CLASSROOM STUDY PACKAGE

CHEMISTRY

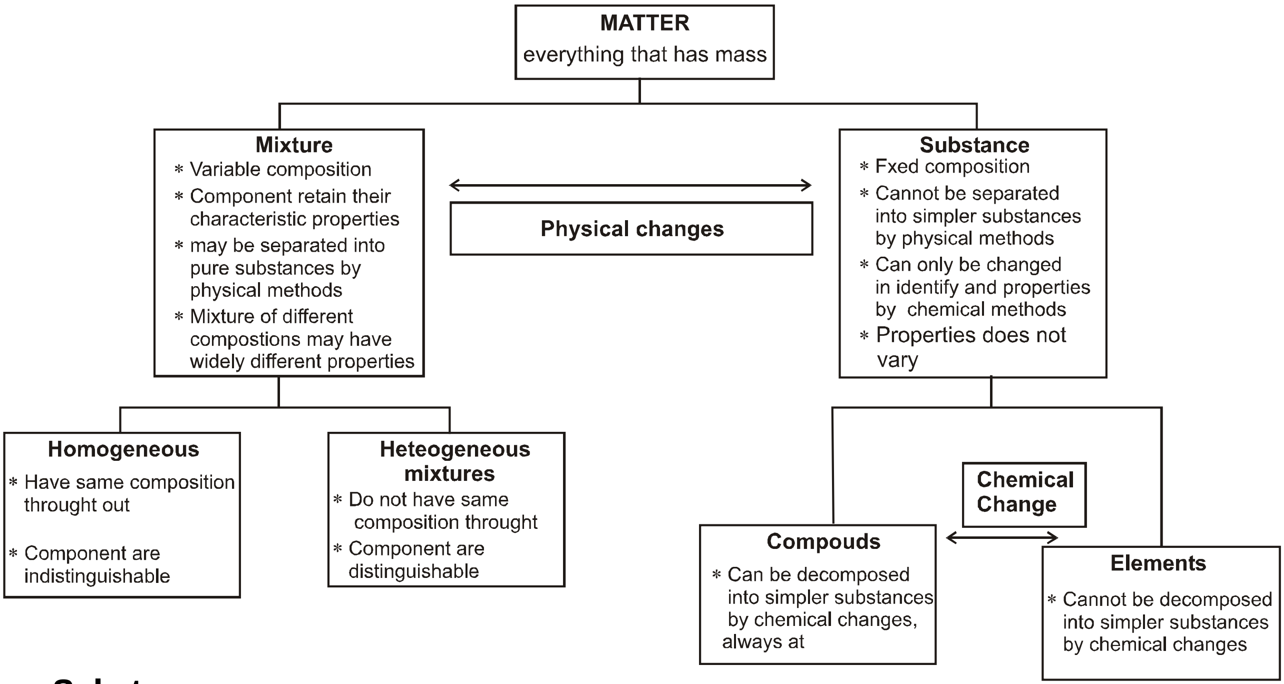
Is Matter Around Us Pure

JEE EXPERT

IS MATTER AROUND US PURE

CONTENTS

IS MATTER AROUND US PURE ?



Pure Substances :

Elements and compounds : A pure substance is made up of only one kind of particles. These particles may be either atoms or molecules. Thus,A pure substance which is made up of only one kind of atoms is called an element while that which is made up of only one kind of molecules is called a compound.

⇒ ***A pure substance is uniform or homogeneous throughout because it consists of only one kind of particles. These particles are similar to one another and cannot be separated into simpler particles by any physical process.***

Elements : Robert Boyle was the first scientist who used the term element in 1661. Antoine Laurent Lavoisier (1743-1794), a French chemist was the first to give a useful definition of an element as follows :

An element is defined as the simplest form or the basic form of a pure substance which can neither be broken into nor built up from simpler substances by any physical or chemical method.

However, the definition given above is not considered to be correct now a days. This is because after the discovery of radioactivity, it has been found that elements can be broken into simpler substances. Hence, the definition of an element has been modified as follows :

An element is now defined as a pure substance that contains only one kind of atoms.

An element is made up of only one kind of atoms which are identical in all respects, size, mass, composition, etc. However, atoms of different elements differ in size, mass and composition.

118 Elements have been discovered so far. Out of these 90 elements have been found to occur in nature whereas the remaining 24 have been synthesized by the scientists in the laboratories by suitable chemical reactions.

Elements can be normally divided into metals, non-metals and metalloids.

There are 22 non-metals and 93 metals.

