Solutions 6.6
Colligative Properties of Solutions
Worksheet

1) A student dissolves 20.0 g of glucose, $C_6H_{12}O_6$, into 511 mL of water at 25°C. The vapor pressure of pure water at 25°C is 3.13 x 10^{-2} atm. Find the vapor pressure of the solution.

2) A student dissolves 50.0 g of ethanol, CH_3CH_2OH, in 70.0 g of water. The vapor pressure of pure water at 25°C is 23.8 mmHg, and that of ethanol is 59.0 mmHg.
   a. Find the vapor pressure of the solution in mmHg.
   b. Is the vapor pressure of the solution greater than or less than that of the pure solvent?

3) Will a non-volatile solute always lower the vapor pressure of the pure solvent in solution? Explain why it does or does not.

4) Will a volatile solute always lower the vapor pressure of the pure solvent? Explain why it does or does not.

5) Which solution from each set has the highest boiling point? Justify your answer.
   a. 1.5 M $Mg(NO_3)_2$ or 1.5 M NaF
   b. 1.0 M C_2H_5OH or 1.0 M NaBr

6) A 25.0g sample of glucose, $C_6H_{12}O_6$, dissolves in 525 mL of distilled water.
   a. What is the boiling point elevation of the solution over the pure solvent? K_b for water is 0.512 kg·K/mol.
   b. At what temperature will the solution boil at sea level?

7) A 25.0 g sample of $Mg(NO_3)_2$ dissolves in 675 mL of distilled water.
   a. What is the boiling point elevation of the solution over the pure solvent? K_b for water is 0.512 kg·K/mol.
   b. At what temperature will the solution boil if the atmospheric pressure is 1.0 atm?

8) A 35.0 g sample of KBr dissolves in 735 mL of distilled water.
   a. What is the boiling point elevation of the solution over the pure solvent? K_b for water is 0.512 kg·K/mol.
   b. What will be the new boiling temperature of the solution at sea-level?
   c. The measured value of the boiling point was slightly less than the calculated value. Explain why this is.

9) How much KOH (in grams) must be dissolved in 350 mL of distilled water to raise the boiling point by 2.0^{o}C?

10) How much glucose, $C_6H_{12}O_6$, (in grams) must be dissolved in 750 g of distilled water to raise the boiling point by 1.2^oC?

11) How much $Ca(NO_3)_2$ (in grams) must be dissolved in 750 g of distilled water to raise the boiling point by 1.2^oC?

12) The van't Hoff factor for a 2.0 M glucose solution is exactly 1, whereas that of a 2.0 M NaBr solution is slightly less than 2. Explain.

13) The van't Hoff factor for a 1.0 M $Ca(NO_3)_2$ solution is greater than that of a 2.5 M $Ca(NO_3)_2$ solution. Explain.

14) A 11.2 g sample of NaCl is added to 542 g of distilled water.
    a. What is the freezing point depression of the solution?
       K_f for water is 1.86 K·kg/mol.
    b. At what temperature will the solution freeze?
    c. The measured temperature at which the solution froze was slightly higher than the calculated temperature. Explain.

15) What mass of butanol, $CH_3CH_2CH_2CH_2OH$, must be added to 8746 mL of distilled water to depress the freezing point to -38.0^oC?

16) What mass of $Be(NO_3)_2$ must be added to 4.3 L of distilled water to depress the freezing point to -10.0^oC?

17) A 45.8 g sample of an unknown alcohol dissolved in 125 mL of distilled water. The freezing point of the solution was measured to be -21.3^oC.
    a. Find the molality of the solution.
    b. Find the number of moles of alcohol in the solution.
    c. Find the molar mass of the unknown alcohol.

18) What is the osmotic pressure that can be created if 25.0 g of NaCl dissolves in 2.00 L of water at 25^oC?

19) A 1.25 g sample of an unknown non-volatile, non acidic, organic compound was added to water to make a 1.2 L solution at 18^oC. This created an osmotic pressure of 0.00382 atm. Find the molar mass of the compound.

20) A 0.50 g sample of an unknown non-volatile, non acidic, organic compound was added to water to make a 748 mL solution at 22.0^oC. This created an osmotic pressure of 0.00947 atm. Find the molar mass of the compound.