

FlexiPrep

Solute, Characteristics, Types of Solute, Definition, Example, Questions (For CBSE, ICSE, IAS, NET, NRA 2022)

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What is Solute?

- A substance that is dissolved in a solution is called a solute.
- In fluid solutions, the amount of solvent present is greater than the amount of solute. One best example of solute in our day-to-day activity is salt and water. Salt dissolves in water and therefore, salt is the solute.
- A homogeneous mixture composed of two or more substances, in which a mixture, a solute is a substance dissolved in another substance known as a solvent. The concentration of a solute in a solution is a measure of how much of that solute is dissolved in the solvent, with regard to how much solvent is present like salt.

Characteristics of Solute

- A solution is a homogeneous mixture of two or more substances.
- The particles of solute in a solution cannot be seen by the naked eye.
- A solution does not allow beams of light to scatter.
- A solution is stable.
- The solute from a solution cannot be separated by filtration (or mechanically) .
- It is composed of only one phase.

Types of Solute

- Homogeneous means that the components of the mixture form a single phase. Heterogeneous means that the components of the mixture are of different phase.
- The properties of the mixture including concentration, temperature, and density can be uniformly distributed through the volume but only in the absence of diffusion phenomena or after their completion. The major types of solute are:
 - Gaseous
 - Liquid
 - Solid

Gaseous

If a solvent is a gas, then only gases are dissolved under a given set of conditions. An example of a gaseous solution is air such as oxygen and other gases dissolved in nitrogen.

Liquid

If the solvent is a liquid, then almost, liquids, and solids can be dissolved. Here are some examples:

- Gas in liquid
 - Oxygen in water
 - Carbon dioxide in water
- Liquid in liquid
 - The mixing of two or more substances of the same chemistry but different concentrations to form a constant.
 - Alcoholic beverages are basically solutions of ethanol in water.
- Solid in liquid:
 - Sucrose (sugar) in water
 - Sodium chloride (NaCl) (salt) in water.

Solid

If the solvent is solid, then gases, liquids and solids can be dissolved.

- Gas in solids
 - Hydrogen dissolves rather well in metals, especially in palladium;
- Liquid in solid
 - Mercury in gold, forming an amalgam
 - Water in solid salt or sugar, forming moist solids
 - Hexane in paraffin wax
- Solid in solid
 - Steel, basically a solution of carbon atoms in a crystalline matrix of iron atoms.
 - Alloys like bronze and many others.
 - Polymers containing plasticizers.

Solute Definition

- A solute is a substance that can be dissolved by a solvent to create a solution. A solute can come in many forms. It can be gas, liquid, or solid. The solvent, or substance that

dissolves the solute, breaks the solute apart and distributes the solute molecules equally. This creates a homogenous mixture, or solution that is equal throughout.

- Solutes in solution are measured by their concentration. The concentration of a solute is the amount of solute divided by the total volume of solution. A solvent can dilute various amounts of solute, depending on how strong of a solvent is used and how easily the solute molecules come apart. This property of solutes to dissolve in a solvent is known as solubility.

Example of Solute

Salt in Water

- When you dump a spoon full of salt into a glass of water, you are creating a solution. The solute is the salt, or NaCl . The solvent is water, or H_2O . The water molecules are negatively charged on the oxygen atoms and positively charged on the hydrogen atoms. Salt is an ionic compound, which consists of two ions: Na^+ and Cl^- . The negative oxygen atoms attract the positive sodium (Na^+), and the positive hydrogen atoms attract the negative chlorine atoms (Cl^-). The attraction between the different molecules pulls the solute apart at a molecular level, and suspends it evenly throughout the water.
- An important factor in how fast the solute will dissolve is the surface area of solute exposed. If coarse salt is used, less surface area is exposed and it will take longer for the same amount of salt to dissolve. A finer salt allows many more ions to be exposed to water, and the solute gets diffused through the water faster. Eventually the salt can no longer be seen on the bottom of the glass because it is evenly distributed throughout the glass.
- A similar process happens with sugar, but the sugar molecules are not the same as salt molecules. Instead of being an ionic compound, the sugar molecules are slightly polar. The molecule of sugar has many OH groups, which create natural dipoles. These positive and negative areas interact with the positive and negative areas of the water molecules, and the solute molecule are torn apart. Just as salt is diffused across a solution, sugar can also be evenly distributed in a cell. This is important for many cellular functions, such as producing energy and larger molecules. Other times, cells must actively transport certain molecules out of the cytosol, to avoid upsetting the pH balance.

Oxygen in Seawater

- An example of a gaseous solute is oxygen. Every fish in the ocean, from the strange creatures in the deepest parts of the ocean to the common coral-dwelling fish that scuba divers love, rely on oxygen dissolved in the water to live.
- The oxygen, which exists as O_2 , is a polar molecule. As such, the polar water molecules have a natural tendency to attract the oxygen. As the waves mix air into the ocean and

the surface of the ocean and atmosphere interact, oxygen is dissolved into the water. The process of diffusion carries the oxygen through the water column, delivering oxygen to organisms throughout the ocean.

- In some situations, the organisms in the ocean can use the oxygen in the water faster than it can be diffused into the water. This can happen when excess nutrient runoff from humans runs into the ocean. The nutrients, which are another solute in water, allow huge algal blooms to grow. These blooms contain far too many algae.
- The algae in the lower layers start to die, and bacteria start to consume them. Between the algae and the bacteria, all of the oxygen gets used up. This creates a dead zone in the water column. If fish start to swim through this column, they could suffocate from lack of oxygen.

Protons in the Cytosol

- Organisms of all kinds must regulate the number of solutes in their cells, to maintain proper cell functions. The acidity of cells is based in part on the number of hydrogen ions (H^+), or protons, found in the solution of cytosol. The protons are attracted to the oxygen atoms of water, because they are electronegative.
- The protons as a solute serve a very important function in cells. While water is able to diffuse through a cellular membrane via osmosis, hydrogen atoms cannot breach the membrane. The concentration gradient creates a potential force that can be used to move other substances. This is known as proton motive force and is used to move a wide variety of substances through the cellular membrane.

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