

Solutions, Types, Properties and Examples, UPSC Notes

July 10, 2026 • vajiramandravi.com



A solution is a **homogeneous mixture** of two or more components. A homogeneous mixture has the same composition throughout. A solution consists of a solvent and a solute. Solutions are a part of our everyday lives as they can be found in almost everything that we use, such as soda, deodorant, sugar, salt, and so on. It encompasses a diverse array of mixtures, each distinguished by unique characteristics and properties.

Solutions

Solutions are homogeneous mixtures of two or more constituents with uniform composition and properties throughout.

- For example, sugar in water or salt in water solutions. These solutions are called homogenous solutions or true solutions.

Components of Solution

A solution comprises a solvent (major component) and a solute (minor component).

- **Solute:** The solute is the component of the solution that **dissolves in the other component (solvent)**. In general, the solute concentration is low in comparison to the solvent concentration.
- **Solvent:** The solvent is the component of a solution that **dissolves a solute**. Solvents are typically liquids or gases. In comparison to the concentration of solute, the concentration of solvent is high.
- **Example:** Sugar syrup is a solution made by dissolving sugar in water with heat. Water serves as the solvent, and sugar serves as the solute.

Properties of Solution

The properties of solutions are fundamental characteristics that distinguish them from other types of mixtures.

- **Homogeneity:** Solutions are uniform throughout, with consistent composition and properties. At a molecular level, the solute particles are evenly distributed within the solvent.
- **Stability:** Solutions maintain their properties over time, remaining in a well-mixed state without separating the components. They don't settle in or undergo noticeable changes easily.
- **Composition consistency:** The composition of a solution remains constant throughout the mixture. This means that the solute-to-solvent ratio remains constant regardless of the amount of solution present.
- **Particle size:** The dissolved particles are extremely small, typically less than 1 nm in diameter. The particles cannot be seen with the naked eye.
- **Filtration:** Because the solute particles in the solutions are so small, they easily pass through the filter paper. As a result, filtration cannot separate solution components.
- **Scattering:** Solutions don't scatter light beams that pass through them. Therefore, in solutions, the light beam's path is invisible.

Types of Solution

Solutions are classified according to various factors, such as the presence of water as a solvent, the amount of solute present, the amount of solvent, and the concentration of solute in two solutions.

Based on Water as the Solvent

- **Aqueous solutions:** These solutions have **water as the solvent**. They are the most common type of solution and are found in many everyday substances.
 - **Examples** of aqueous solutions include saltwater, coffee, vinegar, sugar water, etc.
- **Non-aqueous solutions:** These solutions have a **solvent other than water**. They are less common than aqueous solutions and are typically found in specialized applications.
 - **Examples** of non-aqueous solutions include alcohol solutions, naphthalene in benzene, sulphur in carbon disulphide etc.

Based on Amount of Solvent

- **Dilute solution:** A dilute solution contains small amounts of solute in a large amount of solvent to form a solution.
 - **Examples:** Salt solution, Vinegar, light-coloured tea, pure lemon juice in water, etc.

- **Concentrated solutions:** These solutions have a high concentration of solute. They are considered to be strong and have a relatively large effect on the properties of the solvent.
 - **Examples:** Brine solution, orange juice, dark-coloured tea

Based on Amount of Solute

- **Unsaturated solutions:** These solutions contain less solute than the solvent can dissolve at a given temperature. They are considered to be stable and will not precipitate out of the solution.
 - **Example:** One spoon of sugar in one glass of water.
- **Saturated solutions:** These solutions hold the most solute possible at a given temperature, called saturation. At saturation, solute dissolving equals solute precipitating, reaching equilibrium. No more solute can dissolve beyond this point.
 - **Example:** Air saturated with water vapour.
- **Supersaturated solutions:** These solutions contain more solute than the solvent can dissolve at a given temperature. They are considered to be unstable and will eventually precipitate out of the solution.
 - **Example:** Carbonated water

Based on Concentration of Solute in Two Solutions

- **Isotonic solutions:** These solutions have the same osmotic pressure as the surrounding environment. These solutions have a higher concentration of solute in it.
 - **Examples:** Isotonic energy drinks, normal saline (0.9% NaCl solution) etc.
- **Hypotonic solutions:** These solutions have a lower osmotic pressure than the surrounding environment. The solution contains a lower concentration of solute.
 - **Examples:** Pure water, distilled water etc.
- **Hypertonic solutions:** These solutions have a higher osmotic pressure than the surrounding environment. These solutions have the same solute concentration.
 - **Examples:** Saltwater, corn syrup etc.

