MIXTURE:-

A mixture is a material containing two or more elements or compounds that are in close contact and mixed together in any proportion. The components of a mixture can be separated by simple mechanical means.

Examples:-

1. Air is a mixture of nitrogen, oxygen, carbon dioxide, water vapour (moisture) and a small amount of other substances.
2. Gunpowder is a mixture of nitrate (potassium nitrate), sulphur and coal.

PROPERTIES OF MIXTURE:-

1. A mixture may be homogenous or heterogeneous.
2. The constituents of a mixture can be separated by physical methods like filtration, evaporation, sublimation, magnetic separation, etc.
3. In the preparation of a mixture, energy is usually neither given out nor absorbed.
4. The composition of a mixture is not fixed.
5. Moisture has no definite melting point, boiling point, etc.
6. In the formation of a mixture, no chemical reaction occurs.

TYPES OF MIXTURES:-

i) Heterogeneous Mixture:-

A mixture in which its various constituents are not mixed uniformly is called heterogeneous mixture.

In a heterogeneous mixture, the constituents can easily be identified either with unaided eye or under microscope. For example, in a mixture of sulphur, carbon, nitrate and sand, each of the constituent can be seen under a magnifying glass. Moreover, the composition of mixture is not uniform, i.e., at some place sulphur may be more and at some other place sand or nitre or carbon may be more.

ii) Homogeneous Mixture

A mixture in which different constituents are mixed uniformly is called homogeneous mixture.

A homogeneous mixture should not be confused with a compound. It is because, in case of a compound, the constituents are present in fixed ration by weigh whereas in case of homogeneous mixture, the constituents are not present in fixed ratio by weight, i.e., the amount of constituents in homogeneous mixture can be changed at will.

COMPOUNDS:-

A compound is a pure substance formed from two or more elements combined together in definite proportion by weight.

A compound can only be decomposed by a chemical action into two or more simpler substances e.g. $CaCo_3$, H_2So_4, H_2O etc.

PROPERTIES OF COMPOUNDS:-

1. A compound cannot be separated into its constituent elements by mechanical or physical methods.
2. The properties of a compound differ entirely form those of its constituent elements.
3. When a compound is formed, energy is usually evolved or absorbed (in the form of heat or light) during the chemical reaction.
4. In a compound, the constituent elements are present in a definite proportion by weight.
5. A compound has fixed melting point, a fixed boiling point, etc.
6. A compound is a homogeneous substance, i.e., compound is such a substance which is the same throughout in its properties and composition.

DIFFERENTIATE BETWEEN MIXTURES AND COMPOUNDS:-

Mixtures	Compounds
1. A mixture is obtained when two or more elements or compounds just mix together without involving the formation of any new compound.	1. Elements react together to form a new compound.
2. A mixture is formed as a result of a physical change.	2. A compound is formed as a result of a chemical change.
3. The constituents of a mixture can be easily separated by physical methods such as filtration,	3. The constituents of a mixture cannot be separated by physical methods but can be

evaporation, distillation, sublimation, extraction with solvents, magnet, etc.	separated only by chemical or electrochemical reactions.
4. A mixture shows the properties of its constituents.	4. The properties of a compound are altogether different from those of its constituents.
5. The composition of a mixture is variable, i.e., the constituents of a mixture can be present in any proportion. Therefore, a mixture does not have a fixed formulae.	5. The composition of a compound is always fixed, i.e., the constituent elements are always present in a fixed proportion by mass. Therefore, a compound has a definite formula.
6. A mixture does not have a fixed melting point, boiling point, etc.	6. A compound has fixed melting point, boiling point, etc.
7. A mixture may be homogeneous or heterogeneous.	7. A compound is a homogeneous substance.
8. Energy (in form of heat or light) is neither absorbed nor evolved during the formation of a mixture.	8. Energy (in form of heat or light) is either absorbed or evolved during the formation of a compound.

