Point in blocks

* Factors Affecting the state of Equilibrium

Le-Chatelier's Principle: This Principle states that If a System in equilibrium is subjected to a change in any of the factors that determine the equilibrium conditions of a system then the equilibrium will shift in the direction so as to reduce or to counteract the effect of the change. This principle is applicable to all the physical and chemical equilibria. Let us now apply this principle to explain the effect of change in concentrations, temperature and pressure on various reactions in equilibrium.

1. **Effect of change of Concentration**: When a substance is added to an equilibrium mixture, the stress is relieved by the net reaction in the direction that consumes the added substance.

- When a substance is removed from an equilibrium mixture then stress is relieved by the net reaction in the direction that replenishes the removed substance.

- If Conc. of one or all the reactant species is increased, the equilibrium shifts in the forward direction and more of the products are formed.
- If the Concentration of one or all the products species is increased, the equilibrium shifts in the backword direction forming more reactants.

2.) Effect of Change of temperature: - The equilibrium will shift in the direction of endothermic reaction with increase in temperature.

- The equilibrium will shift in the direction of the exothermic reaction with decrease in temperature.

for ex. formation of NH_3 is an exothermic process. which is increase in temperature opposes the formation of NH_3 and decrease in temperature favours the formation of NH_3.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g); \quad \Delta H^\circ = -92.38 KJ$$

3.) Effect of Pressure Change: According to the Le-Chatelier's principle, increase of pressure on a system at equilibrium will shift the equilibrium in the direction in which pressure is reduced.

Let us consider the following exothermic reaction.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

Suppose at constant temperature it is compressed to half of its original volume. Then total Pressure will become double ($\because PV = \text{constant}$).

Let the molar conc. of different species at equilibrium be $[N_2]$, $[H_2]$, $[NH_3]$. When volume is halved the partial pressure & conc. are doubled.

then

$$Q_c = \frac{(2[NH_3])^2}{(2[N_2])(2[H_2])^3}$$

$$Q_c = \frac{4[NH_3]^2}{(2[N_2])(8[H_2]^3)}$$

$$Q_c = \frac{4[NH_3]^2}{16[N_2][H_2]^3} = \frac{1}{4}\frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{K_c}{4}$$

OR $Q_c < K_c$

$\because Q_c$ is less than K_c, the reaction proceed in the forward direction.