Chapter 9

Goals:

- ✓ Know the definition of a solution, and be able to explain how a solute dissolves into a solvent.
- ✓ Know how temperature and pressure can affect solubility of a solute in a solvent.
- ✓ Be able to express solution concentration in M, % w/v and % v/v.
- ✓ Be able to use the dilution equation.
- ✓ Know the terms osmosis, osmotic pressure, hypotonic, hypertonic and isotonic.
- ✓ Be able to compare solutions in terms of osmolarity.

Solutions

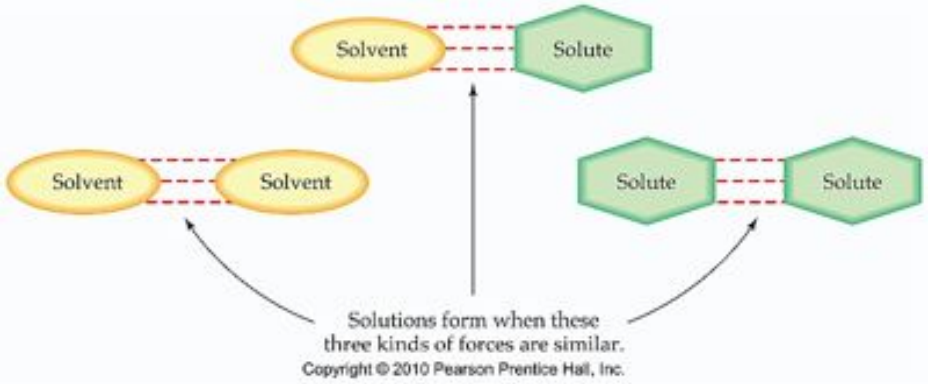
Solution: A homogeneous mixture of two or more substances.

Solute: The substance that is dissolved in a liquid.

Solvent: The liquid that is dissolving another substance(s.

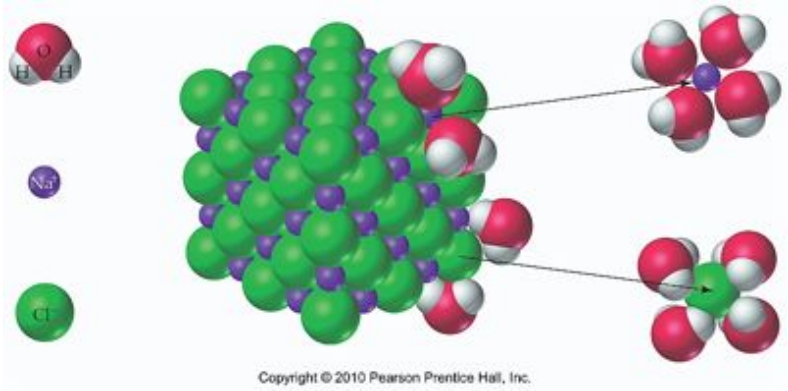
Aqueous solution: When water is the solvent. In Chem 30A we work with aqueous solutions.

Note that the extent to which a solute will dissolve in a solvent is dependent upon the attraction between solute and solvent particles. IFAs are important to determine solubility! In general, like dissolves like.



The Dissolving Process

- Ionic compounds tend to dissolve in water due to ion-dipole interactions. See the solubility chart from chapter 6 for exceptions.



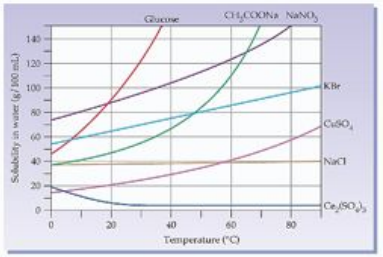
- Polar solutes tend to dissolve in polar solvents.

- Nonpolar solutes tend to dissolve in nonpolar solvents.

Solubility

Solubility refers to the amount of a solute that will dissolve in a given amount of solvent under certain conditions.

1. Temperature: usually as T increases, the solubility will also increase for a solid or liquid. The opposite is true for gases.



2. Pressure: as pressure increases, the solubility of gases increases. There is no affect on solubility of liquids and solids due to pressure.

Concentration

- Molarity: refers to the number of moles of solute per liter of solution.
- w/v %: refers to the number of grams of solute per 100 mL of solution.
- v/v %: refers to the number of milliliters of solute per 100 mL of solution.
- Dilutions: Solutions often come in a concentrated mixture that has to be diluted to the desired concentration. The following equation is used for dilutions: $C_1V_1 = C_2V_2$

Problem:

1. A reaction in Chem 30A calls for each pair of students to use 35.0 mL of a 1.2 M barium chloride solution. If there are 75 pairs of students, then how much barium chloride (in grams) is needed?

