

HW Due 4/10/02: handout

Partial Answers:

1. It's an ideal solution:

$$\Delta S_{\text{mix}}^{\text{is}} = 8.46 \text{ J/mol K}$$

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 K (shortcut method)
(b) y_i and P are known, calculate for T and x_i . Ans.: T = 313 K
(c) Z_i and T, P are known. Ans: L/F = 0.83

- 9.4 (a) T = 126°C

- (b) T = 116°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 cm³/mol; (b) 374.7 cm³/mol; (c) 417 cm³/mol; (d) 423 cm³/mol; (e): 420 cm³/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 Z_i are known, solve for K_i by P-R EOS.

Use of P-R EOS: K(methane) = 10.9; K(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 γ , which is a function of x_i , iteration is needed).

- (c). 56.2°C

- (d). 57°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: γ_1^∞ denote the activity coefficient of component 1 when x_1 is zero.

Partial answer: $y_1 = 0.4482$.

12.7: Hint: follow the procedure outlined on page 429 to iterate for compositions. Start with a guessing like $x_1(\text{alfa}) = 0.9$; $x_1(\text{beta}) = 0.1$.

UNIFAC: composition of cyclohexane: 6 CH₂ groups.

Partial Answer: $x_1(\text{alfa}) = 0.896$.

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). γ (hexane): 0.808; γ (benzene); 0.505.