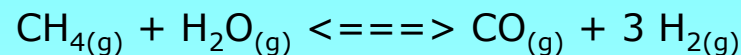


# CALCULATIONS GIVEN $K_{eq}$

Example #1



At 1500°C,  $K_{eq} = 5.67$ ,  $[\text{CO}] = 0.300 \text{ M}$ ,  $[\text{H}_2] = 0.800 \text{ M}$  and,  $[\text{CH}_4] = 0.400 \text{ M}$

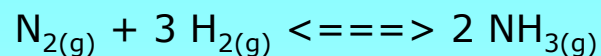
What is  $[\text{H}_2\text{O}]$  at equilibrium?

$$K_{eq} = \frac{[\text{CO}][\text{H}_2]^3}{[\text{CH}_4][\text{H}_2\text{O}]}$$

$\therefore [\text{H}_2\text{O}]$  at equilibrium was  $6.77 \times 10^{-2} \text{ M}$

# CALCULATIONS GIVEN $K_{eq}$

Example #2



What is  $[\text{NH}_3]$  when  $[\text{N}_2] = 0.45 \text{ M}$ ,  $[\text{H}_2] = 1.10 \text{ M}$  and  $K_{eq} = 1.7 \times 10^{-2}$  ?

$$K_{eq} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

$\therefore$  the  $[\text{NH}_3]$  is  $1.0 \times 10^{-1} \text{ M}$

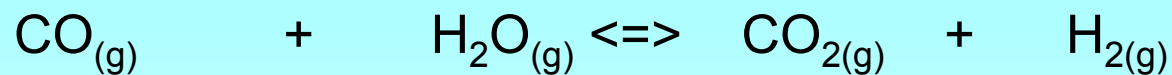
# CALCULATIONS GIVEN $K_{eq}$

Example #3

At equilibrium,  $K_{eq} = 4.06$ .

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

- What are the concentrations of the reactants and products at equilibrium?
- What is the final mass of  $CO_{2(g)}$ ?



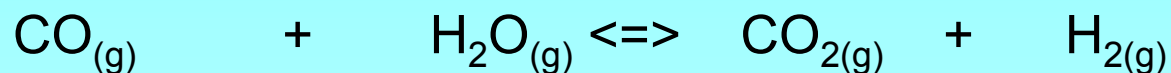
I  
C  
E

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# CALCULATIONS GIVEN $K_{eq}$

Example #3

- What are the concentrations of the reactants and products at equilibrium?
- What is the final mass of  $\text{CO}_{2(g)}$ ?



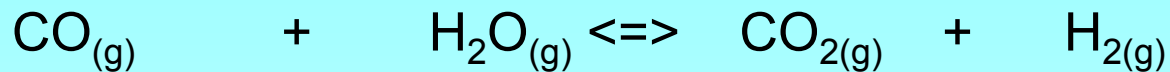
a)  $\therefore [\text{CO}_{(g)}] = 3.32 \times 10^{-2} \text{M}$ ,  $[\text{H}_2\text{O}_{(g)}] = 3.32 \times 10^{-2} \text{M}$ ,  
 $[\text{CO}_{2(g)}] = 6.68 \times 10^{-2} \text{M}$ ,  $[\text{H}_{2(g)}] = 6.68 \times 10^{-2} \text{M}$

# 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,

- What are the concentrations of the reactants and products at equilibrium?
- What is the final mass of  $CO_{2(g)}$ ?



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

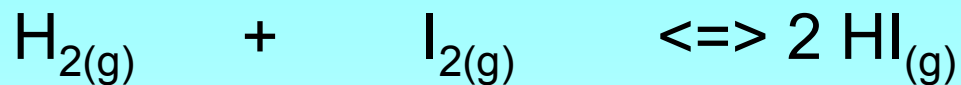
$\therefore$  2.94g of  $CO_{2(g)}$  were produced

# 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?



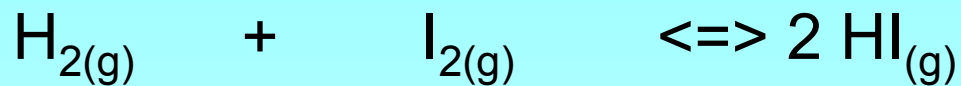
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# CALCULATIONS GIVEN $K_{eq}$

Example #4

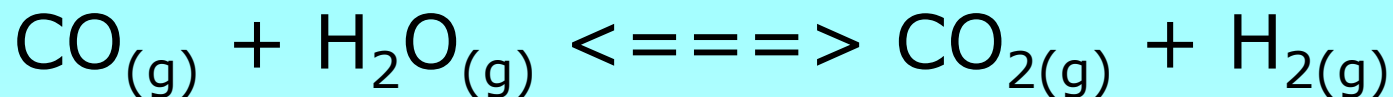
If initial  $[H_2] = 0.200$  M and initial  $[I_2] = 0.200$  M.  $K_{eq} = 55.6$

What is  $[HI]$  at equilibrium?



# CALCULATIONS GIVEN $K_{eq}$

## Example #5



At equilibrium,  $K_{eq} = 10.0$

A reaction vessel is found to contain 0.80 M CO, 0.050 M H<sub>2</sub>O, 0.50 M CO<sub>2</sub> and 0.40 M H<sub>2</sub>.

Determine if the reaction is at equilibrium.



# CALCULATIONS GIVEN $K_{eq}$

Q

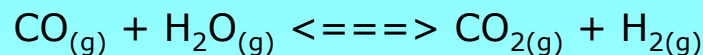
When testing if conditions are at equilibrium Q is the symbol used, rather than  $K_{eq}$ .

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

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

# CALCULATIONS GIVEN $K_{eq}$

Example #5



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

A reaction vessel is found to contain  
0.80 M CO, 0.050 M H<sub>2</sub>O, 0.50 M CO<sub>2</sub> and 0.40 M H<sub>2</sub>.

Determine if the reaction is at equilibrium.

$$Q = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]}$$

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