Solutions

I. Solution - a homogeneous mixture of two or more substances
- A. Homogeneous mixture - one in which the substances are uniformly intermingled
  1. Solvent - the substance which is in the greatest amount
     a. usually a liquid
  2. Solute - the substance dissolved in the solvent
- B. A solution is homogeneous if:
  1. the solute is evenly spread throughout the solvent (by stirring)
  2. the dissolved particles will not come out of solution regardless of time (without evaporation)
  3. the solution is clear or transparent (a beam of light passing through the solution cannot be seen)
  4. the solution cannot be filtered
  5. a solution must be in a single phase (solid, liquid or gas)
- C. Types of solutions
  1. Gaseous - gases mix together in various proportions uniformly
  2. Liquid - can have gases, liquids, or solids dissolve in them
     a. ***Miscible - when two liquids dissolve in each other completely***
        1. ***ex. Alcohol and water***
     b. ***Immiscible - when two liquids do not dissolve in each other***
        1. ***ex. Oil and water***
     c. ***Most liquid solutions are aqueous (aq) - dissolved in water***
        1. ***tinctures - solutions made with alcohol as the solvent***
  3. ***Solid - two solids mixed together form an alloy***
     1. ***ex. Copper and zinc make brass***

II. ***Heterogeneous Solutions***
- A. ***Colloids – 100mu – 1000mu size particles***
  1. ***Particles cannot pass through semipermeable membranes with small pores***
  2. ***Visible under the ultramicroscope***
  3. ***Show <u>Brownian Movement</u> – individual particles follow a random zigzag pattern***
     a. ***Caused by particles bumping into the colloidal particles causing them to change direction in a random fashion***
- B. ***Suspensions – 1000mu – 10,000mu size particles***
  1. ***Cloudy, opaque color***
  2. ***Particles settle on standing***
  3. ***Do not pass through ordinary filter paper***
  4. ***Visible with naked eye or microscope (no Brownian Movement)***

III. Electrolytes and Nonelectrolytes
- A. Electrolytes – substances which conduct electricity when dissolved in water (ionic substances, acids, bases)
  1. Dissociation – the separation of ions that occurs when an ionic compound dissolves
  2. Ionization – the separation of an acid into ions.
  3. Strong electrolytes – completely ionize or dissociate in water (conduct electricity well)
  4. Weak electrolytes – only partially ionize or dissociate in water (relatively insoluble)

B. Nonelectrolytes – substances that do not conduct electricity when dissolved in water (molecular substances)

IV. Concentrations of Solutions

A. Dilute solution - the amount of solute dissolved is small in relation to the amount of solvent
   1. depends on the properties of the solute

B. Concentrated solution - the amount of solute is large in relation to the amount of solvent
   1. depends on the properties of the solute

C. Saturated solution - a solution in which the solvent is holding all the solute it can under the conditions of the solution
   1. any further solute added will not dissolve (solution is in equilibrium)
   2. Solubility Tables (Table D) indicate the saturation points for various substances at various temperatures

D. Unsaturated solution - any solution which has less solute dissolved than it can possibly hold

E. Supersaturated solution - a solution in which more solute is dissolved than can be dissolved under normal conditions
   1. achieved by heating a solution and allowing to cool
   2. any point above the saturation line in the Table D solubility curves

F. Factors which affect the rate of solubility
   1. Size of the particles
   2. Nature of the particles (Like Dissolves Like)
      a. Polar substances dissolve polar substances
      b. Nonpolar dissolves nonpolar
   3. stirring (agitation) - movement of the molecules increases the rate of mixing
   4. amount of solute already dissolved
   5. temperature - increase in temperature increases solubility (solid & liquid solutions)

      a. increase in temperature decreases solubility (gases) - tend to remain in vapor

V. Solution Equilibrium – physical state in which the opposing processes of dissolution and crystallization of a solute occur at equal rates

VI. ***Heat of Solution – the net amount of heat energy absorbed or released when a specific amount of solute dissolves in a solvent***

A. ***IMF's breaking and forming***

VII. Calculating Concentrations of solute

A. Molarity -
   1. Number of moles of solute / 1 liter of solution
   2. Moles of Solute = molarity X volume in liters
   3. Grams of solute = # of moles X mass of one mole

B. ***Molality***
   1. ***Number of moles of solute / 1 Kg of solvent (usually 1L of water)***
   2. ***Colligative Properties***
      a. ***Boiling Point Elevation = 1 mole of particles per 1000g of water increases BP 0.52° C***
      b. ***Freezing Point Depression = 1 mole of particles per 1000g of water decreases FP***

1.86° C

c. ***Effect of electrolytes (ions which dissociate in solution)***

1. ***end up with 1 mole of each ion in solution***
2. ***double or triple the BP and FP depressions depending on the moles of ions.***