SOLUTION:-

A solution is defined as a homogeneous mixture of two or more chemically non-reacting substances whose composition can be varied within limits.

SOLVENT:-

The liquid in which a substance is dissolved is called a solvent. A solvent is thus dissolving agent. In a true solution, i.e., a completely homogeneous solution, the solvent is called the medium of dispersion. Solvent is always present in a higher quantity.

SOLUTE:-

The substance which is dissolved in a solvent to produce a solution is called a solute. The solute particles in a true solution are called dispersed particles. Solvent is always present in a lower quantity.

Examples:- The substance present in lower amount in a solution is called the solute, whereas that present in greater amount is called the solvent.

AQUEOUS SOLUTION:-

A solution produced by dissolving a substance in water is known as an aqueous solution. For example, the solutions of sodium chloride, ammonium chloride and copper sulphate in water are all aqueous solutions of these substances.

NONAQUEOUS SOLUTION:-

There are some substances which can form solutions by dissolving in liquids other than water such as alcohol, acetone, carbon tetrachloride and carbon disulphide. Such solutions are called nonaqueous solutions.

TRUE SOLUTION:-

If the mixture of the substances in a solution is truly homogeneous, the particles cannot be distinguished from one another, even under a microscope. In such a solution, the solute particles disappear into space between the particles of the solvent. Such a solution is called a true solution.

PROPERTIES OF SOLUTIONS:-

1. A solution is clear and transparent. For example, a solution of sodium chloride in water is clear and transparent.
2. The solute in a solution does not settle down even after the solution is kept undisturbed for some time.
3. In a solution, the solute particles cannot be distinguished from the solvent particles or molecules even under a microscope. In a true solution, the particles of the solute disappear into the space between the solvent molecules.
4. A solution is homogeneous, i.e., the composition of a solution is the same throughout.
5. The components of a solution cannot be separated by filtration.
6. The diameter of the solute particles in a solution is of the order of 10^{-8} cm.

TYPES OF SOLUTION:-

Solutions can be divided into two classes depending upon the amounts of solute dissolved.

1. **Unsaturated solution:-** An unsaturated solution is one in which more solute can be dissolved without increasing the temperature. For example, a solution of sugar in water in which more sugar can dissolve at a given temperature is an unsaturated solution.
2. **Saturated solution:**- There is a limit to the amount of solute that can be dissolved in a fixed amount of solvent at a particular temperature. A solution in which the maximum possible amount of a solute is dissolved at a given temperature is known as a saturated solution.
3. **Supersaturated solution:**- Sometimes it is possible to prepare a solution with an amount of solute higher than that required to prepare a saturated solution. This kind of solution is called a supersaturated solution. For example, 100g of water of 20^0C and 1 atm can dissolve a maximum of 34.7 g of KCL. So, a solution that contains 34.8g of KCL in 100g of water of 20^0C and 1 atm is a supersaturated solution. A supersaturated solution at a given temperature can be made by slowly cooling a saturated solution prepared at a higher temperature.

   Supersaturated solutions are very unstable. The excess solute (0.1 g) in the solution mentioned above may quickly crystallize to make the solution saturated. Stirring, scratching the side of the container or adding a small piece of the solute fro outside is sufficient to cause precipitation of the excess solute.

CONCENTRATION OF A SOLUTION:-

The concentration of a solution is expressed as the amount of the solute present in a given amount of the solvent or solution. It is normally expressed as mass percent or as volume percent.

- **Mass Percent**

  Mass percent of a solution may be defined as:

  the number of parts by mass of one component (solute or solvent) per 100 parts by mass of the solution.

  If A and B are the two components of a binary solution,

  Mass present of A = $\frac{W_A}{W_A + W_B} \times 100$ Where W_A is the weight of solute and W_B mass of solvent.

- **Volume Percent**

  Volume percent of solution may be defined as:

  the number of parts by volume of one component (solute or solvent) per 100 parts by volume of the solution.

