## DEFINITION OF SOLUTION:

A solution is a **homogenous mixture** of two or more different substances (i.e. solute and solvent) having uniform chemical composition and similar physical properties throughout.

## SOLUTE:

It is that component of solution which is present comparatively in **smaller** quantity. E.gin 5% aqueous sugar solution, sugar is solute as it is in smaller amount.

## SOLVENT:

It is that component of solution which is always in **greater** amount in which solute is dissolved. E.g in 10% table salt solution, water is solvent as it is in large amount.

## AQUEOUS SOLUTION:

The solution containing water as solvent is called as aqueous (aqua means water) solution denoted by (aq). Water us considered to be universal solvent.

### TYPES OF SOLUTION

| S.No: | State Of Solution | State Of Solute | State Of Solvent | Example |
|---|---|---|---|---|
| **GASES** | | | | |
| 1 | Gas | Gas | Gas | 1. Air (mixture of 78% $N_2$, 21% $O_2$ and 1% other gases)<br>2. Water gas (mixture of CO + $H_2$ gas)<br>3. Coal gas |
| 2 | Liquid | | Liquid | 1. Carbonated drinks ($CO_2$ in water) like pepsi etc.<br>2. Air dissolved in water.<br>3. Ammonia gas in water. |
| 3 | Solid | | Solid | $H_2$ gas adsorbed over palladium metal |
| **LIQUIDS** | | | | |
| 4 | Gas | Liquid | Gas | 1. Clouds (water vapors in air)<br>2. Steam |
| 5 | Liquid | | Liquid | 1. Alcohol in water.<br>2. Vinegar |
| 6 | Solid | | Solid | 1. Sodium amalgam (Hg in Na)<br>2. Dental amalgam (Hg in Ag) |
| **SOLIDS** | | | | |
| 7 | Solid | Solid | Gas | Smoke (carbon particles in air) |
| 8 | Liquid | | Liquid | 1. Sea water (NaCl and other salts in water)<br>2. Sugar in water. |
| 9 | Solid | | Solid | 1. Metal alloys<br>2. Brass (Cu and Zn)<br>3. Bronze (Cu and Sn) |

## DEFINITION OF SUSPENSION:

Suspension is defined as **heterogeneous mixture** consists of visible particles, each of which contains many thousands or even millions of molecules, surrounded by molecules of liquid.

**Explanation:**

If fine sand is stirred in water, the crystals do not dissolve, but even after several days some of the smallest particles remain suspended, such a mixture is called a suspension.

**Examples:**

1. **Smoke:** A suspension of the carbon particles in air or in a gas.
2. **Mud (Slime):** A suspension of fine particles of solid in small quantity of liquid.
3. **Foam (Forth):** A suspension of fine particles of a gas in a liquid.
4. **Emulsion:** A suspension of fine particles of one liquid into another in which it is not soluble.

## DIFFERENCE BETWEEN SOLUTION AND SUSPENSION

| S.NO: | SOLUTION | SUSPENSION |
|---|---|---|
| 1 | The size of solute particles lies between 0.1 – 1 nm. | The size of solute particle is larger than 1000nm. |
| 2 | Solute particles cannot be seen with low power microscope. | Solute particles can be seen with low power microscope. |
| 3 | It is homogeneous. | It is heterogeneous. |
| 4 | Solute particles of solution do not settle down | Solute particles of solution settle down |
| 5 | It is transparent. | It is not transparent. |
| 6 | Its components cannot be separated by filtration. | Its components can be separated by filtration. |

## SOLUBILITY AND FACTOR AFFECTING SOLUBILITY

**Definition:**

Solubility is the extent of a solvent to dissolve solute. The amount of solute in grams required to be dissolved in 100g or 100ml of a solvent to prepare a saturated solution at room (or given) temperature.

**Unit Of Solubility:**

1. The solubility is expressed in g/100ml water at a specific temperature.
2. The practical and S.I unit of solubility is mole/litre (mole/$dm^3$).

## FACTORS AFFECTING SOLUBILITY:

Solubility depends upon following factors.

1. Temperature
2. Pressure
3. Nature of solute and solvent.

### 1. EFFECT OF TEMPERATURE ON SOLUBILITY

**a. Effect Of Temperature On Solubility Of Solids In Liquids:**

The solubility of solids in liquids usually increases with rise in temperature.

