CH104 Assigned Problems Chapter 12

Section	Problems
12.1-12.4	Chang: 2-6, 8, 10-12. SP: 1-3
12.5	Chang: 13-15, 19, 22, 24. SP: 4, 5
12.6	Chang: 26, 29-31, 33
12.7	Chang: 34, 37, 38, 40, 44. SP: 6
12.8	Chang: 45, 52, 58-60, 63, 67, 71, 76, 77. SP: 7-11
12.9	Chang: 82-84, 86, 91-93. SP: 12, 13

CH104 Supplementary Problems: Chapter 12

Read the sections, do the assigned problems from Chang, and make sure you understand the concepts. Then attempt the problems below without referring to the book, except as noted. Use a periodic table when necessary.

Data and equations:

$c = kP$ $\quad\quad$ $\Delta T_f = K_f m$

$P_1 = X_1 P_1^\circ$ $\quad\quad$ $\Delta P = X_2 P_1^\circ$ $\quad\quad$ $\Delta T_b = K_b m$

$\pi = MRT$ $\quad\quad$ Tables 12.2 and 12.3 may be used as needed.

1. List the types of intermolecular forces that exist between molecules of:
   (a) KCl in CCl_4
   (b) Br_2 in $CH_3CH_2CH_3$
   (c) IBr in CCl_4
   (d) Cl_2 in H_2O
   (e) NaI in H_2O

2. Arrange the following in order of increasing solubility in H_2O: CO_2, $MgCl_2$, CH_3CH_2OH, CS_2.

3. Arrange the following in order of increasing solubility in CCl_4: Br_2, KBr, IBr, CBr_4.

4. A solution is made by dissolving 25.0 g of NaCl in enough water to make 1.00 L of solution. The density of the resulting solution is 1.0 g/cm^3. Calculate the mass percent, molarity, molality, and mole fraction of NaCl.

5. An aqueous antifreeze solution is 40.0% ethylene glycol ($C_2H_6O_2$) by mass. The density of the solution is 1.05 g/cm^3. Calculate the molality, molarity, and mole fraction of the ethylene glycol.

6. Calculate the solubility of O_2 in water at a partial pressure of 120 mm Hg at 25 °C. The Henry's Law constant for O_2 at 25 °C is 1.3×10^{-3} mol/L atm.

7. A solution is prepared by mixing 50.0 g of glucose ($C_6H_{11}O_6$) with 600.0 g of water. What is the vapor pressure of this solution at 25 °C? (At 25 °C the vapor pressure of pure water is 23.8 mm Hg.)

8. A solution is prepared by mixing 1.0 mol of methanol (CH_3OH) and 1.0 mol of propanol ($CH_3CH_2CH_2OH$). What is the total vapor pressure above this solution at 40 °C? What is the composition of the vapor at 40 °C (in mole fractions of CH_3OH and $CH_3CH_2CH_2OH$)? At 40 °C the vapor pressures of pure methanol and pure propanol are 303 mm Hg and 44.6 mm Hg, respectively.

9. When 2.60 g of a substance that contains only indium and chlorine is dissolved in 50.0 g of tin (IV) chloride, the normal boiling point of the tin(IV) chloride is raised from 114.1 °C to 116.3 °C. If K_b = 9.43 °C/*m* for $SnCl_4$, what are the molar mass and molecular formula of the solute?

10. A solution is prepared by dissolving 24 g of sucrose ($C_{12}H_{22}O_{11}$) in 175 g of water. Calculate the boiling point, freezing point, and osmotic pressure at 25 °C of this solution. Sucrose is a nonelectrolyte and the density of the solution is 1.1 g/mL.

11. An organic compound was analyzed and found to contain 40.0% C, 53.3% O, and 6.71% H. 10.0 g of the compound was added to enough water to make 100.0 mL of solution, and the osmotic pressure of the solution was found to be 13.6 atm at 25 °C. What are the empirical and molecular formulas of the organic compound?

12. Place the following solutions in order of increasing freezing-point depression:
    (a) 1.0 *m* NaCl in water
    (b) 1.3 *m* $MgCl_2$ in water
    (c) 1.5 *m* glucose in water
    (d) 1.0 *m* $FeCl_3$ in water

13. A 1.00 g sample of each of the following compounds is dissolved separately in 25.0 g of water. The freezing-point depressions for the solutions are shown below:

$Co(NH_2CH_2CH_2NH_2)_2Cl_3$	0.52 °C
$Co(NH_2CH_2CH_2NH_2)_3Cl_3$	0.87 °C

What are the experimental values of *i* for the two compounds?