  Mathematically, Volume percent of A = $\frac{V_A}{V_A + V_B} \times 100$

  Volume percent of B = $\frac{V_B}{V_A + V_B} \times 100$

  Mass percentage is use to express those solutions where solvent and solute are expressed in Kg's or grams. In volume percentage both are expressed in liters.

SUSPENSIONS:-

A suspension is a heterogeneous mixture in which small particles of a solid do not dissolve but remain suspended throughout the mass of the liquid or gas.

Examples:- Muddy water, sand-water mixture, chalk-water mixture, paints, etc., are suspensions.

PROPERTIES OF SUSPENSIONS:-

1. A suspension is a heterogeneous mixture.
2. The particles in a suspension are large enough to be visible either to the unaided eye or under an ordinary microscope.
3. The particles in a suspension are too large to remain in suspension ofr a long period. If a suspension is allowed to stand, the suspended particles settle down at the bottom.
4. The particles in a suspension can be separated from the liquid by filtration.
5. In a suspension, the size (diameter) of the particles is of the order of 10^{-5} cm or larger.

COLLOIDS OR COLLOIDAL SOLUTION:-

Colloidal solution appears homogenous but actually it sis heterogenous..

A colloidal solution is somewhat between a true solution and a suspension. The sizse of a colloidal particle is larger than that of one in a true solution but smaller than that of one in a suspension. A colloid has properties that are intermediate between those of a true solution and a suspension. Examples of colloids or colloidal solutions are milk, ink, blood, toothpaste, starch solution, air (containing dust), clouds, mist (dispersion of water droplets in air), smoke and jellies. A colloid is usually translucent or opacue.

Thus, a colloid is a solution in which the size of the solute particles lies between that of particles in a true solution and that of those in a suspension.

PROPERTIES OF COLLOIDAL SOLUTION:

The following are the properties of a colloidal solution:

1. **Heterogenous nature:** A colloidal solution is heterogenous. The particles are visible under a powerful microscope.
2. Filtration: The particles in a colloid can pass through a filter paper.
3. Stability: The particles in a colloid are quite stable. They7 do not settle down at the bottom when the colloid is left to stand.
4. Size of particles: The most characteristic property of a colloidal particle is its size. Colloidal particles have sizes ranging from 10^{-7} cm to 10^{-5} cm.
5. Brownian movement: Colloidal particles are in a state of constant and rapid zig-zag motion, called Brownian movement. Brownian movement arises due to the collisions of the colloidal particles with molecules of the liquid.
6. Electrophoresis: Many colloidal particles are electrically charged. So, when an electric field is set up in a colloidal solution, the charged colloidal particles move towards the oppositely charged electrode and are precipitated. The movement of charged colloidal particles under the influence of an electric field is known as electrophoresis. In the electric field, different colloidal materials move with different velocities. This property is used to study mixtures of proteins, enzymes, etc., and to determine the protein content of body fluids.

PURE SUBSTANCES:-

A pure substance means a single substance (or matter) which cannot be separated into other kinds of matter by any physical process.

Thus, ghee or oil is not a pure substance because it has a number of other substances mixed with it. Similarly, air is also not a pure substance as a number of gases like oxygen, nitrogen, carbon dioxide, water vapours etc. are present in it.

TYPES OF PURE SUBSTANCES:-

On the basis of their chemical composition, substances can be classified either as elements or compounds.

ELEMENTS:-

The word element was introduced for the first time by Lavoisier, a French chemist. According to him,

An element is the simplest or basic form of a pure substance which cannot be broken into anything simpler than it by physical or chemical methods.

The definition of an element has been modified. It may now be defined as:

The pure substance which is made up of one kind of atoms only

The common examples of elements are hydrogen, carbon, oxygen, nitrogen, sulphur, copper, silver, gold etc. nearly 118 elements are known.

TYPES OF ELEMENTS:-

Elements are further classified into three types on the basis of their physical state and properties. These are metals, non-metals and metalloids.