Based on the Physical State of the Solute and Solvent

During the formation of a solution, any state of matter (solid, liquid, or gas) can act as both a solute and a solvent. As a result, these solutions can be categorised into nine different types based on the physical states of the solute and solvent.

Types of Solution (Solute-Solvent)	Examples
Solid-solid	Alloys like brass, bronze, etc.
Solid-gas	Sublimation of substances like iodine, camphor, etc into the air.
Solid-liquid	The solution of sugar, salt, etc in water.
Liquid-solid	Hydrated salts, mercury in amalgamated zinc, etc.
Liquid-gas	Aerosol, water vapour in the air.

Liquid-liquid	Alcohol in water, benzene in toluene
Gas-solid	Hydrogen absorbed in palladium
Gas-gas	A mixture of gases, etc
Gas-liquid	Aerated drinks

Heterogenous Solutions

While the above solutions are a homogenous mixture in nature, there are some heterogenous solutions. They typically have larger sizes than the true solutions.

Colloidal Solutions

Colloidal solutions are also heterogeneous mixtures **but appear to be homogenous** as the particles of the solute are larger than those in true solutions.

- **Properties of colloidal solutions:**

- **Particle size:** Colloidal particles are small (between 1 nm to 1000 nm), too tiny to be seen individually with the naked eye but large enough to scatter light (exhibiting the Tyndall effect).
- **Homogeneity and Heterogeneity:** While a colloidal solution appears homogeneous due to the small size of particles, it is heterogeneous.
- **Stability:** Colloids remain stable over time, do not settle down when left undisturbed, and resist gravitational forces.
- **Filtration:** Colloidal particles cannot be easily filtered out but can be separated using specialised techniques like centrifugation.

- **Examples of colloidal solutions:**

- **Milk:** Fat particles (solute) dispersed in water (solvent)
- **Fog:** Water droplets (solute) dispersed in the air (solvent)
- **Paint:** Pigment particles (solute) dispersed in a liquid medium (solvent)

- **Classification of colloidal solutions:**

- **The dispersed phase** (solute-like particles) and the **dispersion medium** (where the dispersed phase is suspended).
- Colloids are categorized by the state of the dispersion medium and the dispersed phase.

Suspensions

A suspension is a heterogeneous mixture where solute particles do not dissolve but remain suspended.

- **Properties of suspensions:**

- **Heterogeneous mixture:** The composition in a suspension is not uniform. The solid particles are suspended throughout the liquid, but they are not dissolved in it.
- **Large particles:** The particles of a suspension are large (greater than 1000 nm) enough as compared to true and colloidal solutions that they can be seen with the naked eye.

- **Scattering of light:** The suspended particles are large enough to be seen individually and can scatter a beam of light, making its path visible (demonstrating the Tyndall effect).
 - **Settling:** When left undisturbed, the solute particles settle at the bottom of the container due to gravity, making suspensions unstable.
 - **Filtration:** Suspended particles can be separated from the mixture by filtration. Once settled, the suspension loses its scattering ability and becomes clearer.
 - **Examples of suspensions:**
 - **Muddy Water:** Dirt or soil particles suspended in water.
 - **Chalk in Water:** Suspended chalk particles in water.
 - **Paints:** Paints consist of pigments suspended in a liquid medium.
 - **Blood:** Red and white blood cells, and lymphocytes suspended in plasma
-

Source: <https://vajiramandravi.com/upsc-exam/solutions/>

© Vajiram & Ravi. For personal use only.