REVIEW QUESTIONS

Chapter 13

1. Commercial nitric acid has a density of 1.42 g/mL and is 16.0 M. Calculate the mass of percent and molality of HNO_3 in this solution.

2. The density of a 1.80 M solution of LiBr in acetonitrile (CH_3CN) is 0.826 g/mL. Calculate the concentration of this solution in (a) molality, (b) mole fraction of LiBr, and (c) mass percent of CH_3CN.

3. Both methanol (CH_3OH) and ethylene glycol ($C_2H_6O_2$) are used as antifreeze. Which is more effective–that is, which produces a lower freezing point if equal amounts of each are added to the same amount of water?

4. Arrange the following solutions in the order of increasing boiling point. (Assume complete dissociation for strong electrolytes)

   0.040 m glycerol ($C_3H_8O_3$)
   0.025 m KBr
   0.010 m $CaCl_2$

5. For each pair of solutions listed below, determine which will have the higher boiling point. (Assume complete dissociation for strong electrolytes)

   a) 1.5 M NaCl and 0.5 M $Al(NO_3)_3$

   b) 2.0 M NaOH and 2.0 M $C_6H_{12}O_6$

   c) 0.4 M Na_2CO_3 and 0.7 M KCl

6. What are the freezing and boiling points of an aqueous solution containing 2.02 g of urea, $(NH_2)_2CO$, in 145 mL of solution? (Density of solution = 1.03 g/mL)

7. A solution of an unknown nonvolatile, non-electrolyte compound was prepared by dissolving 0.250 g of the unknown in 40.0 g of CCl_4. The boiling point of the resultant solution was measured to be 0.357°C higher than the pure solvent. Calculate the molar mass of the unknown solute. (K_b= 5.02 °C/m)

8. Stearic acid ($C_{18}H_{36}O_2$) and palmitic acid ($C_{16}H_{32}O_2$) are common fatty acids. Commercial grades of stearic acid usually contain palmitic acid as well. A 1.115-g sample of commercial grade stearic acid is dissolved in 5.00 mL of benzene (d= 0.879 g/mL). The freezing point of the solution is found to be 5.072 °C. The freezing point of pure benzene is 5.533 °C and K_f for benzene is 5.12°C/m. What is the mass percent of palmitic acid in the stearic acid sample?

9. What is the minimum mass of ethylene glycol ($C_2H_6O_2$) that must be dissolved in 14.5 kg of water to prevent the solution from freezing at –10.0°F?

10. Calculate the vapor pressure of a solution prepared by adding 32.5 g of glycerin ($C_3H_8O_3$) to 140.0 g of water at 70°C. ($P°$=234 torr)

11. A mixture of styrene (C_8H_8, 38%) and ethylbenzene (C_8H_{10}, 62%) is separated by fractional distillation at 90°C. What is the composition of the vapor in equilibrium with this mixture at 90°C, given the following vapor pressure of the two components at this temperature:

$P°_{styrene} = 134$ mmHg and $P°_{ethyl\ benzene} = 182$ mmHg.

12. Calculate the vapor pressure of a solution prepared by adding

a) 32.5 g of glycerin ($C_3H_8O_3$) to 140.0 g of water at 70°C. (P°=234 torr)

b) 5.00 g of Na_2SO_4 to 92.0 g of water at 55°C. (P°=118.0 torr)

13. The vapor pressure of CCl_4 is 0.354 atm and the vapor pressure of $CHCl_3$ is 0.526 atm at 43°C. A solution is prepared from equal masses of these compounds at this temperature.

    a) Calculate the mole fraction of $CHCl_3$ in the vapor above this solution.

    b) If the vapor above the original solution is condensed and isolated in a separate flask, what would be the vapor pressure of $CHCl_3$ above this new solution?