Chapter 6 Solutions and Colloids

Types of Solutions

Gas mixtures are always solutions.

Solid solutions must be formed by solidification from the liquid state.

Give examples and characteristics of each of the common solution types:

Solute		Solvent
Gas solid or liquid	in	Liquid
Gas	in	Gas
Solid	in	Solid

Characteristics of solutions

Uniform particle distribution.

No separation on standing.

Not separable by filtration.

Can be of different compositions.

Liquid solutions generally transparent.

Can be separated by physical means.

Solubility

The solubility is the maximum amount of a particular solute that can dissolve in a given amount of solvent at a specified temperature.

At the maximum of solubility, the solution is said to be saturated.
A solution beyond the maximum of solubility is supersaturated.
If solubility is very low, the solute is considered to be insoluble.

Substances that are polar or ionic are likely to be dissolved by solvents that are polar.

The solubility of liquids and solids usually increases with increasing temperature.

The solubility of a gas in a liquid or solid is likely to decrease with increasing temperature.

The solubility of a gas in a liquid or solid increases with increasing pressure.

Concentration Units

The concentration of a solution is the amount of solute in a given amount of solvent.

Percent concentration:

weight/volume
volume/volume
weight/weight

Molarity is the number of moles of solute dissolved in a liter of solution.

Obtaining a particular solution concentration by dilution depends upon the fact that dilution doesn't change the number of moles of solute.

molarity x volume = moles, and

moles of solute before dilution = moles of solute after dilution

or $M_1V_1 = M_2V_2$ and

volume of solvent added = $V_2 - V_1$

Parts per million and parts per trillion used to refer to very small amounts of solute.

Water as a Solvent

Know some of the unusual properties of water and what makes it a good solvent.

In the process of dissolving ions, water molecules surround the ions and the dipole–ion attractions in solution overcome the ion-ion attractions in the crystal. The process is called solvation generally and in water is hydration.

When crystals of some substances are formed in water some water may stay with the ions in the solid. The water in the crystal is called water of hydration and the crystal is called a hydrate.

Substances that take water from the air to become hydrates are said to be hygroscopic.

The mobility of ions in water is the basis for electrical conductivity of ionic solutions.

> Positive ions move toward the negative electrode or cathode and so are called cations.
> Negative ions move toward the positive electrode or anode and so are called anions.

Substances that conduct electricity when dissolved in water are called electrolytes. Those that do not are nonelectrolytes.

> Strong electrolytes are completely dissociated into ions in water.
> Weak electrolytes are only slightly dissociated into ions in water.

Dissolution of molecular or covalent compounds in water occurs sometimes because the molecule reacts with water but most often because dipole-dipole interactions with the water solvating the molecules (usually through hydrogen bonds) overcome the dipole-dipole interactions between the solute molecules.

Know examples of the importance of water to your body as well as some other biological functions.

Colloids

Colloids most often look like solutions but the dispersed particles are 10 to 1000 times larger than solute particles in solutions which have diameters of about 1 nm. Colloids represent the transition region between solutions and heterogeneous mixtures.

Colloids, unlike solutions, appear turbid, cloudy, or milky because they scatter light. The scattering is called the Tyndall effect.
Colloidal particles do not separate but, unlike solutions, colloidal suspensions of larger particles will separate out of suspension given enough time.

Colligative Properties, Freezing-Point Depression

Properties of a solution that depend only upon the number of solute particles and not on their character are called colligative properties.

Freezing point depression
Boiling point elevation
Vapor pressure lowering
Osmotic pressure

When an ionic substance dissociates in solution each of the ions counts as a particle; so $Ca(NO_3)_2$ contributes 3 particles per formula unit or 3 moles of particles per each mole of calcium nitrate.

Osmotic Pressure

Osmosis refers to the passage of solvent molecules from the more dilute to the more concentrated side of a semipermeable membrane. The external pressure required to equalize the liquid levels on the two sides of the membrane is the osmotic pressure.

Osmolarity is the molarity of a solution multiplied by the number of ions into which each formula unit dissociates.

Solutions with the same osmolarity are called isotonic.

Dialysis

If the pores in a semipermeable membrane are large enough to let small solute molecules and ions through along with solvent but too small to pass large molecules, the osmotic process is called dialysis.

Dialysis is the process by which our kidneys remove toxins from blood.