

$x =$ 1.14 M NH_3