**Name:** KEY (Revised)

**Problem 1:** You are trying to understand if a system of acetone(1) and methanol(2) is ideal or not. Your measurements show that at a temperature of 55°C and a pressure of 72.27 kPa, the mole fractions of acetone in the liquid and vapor phases are 0.0287 and 0.0647, respectively. Conversely, at a pressure of 99.8 kPa and the same temperature, the mole fractions of acetone in the liquid and vapor phases are 0.9448 and 0.9336, respectively.

a) What are the activity coefficients at the two conditions?
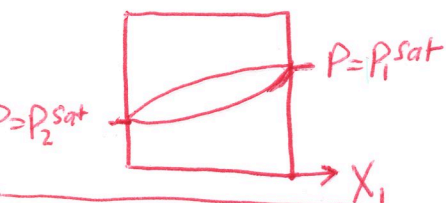


$P = P_1^{sat}$

$P = P_2^{sat}$

$\gamma_i = \dfrac{P_T y_i}{P_i^{sat} x_i}$

@ $P_T = 72.27$, system is mostly methanol (2)

$P_2^{sat} = 72.27$

@ $P_T = 99.8$ kPa system is mostly acetone (1)

$P_1^{sat} = 99.8$ kPa

@ 72.27 kPa $\gamma_1 = \gamma_1^\infty = \dfrac{P_T \times 0.0647}{99.8 kpa \times 0.0287} = 1.63$

$\gamma_2 = 1$

@ 99.8 kpa $\gamma_2 = \gamma_2^\infty = \dfrac{P_T \times (1-0.9336)}{72.27 kpa \times (1-0.9448)} = 1.66$

$\gamma_1 = 1$

(b) What are the Margules constants at these two conditions?

$\ln \gamma_1^\infty = A_{12} \quad \ln \gamma_2^\infty = A_{21}$

$A_{12} = 0.489 \quad A_{21} = 0.507$

**Problem 2:** What is the dew point of an equimolar mixture of component X and Y at 25°C? Use single parameter Margules for any activity coefficient estimations (A = 2.0). The saturation pressure of X at 25°C is 30 kPa, and the saturation pressure of Y is 90 kPa.

$\ln \gamma_1 = A x_2^2 \quad \ln \gamma_2 = A x_1^2$

$P_{dew} = \dfrac{1}{\sum \dfrac{y_i}{P_i^{sat} \gamma_i}}$

$P_{dew} = 74.25 kpa$

@ $P_{dew}$ $y_i = z_i = 0.5$