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Problem 12.11: The laboratory division of your company has sent you the following data for the system n-pentane (1)/propionaldehyde (2) at 35 °C: The activity coefficients of the two components at infinite dilution are 4.0 and the saturation pressures of the pure components are 0.7 and 1 bar, respectively.

a) Does this system exhibit positive, negative, or no deviations from ideal-solution behavior?

b) Assuming the validity of the Margules equation, determine the constants A_{12} and A_{21}.

c) You suspect that this system forms an azeotrope. What is the composition of the two phases and the pressure at the azeotrope?

d) Draw a qualitative *Pxy* graph at 35 °C. On the graph show all the information that you have for this system.

e) Your are designing a single flash separation process for a stream that contains 45% n-pentane (the rest is propionaldehyde). The mixture is to be flashed at 35 °C and you must determine the pressure so that the purity of n-pentane is 95%. What is this pressure?

80

Problem 12.12: At 50 °C the system acetone(1) and chloroform(2) forms an azeotrope with composition $x_1 = 0.416$. The activity coefficients are given by the equation

$$\ln \gamma_1 = Ax_2^2, \quad \ln \gamma_2 = Ax_1^2,$$

where A is constant.

a) What is the pressure at the azeotropic composition at 50 °C?

b) One mole of acetone is mixed with one mole of chloroform at 50 °C, 0.5 bar. What is the phase of the pure components before mixing? What is the phase of the system after mixing?

Additional information: The saturation pressures of the pure components at 50 °C are $P_{\text{acetone}} = 0.81$ bar, $P_{\text{chloroform}} = 0.41$ bar. 0.69 bar (needs new solution)

Problem 12.13: a) Use the data for the system ethyl-methyl ketone(1)-toluene(2) in the notes to obtain the parameters of the van Laar equation.

b) Reconstruct the *Pxy* using the van Laar equation and compare with the data.

Problem 12.14: The following data are for the system water(1)/diethylamine(2).

a) Do the components form an ideal solution?

b) Calculate the fugacity and fugacity coefficient of water in a solution that contains 20% water by mole, at the bubble point at 311.5 K.

P (Pa)	T (K)	x_1	y_1
54382.19	311.50	0.0000	0.0000
48955.97	311.50	0.2000	0.0530
6759.44	311.50	1.0000	1.0000