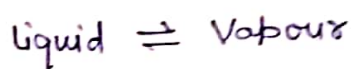


## \* Clausius-Clapeyron Equation :-

The Clausius-Clapeyron equation is derived from the Gibbs-Helmholtz equation. A system consisting of any two phases of a single substance in chemical equilibrium is the Clausius-Clapeyron equation.

Let the system studied be -



$$G_A = G_B$$

Here, there will be no change in free energy -

$$\text{i.e. } \Delta G = \Delta B - \Delta A = 0$$

$$G_A + dG_A = G_B + dG_B \quad \text{--- (I)}$$

A/c to law of thermodynamics -

$$dG = Vdp - SdT \quad \text{--- (II)}$$

In eq<sup>n</sup> (I), for phase - 'A'.

$$dG_A = V_A dp - S_A dT$$

and for phase - 'B'

$$dG_B = V_B dp - S_B dT$$

$$\text{Since, } G_A = G_B$$

\(\therefore\) from eq<sup>n</sup> (I)

$$dG_A = dG_B$$

$$\therefore V_A dp - S_A dT = V_B dp - S_B dT$$

$$\text{or, } \frac{dp}{dT} = \frac{S_B - S_A}{V_B - V_A}$$

$$\therefore \frac{dp}{dT} = \frac{\Delta S}{\Delta V}$$

We know that —

$$\Delta S = \frac{q}{T}$$

$$\text{So, } \boxed{\frac{dp}{dT} = \frac{q}{T \Delta V}} \quad \text{--- (iii)}$$

This eq<sup>n</sup> is called Clausius - clapeyron eq<sup>n</sup>.

Since,

$$\Delta V = V_B - V_A$$

So, eq<sup>n</sup> — (iii) becomes —

$$\boxed{\frac{dp}{dT} = \frac{q}{T(V_B - V_A)}} \quad \text{--- (iv)}$$

This eq<sup>n</sup> — (iv) is another form of clausius-clapeyron equation.

Where,

$q$  = molar heat of vaporisation =  $\Delta H_{\text{vap}}$ .

$V_B$  = volume of water in vapour phase =  $V_g$

$V_A$  = volume of water in liquid phase =  $V_l$

$\therefore$  eq<sup>n</sup> — (iv) becomes —

$$\boxed{\frac{dp}{dT} = \frac{\Delta H_{\text{vap}}}{T(V_g - V_l)}} \quad \text{--- (v)}$$