

CHE221A

ASSIGNMENT-08

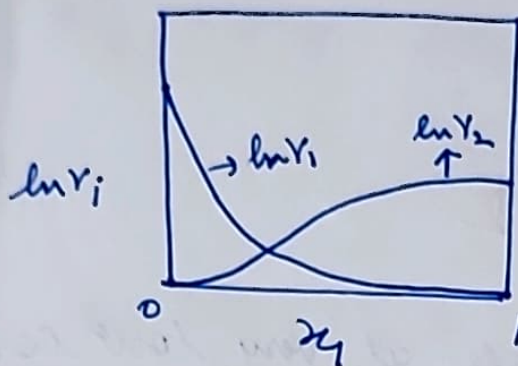
MODEL SOLUTION

Q.26

(a) at $x_1 = 1, y_1 = 1$

$\therefore \ln y_1 = 0$

→ From this we can label as follows →



(b) To find total pressure of the system;

$$P = x_1 y_1 P_1^{sat} + x_2 y_2 P_2^{sat} \quad \text{--- (1)}$$

$x_1 = 0.2 \Rightarrow x_2 = 0.8$

$P_1^{sat} = 1.12 \text{ bar @ } 100^\circ\text{C}$

$P_2^{sat} = 1.01 \text{ bar @ } 100^\circ\text{C}$ [Using steam tables]

∴ Substituting in eq (1);

$$P = (0.2) e^{\left(\frac{1}{0.2}\right)} (1.12) + (0.8) e^{\left(\frac{1}{0.8}\right)} (1.01)$$

∴ $P = 1.524 \text{ bar}$

02

(b) Since, $P > P_1^{\text{sat}}$ & $P > P_2^{\text{sat}}$ it can be concluded that system forms an Azeotrope and it is a low boiling azeotrope. This implies

→ i-i interactions \gg i-j ~~inter~~ interactions
(like) (unlike)

— 1

(d) Using Modified Raoult's Law,

$$y_1 P = x_1 \gamma_1 P_1^{\text{sat}}$$

$$\therefore \boxed{y_1 = 0.379} \quad \text{— 2}$$

(e) Henry's law is applicable at very low concentration

$$\therefore \text{At } x_1 \rightarrow 0, \ln \gamma_1^{\infty} = 2.6$$

$$\therefore \gamma_1^{\infty} = 13.5$$

→ Using, $\gamma_1^{\infty} \cdot P_1^{\text{sat}} = H_1$

$$\therefore \boxed{H_1 = 15.12 \text{ bar}} \quad \text{— 2}$$

(f) Yes, the system exhibits an azeotrope as explained in (b)

— 1

(10)

8] System I -

→ Here, the values of $g_{\text{liq}} < g_{\text{vap}}$ except at a particular mole fraction of $\underline{a'}$. This means liquid phase is more stable than vapor phase. Moreover, this plot shows behavior of low boiling azeotropic systems.

→ at $g_{\text{liq}} = g_{\text{vap}}$ system is in ^{V.L} eqm. — 2.5

System II -

→ Here, for all points ~~and~~ except a particular mole fraction of $\underline{a'}$ $g_{\text{vap}} < g_{\text{liq}}$ which means vapor phase is more stable than liquid phase. This plot shows that the system forms a high boiling azeotrope.

→ at $g_{\text{liq}} = g_{\text{vap}}$ the system is in vapor-liquid equilibrium. — 2.5

(5)

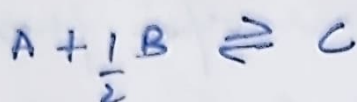
9.3 Given;



$$\Delta g_{rxn}^{\circ} = -1000 \text{ J/mol}$$

$$K_T = 16$$

→ Now;



$$\therefore \Delta g_{rxn}^{\circ} = \sum_i \nu_i g_i^{\circ} \quad - \quad |$$

→ Thus;

$$\Delta g_{rxn}^{\circ} = \frac{-1000}{2}$$

$$\boxed{\Delta g_{rxn}^{\circ} = -500 \text{ J/mol}} \quad - \quad |$$

→ Using;

$$K_T = \left(\prod (y_i \phi_i)^{\nu_i} \right) P^{\Delta \nu}$$

As system is ideal;

$$K_T = \left(\prod (y_i)^{\nu_i} \right) P^{\Delta \nu} \quad - \quad |$$

For previous reaction;

$$K_T = \frac{n_C^2 n_T}{n_A^2 n_B} \cdot P^{-1}$$

For new reaction;

$$K'_T = \frac{n_C n_T^{1/2}}{n_A n_B^{1/2}} \cdot P^{-1/2}$$

$$\therefore k_T' = \sqrt{k_T}$$

$$\therefore \boxed{k_T' = 4} - 2$$

(5)

9.5 From the following relation;

$$\int_{k_{298}}^k dk = \int_{298}^T \frac{dk_{\text{max}}}{RT^2} dT - 2.5$$

Here; dk_{max} is a function only of temperature and not of pressure. Hence k is only dependent on temperature. Thus;

$$\boxed{k = 10} - 2.5$$

(5)