

Open Books and Notes

I. 50 points

Ethyl alcohol and n-hexane are equilibrated at 75°C such that two liquid phases and vapor phase coexist. One of the liquid phases contains 9.02 mole% n-hexane. Given:

$$\left. \begin{aligned} RT \ln \gamma_H &= 8163 X_E^2 \\ RT \ln \gamma_E &= 8163 X_H^2 \end{aligned} \right\} \text{ in } \frac{J}{mole}$$

$$\left. \begin{aligned} P_H^s &= 1.202 \text{ atm} \\ P_E^s &= 0.8714 \text{ atm} \end{aligned} \right\} \text{ at } 75^\circ \text{ C}$$

(E = ethylalcohol, H = n-hexane)

Find:

- 20 points
The composition of the 2nd liquid phase.
- 10 points
The pressure of the system.
- 20 points
The composition of the vapor phase.

II. 50 points

CRC Handbook lists an azeotrope of Acetone (1)/Cyclohexane (2) which boils at 53.0° (P = 1 atm) with composition 0.670/0.330 respectively. Using the Scatchard-Hamer activity coefficient correlation (see below):

a. 25 points

Determine A and B.

b. 25 points

Determine the equilibrium pressure and composition of the vapor phase at 53°C if $x_1 = 0.2$, $x_2 = 0.8$.

<u>Data:</u>	<u>P_i^s (atm) at 53.0°</u>	<u>V_i^o (cm³/mole)</u>
Acetone (1)	0.8018	73.5
Cyclohexane (2)	0.3430	108.1

Scatchard-Hamer Equation:

$$\ln \gamma_1 = \left[A + 2 \left(\frac{B V_1^o}{V_2^o} - A \right) \phi_1 \right] \phi_2^2$$

$$\ln \gamma_2 = \left[B + 2 \left(\frac{A V_2^o}{V_1^o} - B \right) \phi_2 \right] \phi_1^2$$

where: $\phi_i = \frac{V_i^o x_i}{\sum V_i^o x_i}$ (volume fraction)