Analytical Chemistry

1st Class

Fifth Lecture. Analytical Chemistry.

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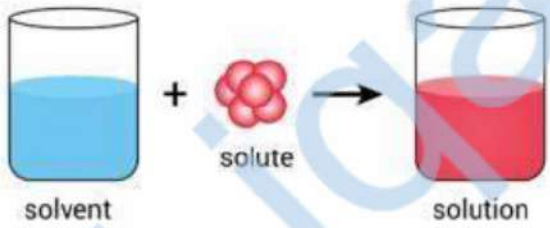
Solution: Properties of Solution



A solution is a homogeneous mixture of two or more substances. A solution is formed of two components: the solute and the solvent. The substance dissolved in the solution is called the **solute**, whereas the component in which the solute is dissolved is known as a **solvent**.

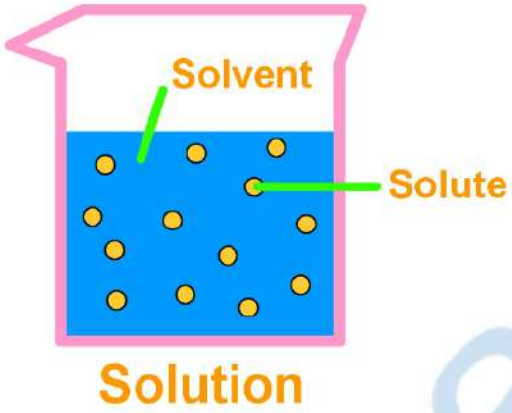
What is a Solution?

A homogeneous mixture of two or more substances where the size of the particle is smaller than 1 nm is called the solution. Some common examples of solutions are sugar in water or salt in water solutions, etc. Unlike a mixture, the particle of solute in a mixture is evenly distributed. The solutions containing water as the solvent are called aqueous solutions. Solutions may contain solids, liquids or gases dissolved as solutes. The particles of a solution are not visible to the naked eye.

Components of Solution

Any solution has two basic components

- **Solute**
- **Solvent**



What is a Solute?

The component of the solution that is dissolved in the other component is called the solute. Generally, **the concentration of solute is low compared to the concentration of solvent.**

What is a Solvent?

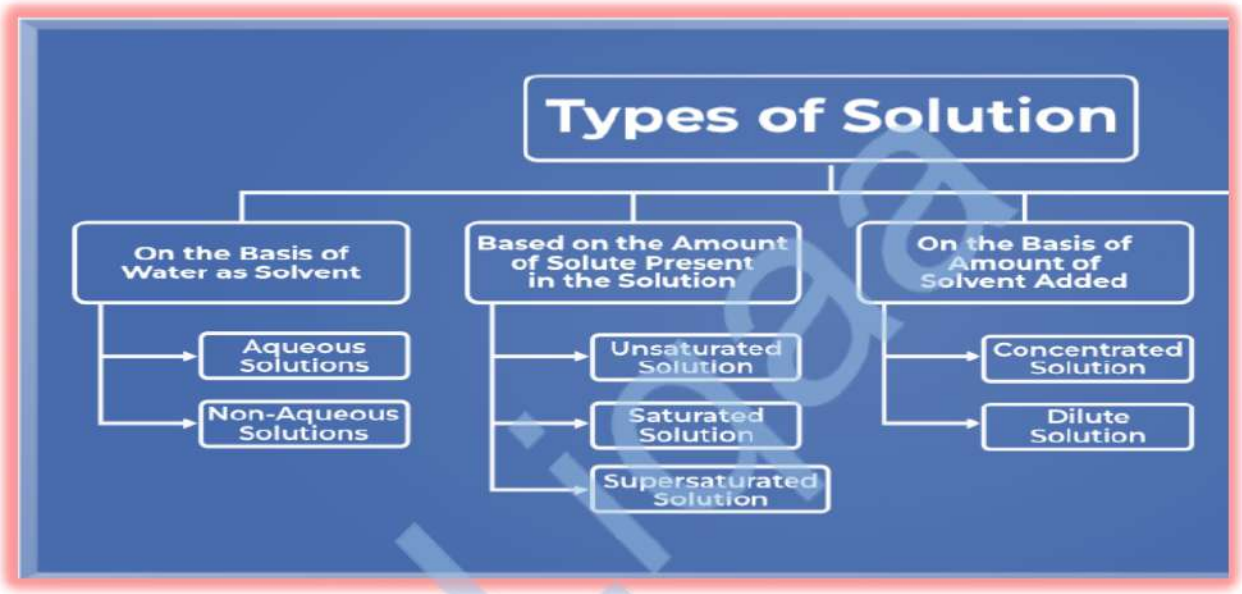
The component of the solution that dissolves a solute is the solvent. Solvents are generally in liquid or gaseous form. **The concentration of solvent is high as compared to the concentration of solute.**

Example in a solution such as lemonade sugar and lemon juice is considered solute, whereas water is considered a solvent. Water is considered the universal solvent.

Types of Solution

Solutions are divided into various classes based on the basis of various factors, like:

1. **water as a solvent.**
2. **amount of solute present.**
3. **amount of solvent.**



1. On Basis of Water as Solvent

The solutions can be divided into two classes depending on whether they contain water as the solvent or not which are,

- Aqueous Solutions
- Non-Aqueous Solutions

Aqueous Solutions

Aqueous Solutions **contain water as the solvent**. Different solutes can be dissolved in water to form such solutions, such as salt water, sugar water or carbon dioxide in water.

Non-Aqueous Solutions

Non-Aqueous Solutions do not contain water as the solvent. The solvent could be other liquids such as ether, petrol, carbon tetrachloride, etc. Some examples of non-aqueous solutions are sulphur in carbon disulphide, naphthalene in benzene, etc.

