

CHM 111**Chapter 11 study guide / learning objectives**

Chapter 11 in the OpenStax text discusses solutions and solution properties. Be able to apply solution terms to common laboratory solutions. Describe what holds solutions together and why certain pairs of chemicals will mix well while other chemicals don't seem to mix at all. Convert between major units of solution concentration.

We will not discuss the section on colloids (section 11.5).

At the end of Chapter 11, you should be able to:*[Definitions / Terminology]*

- Define terms related to solutions: **solution, solute, solvent, saturation, supersaturation, miscible, soluble, molecular solution, electrolyte, nonelectrolyte, strong electrolyte, weak electrolyte**
- Define terms related to the solution process: **solvation**
- Define each of the concentration units: **molarity, molality, mole fraction**
- Define terms related to the colligative properties: **colligative property, osmosis, osmotic pressure, Raoult's Law**

[Solution calculations]

- Convert concentrations from one mass/mole-based concentration unit to another (molality, mole fraction)
- Convert mass/mole-based concentration units (molality, mole fraction) to molarity using the density.
- Convert molarity to mass/mole-based concentration units (molality, mole fraction) using the density.

[The solution process]

- Use the "like dissolves like" principle to determine if two compounds will, when mixed, form a solution. [Hint: You might have to draw a Lewis structure and determine whether the compound is polar, nonpolar, forms hydrogen bonds, etc.]
- Describe how factors *other than molecular structure* influence solubility (factors like temperature and pressure)

[Types of solutions]

- Give examples of possible solute and solvent combinations (solid/liquid, solid/solid, gas/gas, etc.)
- Explain what forces hold the solute and solvent together in a solution
- Describe the process of the solvation of an ion in aqueous solution.

[The colligative properties]

- List and describe the four colligative properties we discussed in class: vapor pressure lowering, boiling point elevation, freezing point depression, and osmotic pressure.
- Explain, using Raoult's Law, how vapor pressure of a solvent changes in the presence of a solute.
- Calculate the freezing point depression or boiling point elevation of a given solution. [Hint - you may have to convert from some other concentration unit to *molality* to do this] OR, calculate the concentration from a freezing point depression or boiling point elevation.
- Calculate freezing point depression and/or boiling point elevation of an *ionic* solution (assuming that *i* is equal to the number of ions produced in solution per formula unit of solute).
- Describe the process of osmosis.
- Use the freezing point depression or boiling point elevation to find the molar mass (molecular weight) of a substance.

[Skills to review]

- You should be proficient with these basic calculations (which were covered in your first semester of chemistry): metric unit conversions, calculation of formula weights for substances, density calculations, conversion from mass to moles or moles to mass using formula weights. These calculations are used routinely to solve problems from this chapter.

[Practice exercises from the OpenStax text]

- 1, 5, 9, 17, 31, 33, 35, 37, 39, 43, 45, 49, 53