* Amongst the metals, only mercury is a liquid metal- Galium. All other metals are solids.
* Amongst the 22 non-metals: 10 non-metals are solids. They are boron, carbon, silicon, phosphorus, sulphur, selenium, arsenic, tellurium, iodine and astatine. 1 non-metal, bromine, is a liquid. Five non-metals, hydrogen, nitrogen, oxygen, fluorine and chlorine are chemically active gases. Six non-metals, helium, neon, argon, krypton, xenon and radon are chemically inactive gases. These are also called noble gases or rare gases.

Solid elements: Majority of the elements are solids at room temperature. For example, iron, copper, aluminium, silver, gold, sodium, potassium, sulphur, phosphorus, carbon (graphite or diamond), iodine, etc.

Liquid Elements : Mercury and bromine are the only two elements which are known to exist in the liquid state. Gallium and cesium become liquid at a temperature slightly above room temperature (303 K).

Gaseous State : Eleven elements are gaseous at room temperature. These are hydrogen, oxygen, nitrogen, fluorine, chlorine, helium, neon, argon, krypton, xenon and radon.

Ĝ= **Elements can be further classified into three types depending upon their atomicity :**

(i) **Monoatomic Elements** :They contain only one atom each, even in their molecules.
e.g. All metals and inert gases

(ii) **Diatomic elements :** They contain two atoms in their molecules. e.g. All other gases such as hydrogen (H_2); Nitrogen (N_2); Oxygen (O_2); fluorine (F_2) and chlorine (Cl_2)

(iii) **Polyatomic Elements** : They contain more than two atoms in their molecules e.g. Ozone (O_3); phosphorus (P_4) and sulphur (S_8)

CHARACTERISTICS OF ELEMENTS :

(i) An element is made up of atoms, which are all alike in every respect.

(ii) An element cannot be sub-divided further by physical or chemical process. However, some elements may be transformed into new elements through nuclear changes.

(iii) Atoms which are the smallest particles constituting an element possess all the physical as well as chemical properties of elements.

(iv) Elements occur in nature, either in a free state or in the form of compounds

(v) Some elements have been prepared artificially in the laboratory as a result of nuclear reactions.

(vi) Amongst the elements, only two are liquids (bromine and mercury), eleven are gases (Hydrogen, nitrogen, oxygen, fluorine, chlorine, helium, neon, argon, krypton, xenon and radon) and the rest are solids at room temperature (25°C). Most of these solid elements are metals.

Symbols of Elements : In order to write the chemical reactions conveniently, each element is represented by a separate symbol. The symbol of an element is the 'First letter" or the 'First letter and another letter" of the English name or Latin name of the element.

Symbols derived from English names of the elements

English name of the element	Symbol
1. Hydrogen	H
2. Helium	He
3. Lithium	Li
4. Carbon	C
5. Nitrogen	N
6.Oxygen	O
7.Fluorine	F

Symbols derived from Latin names of the elements.

English name of the element	Symbol	Latin name of the elements
1. Sodium	Na	Natrium
2. Potassium	K	Kalium
3. Iron	Fe	Ferrum
4. Copper	Cu	Cuprum
5.Silver	Ag	Argentum
6.Gold	Au	Aurum
7. Mercury	Hg	Hydrogyrum
8. Lead	Pb	Plumbum
9. Tin	Sn	Stannum

Significance of the symbol of an Element :

(i) Symbol represents name of the element.

(ii) Symbol represents one atom of the element

(iii) Symbol also represents one mole of atoms of the element

(iv) Symbol represents a definite mass of the element.

