

Unit 9 Water and Solutions

Water is a polar molecule that forms hydrogen bonds.

Hydrogen bonds- weak bond between H and an electronegative atom; important in water, DNA, and proteins.

Polar molecule- bonding results in opposite charges on the ends of the molecule. Due to these properties, water is:

Cohesive (attraction by same molecules)- strong surface tension

Adhesive (attracts other molecules)- forms a meniscus

Desiccant- substance that absorbs water.

Hydrate- a compound whose structure holds water. A crystal of water is referred to as the **water of hydration**, e.g. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ has 5 water molecules in its molecular structure.

Electrolyte- solution forms ions and conducts electricity.

Surfactant- wetting agent that lowers the surface tension of water.

Cation- atom or group of atoms with a positive charge

Anion- atom or group of atoms with a negative charge

Heterogeneous mixture- a heterogeneous mixture is not the same from place to place. One material is suspended, not dissolved within another.

Homogeneous mixture- a homogeneous mixture has the same composition throughout because particles of one substance are dissolved in another

Solution- a mixture of two substances that is uniform throughout.

Solute- the substance dissolved in a solution.

Solvent- the substance in which the solute dissolved in a solution.

Aqueous solution (aq) - solution in which water is the solvent.

Concentration- a measure of the amount of solute dissolved in a specified volume of solution.

Molarity- the concentration of a solution expressed in moles of solute per liter of solution.

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liter of solution}}$$

Molarity conversions

$$V_1M_1 = V_2M_2$$

$$\frac{\text{Volume of}}{\text{solution 1}} \times \frac{\text{Molarity of}}{\text{solution 1}} = \frac{\text{Volume of}}{\text{solution 2}} \times \frac{\text{Molarity of}}{\text{solution 2}}$$

Unsaturated- a solution that will dissolve more solute (make into solution).

Saturated- a solution that contains the maximum amount of solute for a given amount of solvent.

Supersaturated- a solution that contains more solute than it theoretically should contain at that temperature.

Strong electrolyte dissociates completely and is a good electrical conductor.

Weak electrolyte partially dissociates and is a fair conductor.

Acids, bases and soluble ionic solutions are electrolytes.

Non-electrolyte does not dissociate and is a poor conductor of electricity.

Molecular compounds and insoluble ionic compounds are non-electrolytes.

Reaction	Description and Example
Acid-base	<p>Double replacement reaction; most reactions are:</p> $\text{acid} + \text{base} \rightarrow \text{salt} + \text{water}$ $\text{HCl} + \text{LiOH} \rightarrow \text{LiCl} + \text{H}_2\text{O}$
Precipitation	<p>Occurs when two aqueous solutions react and produce a solid precipitate; (s) indicates solid but if precipitate is not identified with a (s) then you can use solubility rules to predict the precipitate formed.</p> $\text{NaCl(aq)} + \text{AgNO}_3\text{(aq)} \rightarrow \text{NaNO}_3\text{(aq)} + \text{AgCl(s)}$
Oxidation-reduction (redox)	<p>An electron(s) from one reactant (reducing agent) is given to the other reactant (oxidizing agent); changes some oxidation numbers in the reactants.</p> $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$ <p>Oxidation number of Fe changes from 0 in reactant (elemental) to +2 in ionic compound FeCl_2. H changes from +1 in reactant (HCl) to 0 in H_2. Fe is oxidized by H^+, and H^+ is reduced by Fe. Half reactions:</p> $\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}^- \quad \text{and} \quad 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$