CALCULATIONS GIVEN K_{eq}

Example #1

$$CH_{4(g)} + H_2O_{(g)} <====> CO_{(g)} + 3\ H_{2(g)}$$

At 1500°C, K_{eq} = 5.67, [CO] = 0.300 M, $[H_2]$ = 0.800 M and, $[CH_4]$ = 0.400 M

What is $[H_2O]$ at equilibrium?

$$K_{eq} = \frac{[CO][H_2]^3}{[CH_4][H_2O]}$$

.: $[H_2O]$ at equilibrium was 6.77×10^{-2}M

CALCULATIONS GIVEN K_{eq}

Example #2

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

What is $[NH_3]$ when $[N_2] = 0.45$ M, $[H_2] = 1.10$ M and Keq = 1.7×10^{-2} ?

$$K_{eq} = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

.: the $[NH_3]$ is 1.0×10^{-1}M

CALCULATIONS GIVEN K_{eq}

Example #3

At equilibrium, Keq = 4.06.

If 0.100 mol of CO and 0.100 mol of $H_2O_{(g)}$ are placed in a 1.00 L container,

a) What are the concentrations of the reactants and products at equilibrium?

b) What is the final mass of $CO_{2(g)}$?

$$CO_{(g)} + H_2O_{(g)} \Leftrightarrow CO_{2(g)} + H_{2(g)}$$

I				
C				
E				

CALCULATIONS GIVEN K_{eq}

Example #3

a) What are the concentrations of the reactants and products at equilibrium?

b) What is the final mass of $CO_{2(g)}$?

$$CO_{(g)} + H_2O_{(g)} <=> CO_{2(g)} + H_{2(g)}$$

a) .: $[CO_{(g)}]=3.32x10^{-2}M$, $[H_2O_{(g)}]=3.32x10^{-2}M$, $[CO_{2(g)}]=6.68x10^{-2}M$, $[H_{2(g)}]=6.68x10^{-2}M$

CALCULATIONS GIVEN K_{eq}

Example #3

If 0.100 mol of CO and 0.100 mol of $H_2O_{(g)}$ are placed in a 1.00 L container,

a) What are the concentrations of the reactants and products at equilibrium?

b) What is the final mass of $CO_{2(g)}$?

$$CO_{(g)} + H_2O_{(g)} <=> CO_{2(g)} + H_{2(g)}$$

$$C = \frac{n}{V}$$

.: 2.94g of $CO_{2(g)}$ were produced

CALCULATIONS GIVEN K_{eq}

Example #4

If initial $[H_2]$ = 0.200 M and initial $[I_2]$ = 0.200 M. K_{eq} = 55.6

What is [HI] at equilibrium?

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

I			
C			
E			

CALCULATIONS GIVEN K_{eq}

Example #4

If initial $[H_2]$ = 0.200 M and initial $[I_2]$ = 0.200 M. K_{eq} = 55.6

What is [HI] at equilibrium?

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

CALCULATIONS GIVEN K_{eq}

Example #5

$$CO_{(g)} + H_2O_{(g)} <====> CO_{2(g)} + H_{2(g)}$$

At equilibrium, $K_{eq} = 10.0$

A reaction vessel is found to contain 0.80 M CO, 0.050 M H_2O, 0.50 M CO_2 and 0.40 M H_2.

Determine if the reaction is at equilibrium.

CALCULATIONS GIVEN K_{eq}

Q

When testing if conditions are at equilibrium Q is the symbol used, rather than K_{eq}.

Q is the "test K_{eq}" variable.

$$Q = \frac{[\text{products}]}{[\text{reactants}]}$$

CALCULATIONS GIVEN K_{eq}

Example #5

$$CO_{(g)} + H_2O_{(g)} <====> CO_{2(g)} + H_{2(g)}$$

At equilibrium, $K_{eq} = 10.0$.

A reaction vessel is found to contain
0.80 M CO, 0.050 M H_2O, 0.50 M CO_2 and 0.40 M H_2.

Determine if the reaction is at equilibrium.

$$Q = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

Since $k_{eq} \neq Q$, then the reaction is_____

CALCULATIONS GIVEN K_{eq}

Summarizing ICE Tables

1. Write out the balanced equation.
2. All values in the table must have mol/L units.
3. Initial [product] = 0, unless otherwise stated.
4. Changes in concentration always occur in the same stoichiometric ratio.
5. Reactants and products will change in opposite directions from each other.

Homework

- P.465 #1,2
- P.466 #3,4
- P.472#5,6