

Chemistry 11
Solutions
Homework 1

Name: _____

Section # _____

(1) If a solution shows positive deviations from Raoult's law, would you expect it to have a higher or lower boiling point than if it were ideal? Explain.

(2) The solubility of benzoic acid (find structure in textbook) is 0.34 g per 100 mL in water at 25 °C and is 10.0 g per 100 mL in benzene (C_6H_6) at 25 °C. Explain this behavior. Would benzoic acid be more or less soluble in 0.1 M NaOH solution than it is in water? Explain.

(3) A solution of sodium chloride in water has a vapor pressure of 19.6 torr at 25 °C. What is the mole fraction of NaCl in this solution? What would be the vapor pressure of this solution at 45 °C? The vapor pressure of water is 23.8 torr at 25 °C and 71.9 torr at 45 °C.

(4) Vinegar is 5.0% aqueous acetic acid solution by mass. If the density of household vinegar is 1.01 g/mL, find the mole fraction, molarity, and molality of this acetic acid solution. The formula for acetic acid is $\text{HC}_2\text{H}_3\text{O}_2$.

(5) A solution is prepared by mixing 50.0 mL of toluene, C_7H_8 ($d = 0.867$ g/mL), with 125 mL benzene, C_6H_6 ($d = 0.874$ g/mL). Assuming that the volumes add upon mixing, find the mass percent, mole fraction, molality, and molarity of the toluene.

(6) Which solvent, water or hexane (C_6H_{14}), would you choose to dissolve each of the following?

a. NaCl

b. HF

c. octane (C_8H_{18})

d. $(NH_4)_2SO_4$

e. acetic acid

f. cupric nitrate

(7) The normal boiling point of methanol is $64.7\text{ }^\circ\text{C}$. A solution containing a nonvolatile solute dissolved in methanol has a vapor pressure of 710 torr at $64.7\text{ }^\circ\text{C}$. What is the mole fraction of methanol in this solution?

(8) What is the composition (in mole fraction) of a pentane-hexane solution that has a vapor pressure of 350 torr at $25\text{ }^\circ\text{C}$? What is the composition (in mole fraction) of the vapor in equilibrium with this solution. At $25\text{ }^\circ\text{C}$ the vapor pressures of pentane and hexane are 511 and 150 torr, respectively.

(9) A flask containing solid NH_4Cl becomes colder as water is added and the salt dissolves.

a. Is the dissolving of NH_4Cl in water exo or endothermic? Why does the salt dissolve?

b. Is the magnitude of $\Delta H_{\text{lattice}}$ of NH_4Cl larger or smaller than the $\Delta H_{\text{hydration}}$ of the ions? Explain.

(10)

a. Use the following data to calculate the combined heats of hydration for the ions in potassium bromate (KBrO_3): $\Delta H_{\text{lattice}} = -745 \text{ kJ/mol}$ $\Delta H_{\text{solution}} = 41.1 \text{ kJ/mol}$

b. Which ion do you think contributes more to the answer to part (a)? Why?

(11) Which ion in each pair has the greater charge density? Briefly explain each answer.

a. Na^+ or Cs^+

b. Sr^{2+} or Rb^+

c. Na^+ or Cl^-

(12) You are given a bottle of solid X and three aqueous solutions of X, one saturated, one unsaturated and one supersaturated. How would you determine which solution is which?

(13) You want to convert among molarity, molality, and mole fraction of a solution. You know the masses of solute and solvent and the volume of the solution. Is this enough information to carry out all the conversions? Explain.