

## CH1020 Worksheet

### Vapor Pressure Colligative Properties

1. Explain how each of the following affects the vapor pressure of a liquid:
  - a. surface area
  - b. temperature
  - c. intermolecular forces
  - d. volume of the liquid
  - e. pressure of the air above the liquid
2. Explain the following observations
  - a. water evaporates more quickly on a hot, dry day than on a hot humid day
  - b. it takes longer to boil eggs at high altitudes than at lower ones.
3. What is the effect of a nonvolatile solute on the vapor pressure of a liquid? Why is the vapor pressure of a solution different from the vapor pressure of the pure liquid solvent?
4. Explain why the lower vapor pressure for a solution containing a nonvolatile solute results in a higher boiling point and lower melting point compared to the pure solvent.
5. What are colligative properties?
6. Explain van't Hoff factor and its role in determining the colligative properties of solutions containing ionic solutes.
7. What is the molality of a solution prepared by dissolving 86.9 g of diethyl ether,  $C_4H_{10}O$ , in 425 g of benzene,  $C_6H_6$ ?
8. Calcium nitrite is used as a corrosion inhibitor in lubricants. What is the molality of a solution prepared by dissolving 18.5 g of calcium nitrite in 83.5 g of distilled water?
9. Isoamyl salicylate (molar mass = 208.25 g/mol) has a pleasant aroma and is used in perfumes and soaps. Which one of the following combinations gives a 0.75 *m* solution of isoamyl salicylate in ethyl alcohol ( $d = 0.7893$  g/mL)?
  - a. 117.2 g isoamyl salicylate in 950.0 mL of ethyl alcohol
  - b. 117.2 g isoamyl salicylate in 750.0 mL of ethyl alcohol
  - c. 117.2 g isoamyl salicylate in 750.0 mL of solution
  - d. 117.2 g isoamyl salicylate in 592.0 g of ethyl alcohol
10. You add 1.00 kg of ethylene glycol ( $C_2H_6O_2$ ) antifreeze to your car radiator, which contains 4450. g of water. What are the boiling and freezing points of the solution?

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11. Calculate the freezing point of a 1.7 *m* aqueous ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) solution.
12. An aqueous solution of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , boils at  $112^\circ\text{C}$ . What is the molality?
13. What is the freezing point of a solution that contains 15.0 g of ethylene glycol,  $\text{C}_2\text{H}_6\text{O}_2$ , in 250 g of water?
14. What mass of ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ), in grams, must be added to 1.00 kg of water to produce a solution that boils at  $105.0^\circ\text{C}$ ?
15. A 4.367 g sample of an unknown hydrocarbon is dissolved in 21.35 g benzene. The freezing point of solution is observed to be  $-0.51^\circ\text{C}$ . Calculate the molar mass of the unknown.
16. Calculate the molar mass of a compound (*assume Van't Hoff factor = 1*) if 4.00 g of the compound plus 50.0 g of water forms a solution which has a boiling point of  $100.41^\circ\text{C}$ .
17. Which aqueous solution will have the highest boiling point?  
a. 0.50 M  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$                       b. 0.50 M NaCl                      c. 0.50 M  $\text{MgCl}_2$
18. Calculate the freezing point and boiling point of each aqueous solution in water.  
a. 0.100 *m*  $\text{K}_2\text{S}$   
  
b. 21.5 g of  $\text{CuCl}_2$  in  $4.50 \times 10^2$  g water  
  
c. 5.5 %  $\text{NaNO}_3$  by mass (in water)
19. A 0.100 M ionic solution has an osmotic pressure of 8.3 atm at  $25^\circ\text{C}$ . Calculate the van't Hoff factor (*i*) for this solution.
20. A 1.2 *m* aqueous solution of an ionic compound with the formula  $\text{MX}_2$  has a boiling point of  $101.4^\circ\text{C}$ . What is the theoretical van't Hoff factor? What is the experimental van't Hoff factor.