

## Homework #9

## Chapter 24/25

1. The vapor pressure (in torr) of the two components in a binary solution are given by the following equations. Determine the values of  $P_1^*$ ,  $P_2^*$ ,  $k_{H,1}$ , and  $k_{H,2}$ .

$$P_1 = 120x_1e^{0.20x_2^2+0.10x_2^3} \quad \text{and} \quad P_2 = 140x_2e^{0.35x_1^2-0.10x_1^3}$$

2. McQuarrie and Simon Problems 24-50 and 24-51. For 24-50, show where the plots follow Raoult's law and Henry's law and for 24-51 comment on meaning of the  $\gamma_i$  values.
3. The solubility of  $N_2$  in blood at 37 °C and a partial pressure of 0.80 atm is  $5.6 \times 10^{-4}$  mol/L. A deep-sea diver breathes compressed air with a partial pressure of  $N_2$  equal to 4.0 atm. Assume the total volume of blood in the body is 5.0 L. Calculate the amount of  $N_2$  gas released (in L) when the diver returns to the surface of water, where the partial pressure of  $N_2$  is 0.80 atm.
4. The density of a glycerol/water solution that is 40.0% glycerol by mass is 1.101 g/mL at 20 °C. Calculate the molality and molarity of the solution at 20 °C.
5. Calculate the mole fraction of glucose in an aqueous solution that is 0.500 molal in glucose.
6. A solution containing 0.80 g of a protein in 100 mL of solution has an osmotic pressure of 2.06 torr at 25 °C. What is the molecular mass of the protein?
7. A solution of mercury(II) chloride is a poor conductor of electricity. A 40.7 g sample of  $HgCl_2$  is dissolved in 100.0 g of water, and the freezing point is found to be -2.83 °C. Use this data to explain why mercury is a poor conductor of electricity.
8. Calculate  $\ln \gamma_{\pm}$  for a 0.0100-molar NaCl solution at 25 °C. Experimentally, it is -0.103.
9. An aqueous solution of NaCl has an ionic strength of 0.315 mol/L. At what concentration will an aqueous solution of  $K_2SO_4$  have the same ionic strength? Why?
10. A forensic chemist is given a white powder for analysis. She dissolves 0.50 g of the substance in 8.0 g of benzene. The solution freezes at 3.9 °C. Can the chemist conclude that the compound is cocaine ( $C_{17}H_{21}NO_4$ )? What assumptions are made in the analysis? The freezing point of benzene is 5.5 °C.
11. Acetic acid is a polar molecule that can form hydrogen bonds with water molecules. Therefore, it has a high solubility in water. Yet acetic acid is also soluble in benzene ( $C_6H_6$ ), a nonpolar solvent that lacks the ability to form hydrogen bonds. A solution of 3.8 g of  $CH_3COOH$  in 80 g  $C_6H_6$  has a freezing point of 3.5 °C. Calculate the molar mass of the solute, and suggest what its structure might be. (Hint: Acetic acid molecules can form hydrogen bonds among themselves.)