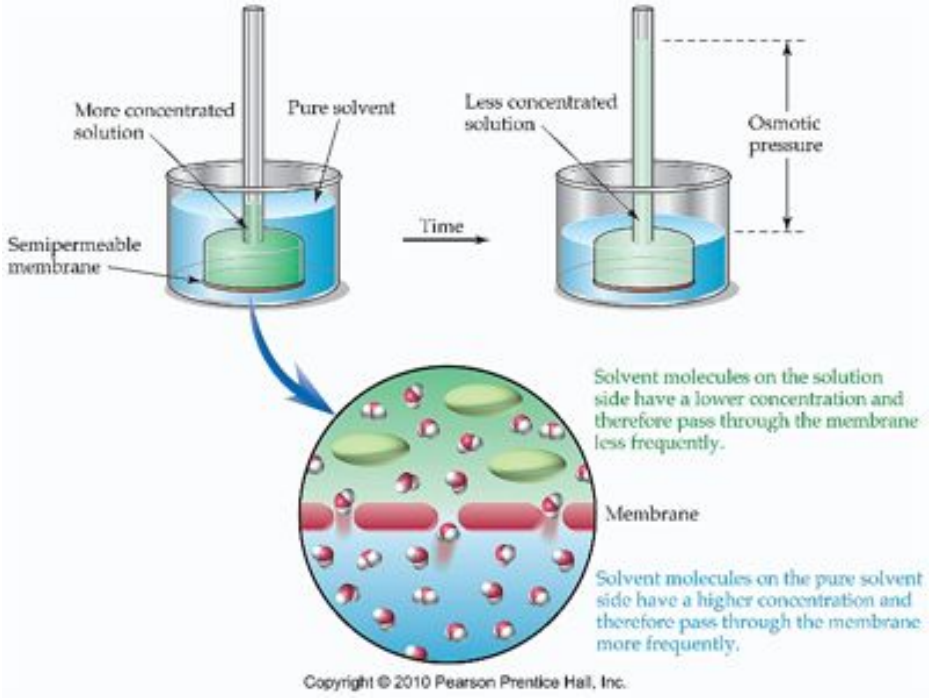
2. Assume Anna already has a solution that is 2.0 M barium chloride. How much of this stock solution would she need to use to prepare enough 1.2 M barium chloride for 75 pairs to use 35.0 mL each?

Osmosis and Osmotic Pressure

Osmosis: The passage of water through a semipermeable membrane from a solution of lower concentration to a solution of higher concentration.

Osmotic Pressure: The pressure required to halt the passage of solvent molecules across a semipermeable membrane.

Osmolarity (osmol): The sum of the molarities of all dissolved particles in a solution. The higher the osmolarity, the higher the osmotic pressure will be for that solution.



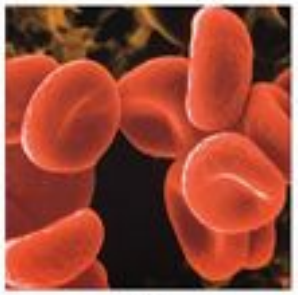
Osmosis in Living Systems

Isotonic: When two solutions have the same osmolarity and solvent does not exchange from one solution to the other via a semipermeable membrane.

Hypotonic: Having an osmolarity less than the surrounding blood plasma or cells

Hypertonic: Having an osmolarity greater than the surrounding blood plasma or cells.

(a)



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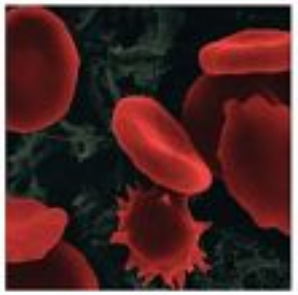

(c)

Problems From Chapters 9

1. An alcohol solution is 25% v/v. What does this mean quantitatively?

2. Express the concentration of an aqueous solution prepared by dissolving 23.4 g of sodium sulfate in 1.5 L of total solution in molarity and % w/v.

3. Which of the following will give rise to the highest osmotic pressure?
   1. 0.25 M KBr
   2. 0.20 M Na_2SO_4
   3. 3.0% w/v NaCl

4. Which of the following is capable of hydrogen bonding with water?
   1. Methane (CH_4)
   2. Ammonia
   3. Carbon tetrachloride