Physical Properties	Metals	Non Metals
State	Metals are solids at room temperature Exception : Mercury (Hg) is a liquid at ordinary temperatures.	The non-metals are either solids or gases at room temperature. Exception : Bromine is a lquid at ordinary temperatures.
Lustre	Metals are generally lustrous, i.e., they have a shining surface and can be polished, e.g. gold, silver, copper, etc., have metallic lustre (shine) and can be polished	Non-metals generally do not have any lustre, e.g., the non-metals sulphur and phosphorus are non-lustrous, i.e., dull. **Exception :** lodine has a lustrous appearnace.
Melting and boiling Points	Metals have generally high melting points and boiling points, e.g., the melting point of iron is 1535°C. **Exceptions :** Sodium, potassium and gallim have low melting points. Their melting points are less than 100°C. The melting point of gallium is so low that it occurs in liquid state at temperature greater than 35°C	Non-metals have low melting points and boiling points. **Exceptions :** Carbon and silicon, which have high melting points and boiling points.
Density	Metals have high densities, i.e., they are heavy, e.g., the density of mercury is 13.58 gm/cm^3 which is quite high. **Exceptions.** Sodium, potassium, calcium and magnesium are lightweight metals. Sodium and potassium are so light that they can float.	Non-metals have low densities. i.e., they are light substances. For example, the density of sulphur is 2g/cm3, which is quite low. **Exception :** The density of diamond (an allotropic form of carbon) is high.
Ductility	Metals are ductile, i.e., they can be drawn into thin wires. Gold and silver are the most ductile metals. Other examples are copper and aluminium which are drawn into wires and are used in electricity wiring.	Non-metals are non-ductile, i.e., they cannot be drawn into thin wires, e.g., sulphur and phosphorus when stretched do not form wires but break into pieces.
Malleability	Metals are generally malleable, i.e., they can be beaten into thin sheets with a hammer, e.g., silver foils are used for decorative purposes on sweets.	Non-metals are non malleable but brittle, i.e. when beaten with a hammer, they break into pieces.
Conduction	Metals are good conductors of heat and electricity. Silver is the best conductor of heat and electricity whereas lead is the poorest conductor of heat. Metals are good conductors of electricity because they contain free electrons to conduct electricity.	Non-metals are generally bad conductors of heat and electricity, e.g., the non-metals like sulphur, phosphorus, etc., do not conduct heat and electricity. **Exception :** Graphite (an allotropic form of carbon) is a good conductor of electricity.
Hardness	Metals are hard (except sodium and potassium which are soft metals) but not brittle. Sodium and potassium are so soft that they can be cut with a knife.	Non-metals are generally soft except diamond (an allotropic form of carbon) which is the hardest substance known.
Sonority	Metals are said to be sonorous, i.e., they make noise when they are hit.	Non-metals are not sonorous.

Metalloids : Elements which have properties in between those of metals and non-metals are called metalloids or semi-metals. For example, silicon (Si), germanium (Ge), arsenic (As), antimony (Sb), and tellurium (Te).

These elements show some properties of metals and other properties of non-metals. For example, they look like metals but are brittle like non-metals. They are neither good conductors of electricity nor non-conductors (insulators) like non-metals. They are generally semi-conductors.

Compounds : A compound is defined as a pure substance made up of two or more elements chemically combined in a fixed proportion by mass.

For example,

(i) Water (H_2O) is a compound made up of two elements, hydrogen (H) and oxygen (O), chemically combined together in a fixed proportion of 1 : 8 by mass

Types of Compounds

1. Inorganic compound mostly obtained from non-living sources such as rocks and minerals
2. Organic compound - obtained from living beings i.e. plants and animals All contain carbon as their essential Constituent. Therefore known as carbon compounds

Properties of Compounds :

Some important properties of compounds are discussed below :

1. A compound is always made up of the same elements combined together in a fixed proportion by mass.

2. A chemical compound is formed as a result of a chemical change (or reaction) and its properties are entirely different from those of its constituents. A chemical compound cannot be formed simple by mixing constituent elements. It is formed only when a chemical reaction takes place between them.

3. A compound cannot be separated into its constituents by simple physical means.

4. A compound has a definite molecular formula and fixed melting point and boiling point.

5. Energy in form of heat or light is usually evolved or absorbed when a compound is formed.

6. A compound is homogeneous substance.

Classification of Compound on the basis of their properties :

(i) Acids : Compounds which give hydronium ion in aqueous solution for e.g. hydrochloric acid, sulphuric acid, nitric acid, formic acid etc.

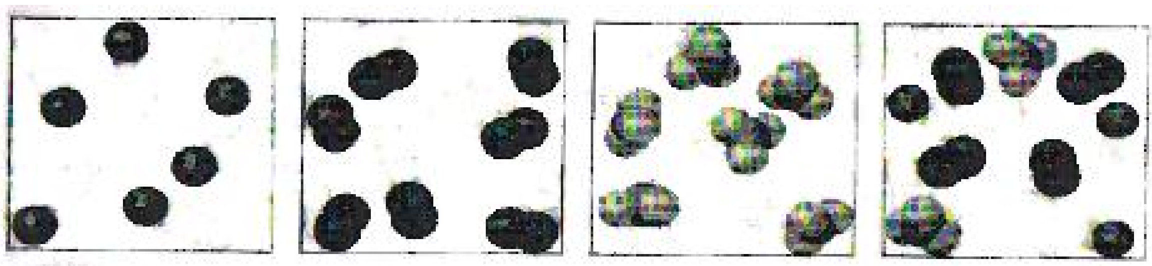
(ii) Bases : Compounds which give hydroxide ion in aqueous solution for e.g. sodium hydroxide, Potassium hydroxide.

(iii) Salts : It is formed by the chemical reaction between acids and bases for e.g. ammonium chloride, zinc sulphate etc.

