HW Due 4/10/02: handout

Partial Answers:

1. It’s an ideal solution:
   \[ \Delta S_{\text{mix}} = 8.46 \text{ J/mol K} \]

2. \[ \bar{H}_{\text{H}_2\text{O}} = 0 \text{ kcal/mol} \]
   \[ \bar{H}_{\text{NaOH}} = 200 \text{ kcal/mol} \]

HW Due 4/17/02: 9.3, 9.4, 9.5, 9.10

9.3 (a) \( x_i \) and \( P \) are known, calculate for \( T \) and \( y_i \). Ans.: \( T = 293.4 \text{ K} \) (shortcut method)
   (b) \( y_i \) and \( P \) are known, calculate for \( T \) and \( x_i \). Ans.: \( T = 313 \text{ K} \)
   (c) \( Z_i \) and \( T, P \) are known. Ans: \( L/F = 0.83 \)

9.4 (a) \( T = 126^\circ \text{C} \)
   (b) \( T = 116^\circ \text{C} \)

9.5 (a) \( L/F = 0.24 \)
   (b) \( L/F = 0.217 \).

9.10. 70.6 min

HW Due 4/24/02: 10.2, 10.4, 10.6, 10.16 and 10.40

10.4 (a) 556 cm\(^3\)/mol; (b) 374.7 cm\(^3\)/mol; (c) 417 cm\(^3\)/mol; (d) 423 cm\(^3\)/mol; (e): 420 cm\(^3\)/mol.

10.6. you may increase your \( y_1 \) from 0 to 1.0 with a step of 0.1, and plot your fugacities as a function of \( y_1 \).

Example answer: for \( y_1 = 0.5 \), \( f_1 \) (hat) = 1.215 MPa; \( f_2 \) (hat) =0.975 MPa by Virial EOS.

10.16. T, P, and Zi are known, solve for \( K_i \) by P-R EOS.
Use of P-R EOS: \( K(\text{methane}) = 10.9; K(\text{benzene}) = 0.0095 \)

HW Due 4/29/02: 11.3, 11.6, 11.10, 11.16, 12.7 and 12.10

11.3 (a) example answer: \( x_1 = 0.2, V = 60.528 \text{ cm}^3/\text{mol}, \)

11.6. Hint: assume vapors are ideal gases, but liquid is non-ideal solution (Modified Raoult’s Law). The following answers are obtained by using Antoine method for P(sat).
   (a). 598.5 mmHg;
   (b) 573 mmHg; (since \( P \) is dependent on \( \gamma \), which is a function of \( x_i \), iteration is deemed).
   (c). 56.2\(^\circ\text{C} \)
   (d). 57\(^\circ\text{C} \)
11.10. Hint: use the equilibrium data to get activity coefficients (again, assuming modified Raoult’s Law), then fit the model.
   Example answer: (c): \( A_{12} = 1.029; A_{21} = 0.982 \).

11.16: Hint: \( \gamma_{1\infty} \) denote the activity coefficient of component 1 when \( x_1 \) is zero.
   Partial answer: \( \gamma_1 = 0.4482 \).

12.7: Hint: follow the procedure outlined on page 429 to iterate for compositions. Start with a guessing like \( x_1(\alpha) = 0.9; x_1(\beta) = 0.1 \).
   UNIFAC: composition of cyclohexane: 6 CH2 groups.
   Partial Answer: \( x_1(\alpha) = 0.896 \).

12.10.
   (a). Assume modified Raoult’s law; also, since the water molar fraction is approaching 1, you can assume its activity coefficient is 1. Answer: 987,000

   (b). Hint: hexane and benzene are miscible and form one organic phase, while water forms the other liquid phase. To estimate, ignore the solubility of organics in water, and assume ideal solutions and ideal gas vapors. Answer: water composition in vapor is 0.15.

   (c). Only the organic solution needs activity coefficients. Benzene has one aromatic carbon group \((1 - AC)\). \( \gamma \) (hexane): 0.808; \( \gamma \) (benzene): 0.505.