Relative amounts of liquid & vapour present are calculated by LEVER RULE:

Let $n_B = n_B(liq.) + n_B(vap.)$

$n_B(liq.)$ = number of moles of component B in liquid

$n_B(vap.)$ = number of moles of component B in vapour.

n_B = total number of moles of component B.

$n = n_{liq.} + n_{vap.}$

n = Total number of moles of both components

$n_{liq.} = n_A(liq.) + n_B(liq.)$ both components in liquid

= Total number of moles of

$n_{vap.} = n_A(vap.) + n_B(vap.)$

= Total number of moles of both components in vapour.

$$al = X_B - x_B = \frac{n_B}{n} - \frac{n_B(liq.)}{n_{liq.}} \quad -(1.)$$

$$av = y_B - X_B = \frac{n_B(vap.)}{n_{vap.}} - \frac{n_B}{n} \quad (2.)$$

Multiply eq. (1.) by $n_{liq.}$ & (2.) by $n_{vap.}$,

$$al \times n_{liq.} = \left(\frac{n_B}{n} - \frac{n_B(liq.)}{n_{liq.}}\right) \times n_{liq.} \quad -(3.)$$

$$av \times n_{vap.} = \left(\frac{n_B(vap.)}{n_{vap.}} - \frac{n_B}{n}\right) \times n_{vap.} \quad (4.)$$

Subtract eq. (4.) from eq. (3.)

$$n_{liq.}(al) - n_{vap.}(av) = \frac{n_B}{n}(n_{liq} + n_{vap}) - (n_B(liq.) + n_B(vap.)) = n_B - n_B = 0$$

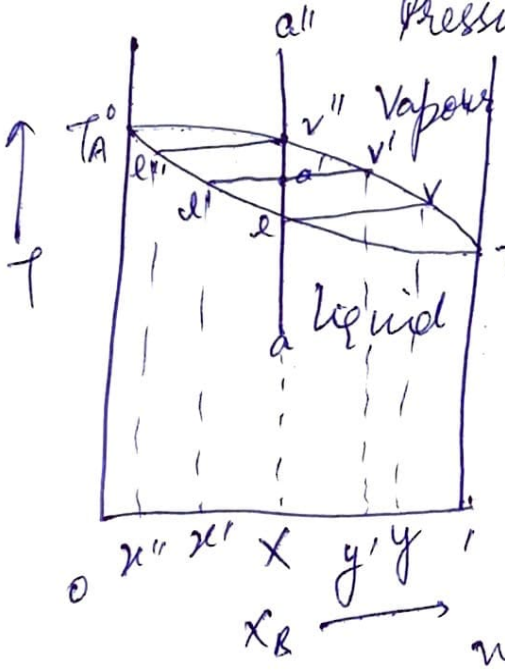
$$\frac{a_v}{a_l} = \frac{n_{liq.}}{n_{vap.}} \quad (5.)$$

Point 'a' is falcrum of lever.

If point 'a' lies close to 'v', a_v will be small & $n_{vap.} >> n_{liq.}$ i.e. system consists more of vapour. (has more volatile component B in large quantity) (from eq. (5))

Similarly, if point 'a' lies close to 'l', a_l will be small & $n_{liq.} >> n_{vap.}$ i.e. system consists more of liquid (has less volatile component A in large quantity).

Temperature – Composition diagram :



From a'', as temperature is decreased, point v'' has last trace of liquid of composition x'' which disappears.

At d, first trace of vapour appears having composition y.

T_B^0 → low boiling point means more volatile component.

Separation of mixture of volatile components by distillation.