Criteria of purity of compounds :

* A solid compound is said to be pure if it has a sharp melting point, i.e. whole of the solid melts within 0.5°C or 0.5 K. Impure solids, on the other hand, have lower melting points than the pure solids because impurities lower or depress the melting points.
* A liquid compound is said to be pure if it has a fixed boiling point, i.e. whole of the liquid distils at a fixed temperature.

DIAGRAM SHOWING COMPARISION OF PARTICLES OF ELEMENTS, COMPOUND, MIXTURE :



(a) Atoms of an element (b) Molecules of an elements (c) Molecules of an compound (d) Molecules of element & compound

IMPURE SUBSTANCES - MIXTURE : A mixture is a material which contains two or more different kinds of particles (atoms or molecules) which are physically mixed in any proportion but not chemically combined.

Thus, a mixture has a variable composition, i.e, does not have a fixed composition. Therefore, no definite formula can be given to a mixture. In other words, a mixture does not have a fixed melting point or a fixed boiling point.

OR

A mixture is a material which consists of two or more pure substances (elements or compounds) which are not chemically combined but are physically mixed in any proportion.

Types of Mixtures : Depending upon the nature of components that are mixed to form mixtures, mixtures have been classified into the following two types

1. **Homogeneous mixtures**. A homogeneous mixture is defied as follows :
   A mixture is said to be homogeneous if all the components of the mixture are uniformly mixed and there are no boundaries of separation between them. For example.
   * A solution of sugar in water is a homogeneous mixture in the liquid phase.
   * A mixture of two or more miscible liquids is also a homogeneous mixture in the liquid phase.
   * Air is a homogeneous mixture of a number of gases such as oxygen, nitrogen, carbon dioxide, inert gases (mainly argon), water vapours etc.
   * Alloys are homogeneous mixtures of two or more metals in the solid phase.
2. **Heterogeneous mixtures**. A heterogeneous mixture is defined as follows:
   A mixture is said to be heterogeneous if all the components of the mixture are not thoroughly mixed and there are visible boundaries of separation between them. For example
   * A mixture of sugar and sand is a heterogeneous mixture because different parts of the mixture will have different sugar sand compositions. Some parts of this mixture will have more of the sugar particles while the other parts will have more of the sand particles. Therefore, there is a visible boundary of separation between the sugar and sand particles although both of them are present in the same phase are i.e. solid phase.
   * A suspension of solids in liquids is a heterogeneous mixture.
   * A mixture of two immiscible liquids is also a heterogeneous mixture.

Properties of Mixtures :

1. A mixture may be homogeneous or heterogeneous.
2. The composition of a mixture is variable.
3. A mixture does not have a definite melting point or a boiling point.
4. Energy is neither absorbed nor evolved during the formation of a mixture.
5. The properties of a mixture are the properties of its constituents. This means that a mixture shows the properties of all the constituents present in it.
6. The constituents of a mixture can be separated by simple physical methods such as filtration evaporation, sublimation, distillation, extraction with solvents, magnets etc.

Types of mixtures : Based on the composition, mixtures can be broadly divided into three groups into three depending on whether the constituents are elements or compounds or both.

1. Element with an element :

Example : (a) Oxygen and nitrogen (b) Sodium and mercury (amalgam)
(c) Copper and zinc alloy

2. Compound with a compound :

Example : (a) Water and salt (b) Water and alcohol
(c) Salt and sugar

3. Element with a compound :

Example : (a) Oxygen and water (Air dissolved in water)
(b) Oxygen, nitrogen, carbon dioxide and water vapour (air)

Mixtures can also be grouped on the basis of their physical states.

Difference between a mixture and a compound :

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, evaporation, distillation, sublimation, extraction with solvents, magnet etc.	3. The constituents of a mixture cannot be separated by physical methods but can be 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	5.The composition of a compound is always

constituents of a mixture can be present in any proportion. Therefore, a mixture does not have a fixed formula.	fixed, i.e. the constituent elements are always present in a fixed proportion by mass. Therefore, a compound hasa definite formula.
6. A mixture does not have a fixed melting point, boiling point, etc.	6. A compound has a 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.

PHYSICAL CHANGES : Those changes in which only the physical properties of the substances change but no new substances are formed are called physical changes. For example

(i) Melting of ice to form water and freezing of water to form ice.
(ii) Boiling of water to form steam and condensation of steam to form water.
(iii) Preparing a solution.
(iv) Breaking a glass tumbler.
(v) Glowing of an electric bulb.

CHEMICAL CHANGES :

Those changes in which new substances are formed are called chemical changes.

