Compounds in Aqueous Solutions

When ionic compounds dissolve in water, it is called *dissociation* ***(already in your notes)***

The formulas look like this....

Are all ionic compounds soluble in water??

7 General solubility guidelines

1. All salts of Group IA, and ammonium are soluble.

2. All salts of nitrates, chlorates and acetates are soluble.

3. All salts of halides are soluble except those of silver(I), copper(I), lead(II), and mercury(I).

4. All salts of sulfate are soluble except for barium sulfate, lead(II) sulfate, and strontium sulfate.

5. All salts of carbonate, phosphate and sulfite are insoluble, except for those of group IA and ammonium.

6. All oxides and hydroxides are insoluble except for those of group IA, calcium, strontium and barium.

7. All salts of sulfides and insoluble except for those of Group IA and IIA elements and of ammonium.

Determining precipitates

When a double replacement occurs, determine if one of the products is insoluble.

-write a balanced equation for ammonium sulfide and cadmium nitrate and determine the phase for each product (both reactants are aq)

Net Ionic Equations

an equation in which only those compounds and ions that undergo a chemical change in a reaction in an aqueous solution

Start with the ionic version of the balanced equation...

$Cd^{2+}(aq) + 2NO_3^-(aq) + 2NH_4^+(aq) + S^{2-}(aq) \longrightarrow$

$CdS(s) + 2NO_3^-(aq) + 2NH_4^+(aq)$

Notice that some ions are the same on both sides of the equation. These ions did not undergo any chemical change, hence they are called *spectator ions.* To write the **net ionic equation**, simply remove the ones that are the same on both sides.

$Cd^{2+}(aq) + S^{2-}(aq) \longrightarrow CdS(s)$

Ionization

(already in your notes) is when a covalent molecule separates into ions in a solution

$HCl \xrightarrow{water} H^+(aq) + Cl^-(aq)$

Many molecular compounds have a H bonded by a polar covalent bond, when these H ionize they then react with the water to form the ***hydronium ion***

$H_2O(l) + HCl(g) \longrightarrow H_3O^+(aq) + Cl^-(aq)$

The formation of the hydronium ion releases energy which helps to break apart more the molecular solute

Strong Electrolytes

-any compound whose dilute aqueous solutions conduct electricity well; this is due to the presence of all or almost all of the dissolved compound in the form of ions.

examples: HCl, HBr, HI, several other acids, and all soluble ionic compounds

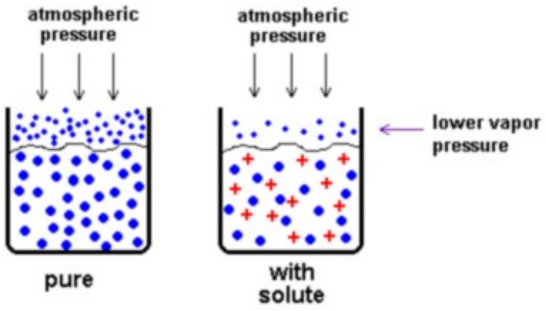
Weak Electrolytes

-any compound whose dilute aqueous solutions conduct electricity poorly; this is due to the presence of a small amount of the dissolved compound in the form of ions

$$HF(aq) + H_2O \rightleftharpoons H_3O^+(aq) + F^-(aq)$$

Colligative Properties of Solutions

-properties that depend on the concentration of solute particles but not on their identity



Freezing-Point Depression

molal freezing point constant for water is

K_f = -1.86 K/*m*

K_f is different for different solvents.

freezing point depression is how much the freezing point is lowered due to the concentration of particles of solute in a solvent -

$\Delta t_f = K_f m$

Boiling-Point Elevation

molal boiling point constant for water is

K_b = 0.51 K/*m*

K_b is different for different solvents.

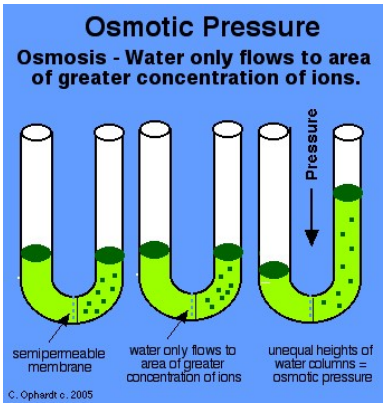
boiling point elevation is how much the boiling point is raised due to the concentration of particles of solute in a solvent -

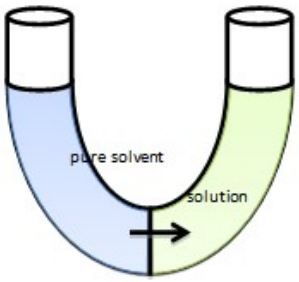
$\Delta t_b = K_b m$

Osmotic Pressure

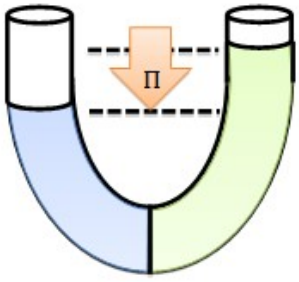
osmosis is the movement of solvent through a semipermeable membrane from the side of lower solute concentration tot he side of higher solute concentration

osmotic pressure is the external pressure that must be applied to stop osmosis

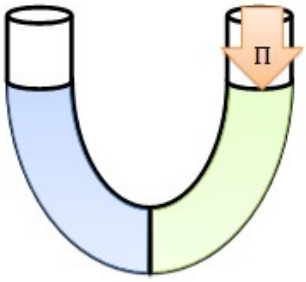




The arrow represents the net movement of solvent. The vertical bar represents a semipermeable membrane that allows the diffusion of solvent but not solute (solution = solute + solvent). Since substances tend to flow from higher to lower concentrations, there will be more solvent entering the solution side than leaving it.



As more solvent diffuses through the membrane over to the solution side, the volume of the solution increases while its concentration decreases. At equilibrium, the difference in height between the compartment holding pure solvent and the compartment with solution is the osmotic pressure, Π.



The osmotic, Π, is the applied pressure required to prevent the volume change.

Regulation of osmosis is vital to the life of a cell because cell membranes are semipermeable. Cells lose water and shrink when placed in a solution of higher concentration. They gain water and swell when placed in a solution of lower concentration. In vertebrates, cells are protected from swelling and shrinking by blood and lymph that surround the cells. Blood and lymph are equal in concentration to the concentration inside the cell.

Electrolytes and Colligative Properties

-when nonelectrolytes dissolve, they particles remain whole, so a 1 *m* solution of sucrose has 1 mol of particles in it. When electrolytes dissolve, the number of particles increases.

-NaCl disassociates into Na and Cl ions, hence 1 *m* NaCl becomes 2 mols of particles. 1 *m* $CaCl_2$ becomes 3 mols of particles.

Determine the freezing point depression of 62.5 g $Ba(NO_3)_2$ dissolved in 1.00 kg of water.
K_f H_2O = -1.86K

Hydrogen sulfide is bubbled through a solution of strontium hydroxide

A manganese (II) nitrate solution is mixed with a sodium hydroxide solution

Solutions of sodium carbonate and lead (II) nitrate are mixed

Aqueous solutions of sodium phosphate and barium chloride are mixed