

Lesson 19: Colligative Properties

text: 245, 251-262

what to know:

- colligative properties, what they are, how they relate to the concentration of solution, and their application to life around us, §6-6
- osmosis, dialysis and your kidneys, p-263

questions:

1. Which of the following statements are true?

- 1.0 M aqueous HCl would have a lower freezing point than a 1.0 M acetic acid solution because HCl is a strong acid and the concentration of dissolved particles is higher in the HCl.
- The vapor pressure of pure benzene at 26.1 °C is 100 mm Hg. The mole fraction of a nonvolatile solute dissolved in the benzene is 0.20.
 - The vapor pressure of the solution is 0.2 x 100 mm Hg.
 - The boiling point of the solution would be lower than the boiling point of pure benzene.
- In an ideal solution of two volatile components, the total vapor pressure at temperature T is equal to the sum of the vapor pressures of each of the pure substances at temperature T.
- The freezing point of 0.200 M NaCl would be lowered twice as much as that of 0.100 M NaCl when compared to the freezing point of pure water.
- If red blood cells are placed into a hypotonic solution, they will swell and burst.
- If one knew the g/L of a solution of an unknown substance and determined the molarity of the solution by measuring the osmotic pressure, the MW of the substance could be easily calculated.
- The following aqueous solutions are arranged according to decreasing freezing points:
0.35 M NaCl, 0.10 M Na₃PO₄, 0.20 M MgCl₂.
- Water is forced up to the top of tall trees by a process of reverse osmosis.
- Salt helps melt ice on sidewalks by supplying the energy required for the melting process.
- A 5.0 M aqueous solution of methyl alcohol will protect a radiator from freezing just as well as a 5.0 M solution of ethylene glycol (normal antifreeze).
- A red blood cell with dissolved particles of 0.25 M will shrink when placed into pure water.
- 0.25 M solutions of NaCl and KNO₃ in water will have the same osmotic pressure.

2. Draw a phase diagram for water labeling the axes and various areas on the graph. Also show what the graph would look like for a solution of sugar in water.

3. Which is not a colligative property? osmotic pressure, solubility, boiling point elevation

4. What is reverse osmosis and how does it work?

5. As compared to the vapor pressure of 0.10 M aqueous glucose (C₆H₁₂O₆), the vapor pressure of 0.10 M aqueous sucrose (C₁₂H₂₂O₁₁) will be (-almost twice as high, -the same, -1/2 as high).

6. Given an aqueous unknown liquid with a freezing point of -0.50 °C. The boiling point of the liquid under the same conditions will be (-higher than pure water, -lower than pure water, -the same as pure water, -either lower or higher than pure water depending on the atmospheric pressure).

7. The temperature of a 6 molal aqueous solution of sodium chloride in equilibrium with ice will be: (-Zero degrees Celsius, -lower than zero degrees C, -dependent on the atmospheric pressure).

8. Why are mole fraction and molality used instead of molarity when dealing with colligative properties?

9. Why does an ice-water bath get colder when salt is dissolved in the water?

10. How does salt keep a salt-cured ham from spoiling?