**b. Effect Of Temperature On Solubility Of Gases In Liquids:**

The solubility of gases in a liquid (unlike solids) decreases with increasing temperature. Thus when a solution comprising of gas in a liquid is heated, gases are evolved.

## 2. EFFECT OF PRESSURE ON SOLUBILITY:

a. The solubility of solids and liquids in liquid solvent are not affected by pressure.
b. The solubility of gases in liquids considerably increases with increasing pressure.
c. The quantitative relationship between gas solubility and pressure is given by **Henry's Law**, which states that:

*"The solubility of gas at constant temperature is directly proportional to the pressure of gas."*

At S.T.P $m \alpha p$

$m = kp$

where;

m = amount of gas dissolved.
P = Partial pressure of gas over the solution.
k = Henry's Law Constant (with unit mole/liter-atm)

## 3. EFFECT OF NATURE OF SOLUTE AND SOLVENT ON SOLUBILITY:

Substances with similar types of polarity tend to be soluble in one another. This generalization is a guiding rule of solubility and is often simply stated as **"like dissolve like"** Thus polar or ionic solutes easily dissolve in polar solvents whereas non-polar solutes easily dissolve in nonpolar solvents and hence it is said that like dissolve like.

### DEFINITION OF UNSATURATED SOLUTION:

"*An unsaturated solution is that solution which contains less amount of solute than it has the capacity to dissolve."*

### DEFINITION OF SATURATED SOLUTION:

"*A saturated solution is that solution which contains maximum equilibrium amount of solute that can be dissolved in a given solvent at a particular temperature*." A saturated solution can hold no more of the solute and there is a dynamic equilibrium between the undissolved and dissolved solute.

### DEFINITION OF SUPER SATURATED SOLUTION:

"*A super saturated solution is that solution that contains greater amount of dissolved solute than that present in saturated solution at the given temperature."* Preparation of super saturated solution is required for crystallization.

## CRYSTALS AND CRYSTALLIZATION

**Crystals:**

*"Crystals are homogenous solid, having regular and definite geometrical shape with faces and sharp edges. Pure crystals have sharp melting point."*

**Crystallization:**

*"The process in which dissolved solute comes out from solution and forms crystals is called as crystallization."* Crystallization may occur by the process of evaporation or by cooling heated solution. Preparation of super saturated solution is required for crystallization. Crystallization is simple and general technique for purification or impure compounds.

## STRENGTHS OF SOLUTION

**Definition:**

*The strength (concentration) of a solution means the mass or volume of solute present in known amount of solvent or solution.*

$$\text{Concentration of solution} = \frac{\text{Amount of solute (g/mole/gram equivalent)}}{\text{Volume or mass of solvent or solution}}$$

## METHODS OF EXPRESSING CONCENTRATION:

The following are the common methods of expressing the strength or concentration of solution (i.e. concentration units).

1. Molarity (M)
2. Molality (m)
3. Normality (N)
4. Mole Fraction (X)
5. Percentage concentration (%)

## MOLARITY:

**Definition:**

It is defined as *"The number of moles of solute dissolved per 1 liter (1dm$^3$) of a solution."*

It is denoted by M. The molarity of any solution is calculated by diving the number of moles of solute by the number of liter of solution. It has the unit mole/liter (mole/dm$^3$).

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Liter of solution}} = \frac{n}{V}$$

## MOLALITY:

**Definition:**

It is defined as *"The number of moles of solute dissolved per 1 kilogram (1000g) of a solvent."*

It is denoted by m. The molality of any solution is calculated by diving the number of moles of solute by the number of kilogram (1000g) of solvent. It has the unit mole/liter (mole/gm).

$$\text{Molality} = \frac{\text{Number of moles of solute}}{\text{Kg of solvent}}$$

## MOLE FRACTION (X)

**Definition:**

"Mole fraction (X) of any component in a solution is the ratio of number of moles of the component to the total number of moles of all the substances making up a solution." The mole fraction is a dimensionless quantity i.e. it has no unit because it expresses the ratio of two similar quantities. The sum of mole fraction of all components in a solution is always unity (1) i.e.

$$X_a + X_b = 1$$

$$\text{Mole Fraction (X)} = \frac{\text{Moles of one component}}{\text{Total number of moles making up solution}}$$

## FILL IN THE BLANKS

i. Homogenous ii.Water iii. Aqueous solution iv. 90 v. M