Effect of Pressure on Chemical Equilibrium

Chemistry — NEET UG Study Notes

The effect of pressure is important in equilibria involving gaseous reactants and products. According to Le Chatelier's principle, an equilibrium system responds to an increase or decrease in pressure by shifting in a direction that tends to oppose the change.

1. Effect of increasing pressure

When pressure is increased by decreasing the volume, equilibrium shifts towards the side having fewer moles of gaseous substances.

Example: Formation of ammonia

\[\mathrm{N_2(g)+3H_2(g)\rightleftharpoons2NH_3(g)} \]

4 moles

Reactants

1 N_2 + 3 H_2

2 moles

Products

2 NH_3

Increasing pressure favours the forward reaction, increasing the equilibrium yield of ammonia.

2. Effect of decreasing pressure

When pressure is decreased by increasing the volume, equilibrium shifts towards the side having more moles of gaseous substances.

For the same reaction:

\[\mathrm{N_2(g)+3H_2(g)\rightleftharpoons2NH_3(g)} \]

Decreasing pressure favours the reverse reaction, producing more nitrogen and hydrogen.

3. When does pressure have no effect?

If the total number of gaseous stoichiometric moles is equal on both sides, a pressure change caused by changing volume does not shift the equilibrium of an ideal-gas reaction.

Example:

\[\mathrm{H_2(g)+I_2(g)\rightleftharpoons2HI(g)} \]

- Reactant side: 2 gaseous moles.
- Product side: 2 gaseous moles.

Therefore, changing pressure by changing volume does not shift the equilibrium.

4. Quick revision table

Change	Direction favoured
Increase pressure	Side with fewer gaseous moles
Decrease pressure	Side with more gaseous moles
Equal gaseous moles on both sides	No shift
Add inert gas at constant volume	No shift
Add inert gas at constant pressure	Side with more gaseous moles may be favoured

NEET UG key point: Pressure changes can alter equilibrium concentrations, but the equilibrium constant K remains unchanged if temperature is constant. Pressure has no direct effect on the equilibrium position of reactions involving only solids and liquids, assuming their volumes are effectively unchanged.