ChBE 3130A Lively Quiz 6 **Date:** 03/10/2016

Name: Solutions

Problem 1: The excess Gibss energy for the system chloroform (1) / ethanol (2) at 55°C is described by the Margules equation:

A_{21} A_{12}

$$\frac{G^E}{RT} = (1.42x_1 + 1.42x_2)x_1x_2$$

The vapor pressures of chloroform and ethanol at 55°C are:

P_1^{sat}=82.37 kPa and P_2^{sat} = 37.31 kPa.

$\begin{cases} A_{12} = A_{21} = 1.42 \\ x_1 = x_2 = 0.5 \end{cases} \Rightarrow \boxed{\gamma_1 = \gamma_2}$

What is the bubble point pressure for an equimolar mixture of chloroform and ethanol? What is the composition of the first bubble that forms?

$\gamma_1 = \exp[A_{12}x_1^2] = \exp[(1.42)(0.5)^2] = 1.4262$

$P_{bubble} = \sum x_i \gamma_i P_i^{sat} = x_1\gamma_1 P_1^{sat} + x_2\gamma_2 P_2^{sat} = x_1\gamma_1(P_1^{sat} + P_2^{sat})$

$P_{bubble} = (0.5)(1.4262)(82.37 + 37.31) = \boxed{85.344 \text{ kPa}}$ This is impossible since it is not b/w P_1^{sat} and P_2^{sat}

$y_1 = \frac{x_1\gamma_1 P_1^{sat}}{P_{bubble}} = \frac{(0.5)(1.4262)(82.37)}{(85.344)} = \boxed{0.688}$

"A" values were poorly chosen.

Problem 2: True / false

(a) Non-ideal vapors in equilibrium with ideal solutions have negative deviations from Raoult's Law: True

(b) Thermodynamically, when liquids split (e.g., oil and water), these are still described as a single liquid phase: False

(c) Heats of solution are always exothermic: False

Useful equation: $ln\gamma_1 = Ax_2^2$