Solutions Colligative Properties DCI

| Name _____ | Section _____ |
|---|---|

1. Define the term *colligative property* and list those physical properties of a solution that can be classified as colligative properties.

2. Illustrate and explain how the presence of a nonvolatile solute affects the vapor pressure of a liquid.

3a. How does the vapor pressure exerted by the solvent change as the concentration of solute increases?

b. Write Raoult's law and define each term.

c. Calculate the expected vapor pressure at 25 °C for a solution prepared by dissolving 97.4 g of common table sugar (sucrose, MM = 342 $\frac{g}{mol}$ ) in 453 mL of water.

**Ans: 23.5 mmHg**

d. A solution was prepared by adding 20.0 g of urea to 125 g of water at 25 °C, a temperature at which pure water has a vapor pressure of 23.76 mm of Hg. The observed vapor pressure of the solution was found to be 22.67 mm of Hg. Calculate the molecular weight of urea.

**Ans: 59 $\frac{g}{mol}$**

e. Show the derivation of a mathematical relationship for the vapor pressure lowering ($P^{\circ}_{solvent} - P_{solution}$) of a liquid following the addition of a nonvolatile solute.

4. Explain how the addition of a nonvolatile solute affects the freezing point and boiling point of water.

5a. Write the general mathematical relation which describes the dependence of the freezing point or boiling point on the molality of solution.

b. Calculate the freezing point and boiling point of a solution prepared by mixing 6.00 g of $C_6H_{12}O_6$ with 35.0 g of $H_2O$.

**Ans: $T_{fp}$ = –1.77 ˚C : $T_{bp}$ = 100.486 ˚C**

c. A solution containing a nonelectrolyte dissolved in water has a boiling point of 100.305 ˚C. Calculate the freezing point of the same solution.

**Ans: $T_{fp}$ = -1.11 ˚C**

d. What is the molecular mass of nicotine if 5.04 grams of this compound changes the freezing point of 90.0 g of water by 0.647 ˚C?

**Ans: 161 $\frac{\mathbf{g}}{\mathbf{mol}}$**

e. Calculate the freezing point and the boiling point of a saturated solution of $Li_2CO_3$. The solubility of lithium carbonate is 0.72 g per 100 g of water at 100 ˚C.

**Ans: $T_{fp}$ = –0.544 ˚C : $T_{bp}$ = 100.149 ˚C**

f. 2.57 g of an ionic compound with the formula KX are dissolved in 120 g of water. The freezing point of the solution was lowered by 1.37 ˚C. Determine the formula weight of X.

**Ans: 19 $\frac{\mathbf{g}}{\mathbf{mol}}$**

6a. Define the terms *semipermeable membrane, osmosis* and *osmotic pressure.*

b. Using a kinetic molecular model illustrate the movement of solvent molecules across a semipermeable membrane which separates pure water from a solution of sugar and water. Using this illustration explain what happens in reverse osmosis.

7. Give three examples of colloids.