Unit 4 - Equilibrium

- What is an equilibrium?
- Rate of reaction
  - Transition state, Activation energy
- Factors affecting Reaction Rate
- Percent Reaction / Percent Yield
- Equilibrium Law
- Le Chatelier's Principle

7.05 g of hydrogen reacts with 167 g of chlorine to produce 24.12 g of hydrogen chloride at equilibrium. Determine the percent reaction and write the equilibrium expression.

$$H_{2(g)} + Cl_{2(g)} \overset{14.0\%}{\rightleftharpoons} 2HCl_{(g)}$$

	H_2	Cl_2	HCl
init.	7.05 g	167 g	
eqm.			24.12 g

If H_2 is L.R.

$$7.05\text{g } H_2 \times \frac{1\text{ mol } H_2}{2.02\text{g } H_2} \times \frac{2\text{ mol } HCl}{1\text{ mol } H_2} \times \frac{36.46\text{g } HCl}{1\text{ mol } HCl} = 254.50\text{ g } HCl$$

If Cl_2 is L.R.

$$167\text{g } Cl_2 \times \frac{1\text{ mol } Cl_2}{70.90\text{g } Cl_2} \times \frac{2\text{ mol } HCl}{1\text{ mol } Cl_2} \times \frac{36.46\text{g } HCl}{1\text{ mol } HCl} = 171.76\text{ g } HCl$$

$\therefore Cl_2$ is L.R.

$$\%\text{ rxn} = \frac{\text{exp.}}{\text{theor.}} \times 100\%$$

$$= \frac{24.12\text{g}}{171.76\text{g}} \times 100\%$$

$$= 14.0\%$$

Equilibrium Law

A mixture of H_2 and I_2 is allowed to react at 448°C. When the equilibrium is established the concentrations of the participates are found to be $[H_2]$ = 0.46 mol/L, $[I_2]$=0.39 mol/L, and [HI] = 3.0 mol/L. Calculate the value of K at 448°C from these data.

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

$$K = \frac{[HI_{(g)}]^2}{[H_{2(g)}][I_{2(g)}]}$$

Le Chatelier's Principle

$2SO_{2(g)} + O_{2(g)} \longleftrightarrow 2SO_{3(g)} + \text{energy}$

⇒remove $SO_{3(g)}$ →

⇒heat system ←

⇒decrease volume (increase pressure) →