2. On Basis of Amount of Solute

The solutions can be divided into **three classes depending on the amount of solute** present in the solution which are:

- **Unsaturated Solutions**
- **Saturated Solutions**
- **Supersaturated solutions**

Unsaturated Solutions

The amount of solute that is contained in lesser amounts than the maximum value, that is before the solution reaches the saturation level is called an unsaturated solution. No remaining substances leave at the bottom, that is, all the solute is dissolved in the solvent. An unsaturated solution is basically a chemical solution which has a **solute concentration lesser** than its corresponding **equilibrium solubility.**

Saturated Solutions

A solvent can dissolve some particular types of solutes in it. **The maximum amount of solute that can be dissolved in a solvent at a specified temperature can be termed a saturated solution. A solution cannot dissolve any more solute further upon reaching saturation**. The undissolved substances remain at the bottom. The point at which the solute stops dissolving in the solvent is termed **the saturation point.**

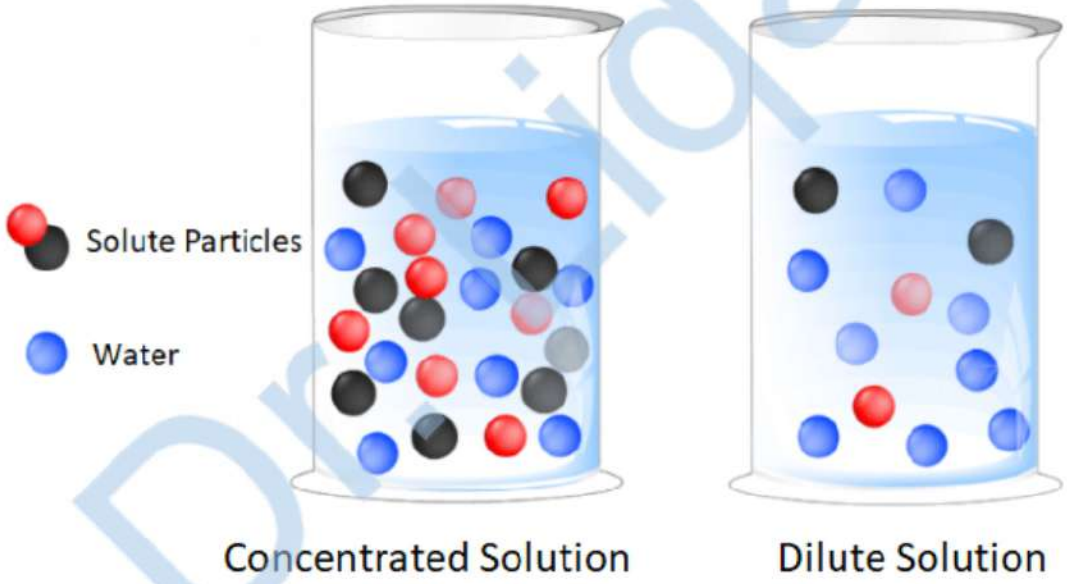
Supersaturated Solutions

The amount of solute contained in the solution exceeds the maximum amount of solute. The solution has already reached and crossed the saturation point. The solute is dissolved into the solution forcefully by raising the temperature or pressure of the solution. The solute particles on further dissolve, **crystal out in the bottom of the container by the method called crystallization.**

3. On Basis of Amount of Solvent

The solutions can be divided into two classes depending on the amount of solvent in the solution which are,

- **Concentrated Solutions**
- **Dilute Solutions**



Concentrated Solutions

A concentrated solution contains large quantities of solute in the given solvent to form a solution. Some examples of concentrated solutions are mango juice, brine solution or dark color tea.

Dilute Solutions

A dilute solution contains small quantities of solute in the given large quantity of solvent to form a solution. Some examples of dilute solutions are salt solutions or light color tea.

Depending upon the physical states of solute and solvent, we can classify solutions into nine different types. The table given below tells us about **all nine types of solutions:**

Types of Solution	Solute	Solvent	Examples
Solid-Solid	Solid	Solid	Alloys like brass, bronze etc.
Solid-liquid	Solid	Liquid	The solution of sugar, salt etc in water.
Solid-Gas	Solid	Gas	Sublimation of substances like iodine, camphor etc into the air.
Liquid-Solid	Liquid	Solid	Hydrated salts, mercury in amalgamated zinc, etc.
Liquid-Liquid	Liquid	Liquid	Alcohol in water, benzene in toluene
Liquid-Gas	Liquid	Gas	Aerosol, water vapour in the air.
Gas-Solid	Gas	Solid	Hydrogen absorbed in palladium
Gas-Liquid	Gas	Liquid	Aerated drinks
Gas-Gas	Gas	Gas	A mixture of gases, etc

Properties of Solution

Various properties of the solution are,

1. Solution is a homogeneous mixture.
2. Solutions are generally very stable, which implies that the solute particles do not separate out on keeping.
3. The particles dissolved are extremely small in size, generally less than 1 nm in diameter.
4. Since the size of solute particles in the solutions is extremely small, they can easily pass through the filter paper. Therefore, components of a solution cannot be separated by filtration.
5. The particles of a solution are negligibly small and cannot be seen even with a microscope.
6. Since the size of solute particles in the solutions is extremely small, a true solution does not scatter light.

What is a Mixture?

When two or more substances are mixed together they form mixtures. In a mixture, the composition of the matter mixed is not always consistent. Some examples of the mixture include air, soil, sand, blood, etc. are different examples of mixtures. Mixtures are classified into two basic classes:

- **Homogeneous Mixture:** If the component of a mixture is distributed uniformly is it known as a homogeneous mixture.
- **Heterogeneous Mixture:** If the component of a mixture is distributed non-uniformly is it known as a heterogeneous mixture.