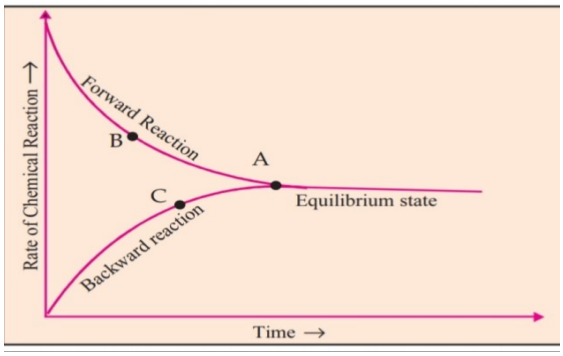
STD 10 CHEMISTRY CHAPTER 5 COMPOUNDS OF NON METALS
FIRST BELL CLASS 28 (EM) NOTES & WORKSHEET

CHEMICAL EQUILIBRIUM



- **Which are the graphs that indicate forward and backward reaction?**
  Graph B – Forward reaction
  Graph C – Backward reaction
- **What happens to the rates of forward and backward reactions as time progresses?**
  Rate of forward reaction decreases and rate of backward reaction increases.
- **What happens at the point A?**
  At the point A, the two graphs meet at that point. At this point the rates of both forward and backward reactions become equal. Thus the system attains equilibrium state.

> **Chemical equilibrium – The stage at which the rate of the forward reaction becomes equal to the rate of the backward reaction in a reversible reaction is known as chemical equilibrium.**

Characteristics of chemical equilibrium

- **At equilibrium state, both the reactants and the products are present in the system**
- **The rates of forward and backward reactions become equal at the equilibrium state.**
- **Chemical equilibrium is dynamic at the molecular level.**
- **Chemical equilibrium is attained in closed systems.**

> **What is Le Chatlier's Principle?**
> ***When the concentration, pressure or temperature of a system at equilibrium is changed, the system will readjust itself so as to nullify the effect of that change and attain a new state of equilibrium.***

Industrial preparation of Ammonia (Haber process)

Nitrogen and hydrogen react in the ratio 1:3 at a very high pressure (200 atm) and a temperature 450^0C in presence of spongy iron as catalyst to produce ammonia.

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)+Heat$$

Influence of concentration on Equilibrium

Chemical equation for the industrial preparation of ammonia is given below.

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

a. If the concentration of nitrogen or hydrogen (reactants) is increased, according to Le Chatlier's principle, the system rearranges tries to decrease the concentration of reactant. As a result the system convert the increased amount of reactant into product. Thus the rate of forward reaction increases.

b. If the concentration of ammonia (product) increases, according to Le Chatlier's principle , the system tries to decrease the concentration of product by converting into reactant. Thus the rate of backward reaction increases.

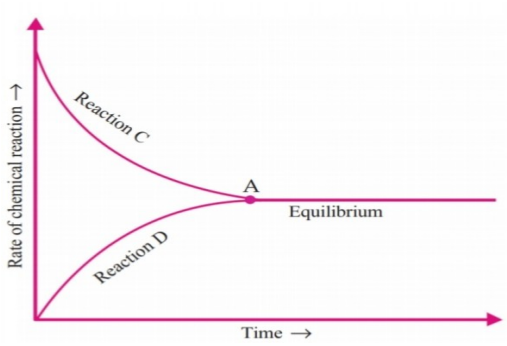
For a reversible reaction at equilibrium,

- ***If the concentration of reactant increases, the rate of forward reaction increases.***
- ***If the concentration of product increases, the rate of backward reaction increases.***

Action	Change of concentration	Change in rate
More hydrogen is added	Increases the concentration of reactant	Rate of forward reaction increases.
More ammonia is added	Increases the concentration of product	Rate of backward reaction increases.
Ammonia is removed	Decreases the concentration of product	Rate of forward reaction increases.
More nitrogen is added	Increases the concentration of reactant	Rate of forward reaction increases.

Worksheet

1. **The graph for the reaction $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$ is given below.**



a. Identify the reactions C and D

b. In which point rate of forward and backward reactions becomes equal?

2. During the manufacturing of ammonia, the product ammonia is frequently removed from the system. Explain why?

3. $2SO_2(g)+O_2(g) \rightarrow 2SO_3(g)+Heat$

In the above reaction find out the influence of the following factors in the rate of forward reaction.

a. Increase the amount of oxygen

b. SO_3 is removed

c. Decrease the amount of SO_2

4. In Haber process, what change is to be made in concentration to get maximum yield of ammonia?

5. $2NO(g)+O_2(g) \rightarrow 2NO_2(g)+Heat$

In the above reaction how do the following changes influence the rate of forward reaction?

a. Amount of NO is increased

b. Amount of O_2 is increased

c. NO_2 is removed from the system

d. Decrease the amount of O_2

Prepared by USHAKUMARY. S
HST Physical science
Govt HSS Karunagappally