**Solutions**

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A solution is a homogenous mixture of two or more substances. The substances may be in any state, solid, liquid or gas.

For liquid and gas or liquid and solid solutions, the gas or solid is the solute. For all other cases, the substance in smaller amount is the solute.

Gas + Gas – Air

Gas + Liquid – Carbonated Drinks

Liquid + Liquid – Ethanol + Water (miscible)

Solid + Liquid – NaCl + Water Keep stirring and solid dissolves. At saturation point, for a certain temperature, solid stops dissolving. If temperature is increased, more solid can dissolve.

Solid + Solid – Gold + Silver Alloy

## Equilibrium Vapor Pressure

The pressure created by the vapor phase of a substance on its liquid phased, when the rates of evaporation and condensation have reached an equilibrium.

## Boiling Point

The point at which the vapor pressure of a liquid is equal to the pressure in the environment around the liquid.

Colligative Properties of Dilute Solutions

Colligative properties of solutions are properties that depend upon the concentration of solute molecules or ions, but not upon the identity of the solute. Used to find unknown mass of a solute.

* Lowering Vapor Pressure: Vapor pressure of a solvent decreases when a non-volatile solute is dissolved in it (related to Rault’s Law)
* Elevating Boiling Point: Boiling point of a solvent increases when a non-volatile solute is dissolved in it.

## Raoult’s Law of Ideal Solution

States that the vapor pressure of a solution is dependent on the mole fraction of a solute added to solution.

Colligative property.

Vapor Pressure of Solution = Mole Fraction of Solvent X Vapor Pressure of Pure Solvent

## Osmosis

A process by which molecules of a solvent tend to pass through a semi-permeable membrane from a less concentrated solution into a more concentrated one.

Osmotic Pressure

Pressure that, when applied to the solution, just stops osmosis.

Colligative property.

### Reverse Osmosis

A hydrostatic pressure greater than the osmotic pressure is applied in order to force a solvent to pass through a porous membrane in the direction opposite to that for natural osmosis.

## Henry's Law

The amount of dissolved gas in a liquid is proportional to its partial pressure above the liquid at constant temperature.

Sg = kPg (Solubility of Gas = Henry’s Constant X Partial Pressure)

## Effect of Pressure and Temperature on Solubility of Gasses

Pressure increases, solubility increases (Henry’s Law)

Temperature increases, solubility decreases

## Effect of Temperature on Solubility of Solids

Temperature increases, solubility increases

## Critical Solution Temperature

Temperature above or below which two immiscible liquids become miscible for all proportions. For some liquids this occurs above a certain temperature (upper CST) and for some it occurs below a certain temperature (lower CST).

## Solvolysis

Solvolysis is a type nucleophilic substitution in which the nucleophile (electron rich substance) is the solvent.

## Ideal Solution

A solution that complies perfectly with Roult’s Law. Its properties can thus be predicted.

## Units of Concentration:

Molarity – moles of solute per liter solution

Molality – moles of solute per kg solvent

Normality – grams of solute per liter solution

Formality – molecular weight of solute in grams per liter solution

Percentage – solvent/solution X 100%

Molarity, Normality and Formality affected by temperature.

Moles = weight/molecular weight

## Clausius-Clapeyron Equation

For any liquid,

where is the vapor pressure at some temperature , is the gas constant and is the enthalpy of vaporization.

For two temperatures, the two equations formed can be combined to give

This is known as the Clausius-Clapeyron Equation.