- **Metals:-**

  Nearly 70 elements belong to a particular class known as metals. In the metals, the atoms are very closely packed together and have special types of bonds known as metallic bonds. Because of very tight or close packing, the metals are quite hard. The important characteristics of the metals are listed.

  1. Metals are solids at room temperature.

2. Metals have shining surface. They have generally silver-grey or golden-yellow surfaces. This property is known as luster.
3. Metals are good conductors of heat and electricity.
4. Metals are generally quite hard.
5. Metals are malleable in nature. It means that they can be beaten to form very fine thin sheets. For example, fine aluminium foils are used for wrapping different types of food. Similarly, thin foils of silver are used for decorating sweets.
6. Metals are ductile in nature. It means that very fine and thin wires can be drawn from the metals. For example, all electric wires drawn form different metals are very fine.
7. Metals are sonorous which means that when they are bent or hit, they produce a tinkling sound.
8. Metals have generally high melting and boiling points.

- **Non-Metals:-**

Non-metals as the name suggests are opposite to metals which means that their properties are quite different from the metals. They are comparatively less in number. Only about fourteen to fifteen elements are non-metals. The important properties of the non-metals are listed.

1. Non-metals are either gases or solids at room temperature.
2. Non-metals vary in colour. Solids have generally dull surfaces.
3. Non-metals are mostly poor conductors of heat and electricity.
4. Most of the non-metals are quite soft and have smaller densities than metals.
5. Non-metals are non-malleable and non-ductile in nature.
6. Non-metals are also not sonorous in nature.
7. As compared to metals, the non-metals have very low melting and boiling points.

- **Metalloids**

There are a few elements which possess the characteristics of both the metals and non-metals. These are actually border-line elements and are known as metalloids. A few common examples of metalloids are : Arsenic, Antimony, Bismuth.

PHYSICAL CHANGES:-

A physical change is one in which some of the physical properties (colour, shape, state, etc.) of the substances undergoing change are altered temporarily but the actual composition and mass of the substances remain unchanged and no new substances are produced. The substance is restored to its original state as soon as the cause of change is withdrawn.

Example:- The dissolution of common salt into water is a physical change. The solution of common salt in water when evaporated to dryness gives back common salt. The common salt obtained from the evaporation of its aqueous solution has the same properties as the original common salt. Thus, the dissolution of common salt in water is a physical change.

CHEMICAL CHANGES:-

A chemical change is one in which the substances undergoing change are transformed into new substances whose properties (mass, composition, etc.) are entirely different form those of the original substances. The new substances cannot be changed back to the original substances even if the cause of change is withdrawn.

Example:-

The burning of wood, ripening of fruits, digestion of food in our body, cooking of rice, rusting of iron, souring of milk, formation of water from hydrogen and oxygen, etc., are all chemical changes. In all these changes, the original substance cannot be obtained back.

Burning of coal is chemical change:- Coal is a black solid. When it is burnt in oxygen, a colourless gas is produced which does not burn, rather it extinguishes a burning substance. The colourless gas is carbon dioxide.

$$C + O_2 \rightarrow CO_2$$

DISTINGUISH BETWEEN PHYSICAL AND CHEMICAL CHANGES:-

Burning of candle is both physical as well as chemical change

Physical change	Chemical change
1. The identity of the substance is maintained. 2. No new substance is produced. 3. Only the physical state or some of the physical properties of the substance are changed. 4. The change is temporary. The substance returns to its original state as soon as the cause of change is withdrawn. 5. Heat-change may or may not occur. 6. Physical changes are reversible changes.	1. The identity of the original substance is completely lost. 2. A new substance is always produced. 3. The physical as well as the chemical properties of the substance are changed. 4. The change is permanent. The substance after the change cannot come back to its original state even when the cause of change is withdrawn. 5. Heat-change must occur. 6. Chemical changes are irreversible changes.