In a chemical change, the original substances lose their identity and get converted into new substances. The new substances thus formed can not be converted back into original substances by any physical process. Thus, chemical changes are permanent and hence are irreversible. For example

(1) Burning of magnesium ribbon.
(2) Burning of a piece of paper.
(3) Burning of hydrogen in air or oxygen.
(4) Rusting of iron.
(5) Formation of iron sulphide from iron and sulphur.

Difference between Physical and Chemical Changes :

PHYSICAL CHANGE	CHEMICAL CHANGE
1. A physical change brings about changes in physical properties of the substance such as physical state, shape and size, etc., For example ice (solid) melts to form water (liquid)	1. A chemical change brings about changes in the chemical properties of the substance. For example, iron undergoes rusting to from hydrated iron oxide. The chemical properties of hydrated iron oxide are different from those of iron.
2. There is no change in the chemical composition both ice and steam have the same chemical composition (made up of water molecules) as that of liquid water.	2. There is always a change in the chemical composition of the substance during the physical For example, iron and rust have different chemical composition.
3. No new substance is formed in a physical change.	3. A new substance is always formed during a chemical change
4. Physical changes are temporary and hence are easily reversible.	4. Chemical changes are permanent and hence are irreversible.
5. No amount of heat and light energy is usually absorbed or given out during a physical change.	5.Large amounts of heat and light energy are always absorbed or given out in a chemical change.

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

It may be noted that all mixtures are not solutions. If a mixture is to be called as solution, it must satisfy the following two conditions :

(i) The components of a mixture should be non-reacting and
(ii) mixture should be homogeneous.

Components of a solution : The substances present in a homogeneous solution are called components of the solution. A solution basically has two compounds i.e., a solvent and solute.

(i) Solvent : The component of a solution which present in large proportion, is called solvent.

Note :
Usually, a solvent is the LARGER component of the solution.
For example : In the solution of copper sulphate in water, water is the solvent. Similarly, in paints, turpentine oil is the solvent.
(ii) Solute : The component of the solution which is present in small proportion is called solute.
For example : In the solution of common salt in water, the common salt is solute.
G **Note :** Usually, solute is the SMALLER component of the solution.

Name of the solution	**Solute**	**Solvent**	**Examples**
Solid Solutions 1.Solid in solid	Solid	Solid	Alloys like steel, brass, bronze, German silver, solder etc.
2.Liquid in solid	Liquid	Solid	Hydrated crystals such as blue vitriol (hydrated copper sulphate), dental amalgam (mercury liquid and silver solid)
3. Gas in solid	Gas	Solid	Gases adsorbed over the surface of metals (such as nickel, palladium platinum etc.) under pressure.
Liquid Solutions 4. Solid in liquid	Solid	Liquid	Sugar, common salt or other salts dissolved in water, tincture of iodine.
5. Liquid in liquid	Liquid	Liquid	Mixture of two miscible liquids such as acetone and water, alcohol and water, vinegar (acetic acid and water) etc.
6. Gas in liquid	Gas	Liquid	carbonated drinks. Here, carbon dioxide is dissolved in water under pressure.
Gaseous Solutions 7. Solid in gas	Solid	Gas	Camphor in air or iodine in air.
8. Liquid in gas	Liquid	Gas	Clouds and fog. Here, water drops (liquid) are dispersed in gas (air)
9. Gas in gas	Gas	Gas	Air is a mixture of gases like nitrogen, oxygen, carbon dioxide, inert gases etc.

Properties of Solutions

The main characteristics of a solution may be summed up as follows :

1. A solution is a homogeneous mixture.
2. The components of a solution do not chemically react with one another.
3. The particles of a solutions are smaller than I nm (10^{-9} m) in diameter. So, they cannot be seen by naked eyes or even under a microscope.
4. Because of small size, the solute particles do not scatter a beam of light passing through the solution. Therefore, the path of light is not visible in a solution.
5. The particles of the solute in a solution pass through the filter paper thereby showing that the solute particles are smaller than the pores of the filter paper.
6. When the solution is allowed to stand undisturbed, the particles of the solute do not settle down. This shows that solutions are stable.
7. A solution is always transparent in nature.

True Solution : The solution of sugar, common salt, acetic acid, etc. in water are called true solutions because in these solutions, the particles of the solute (sugar, salt, acetic acid , etc.) are so thoroughly mixed with water that they cannot be distinguished one from the other.

Types of Solutions :

(I) On the basis of solvent :

Aqueous and Non-aqueous Solutions : Most of the substances are soluble in water. That is why water is sometimes called a 'Universal solvent'. However, all substances do not dissolve in water. Therefore, other solvents such as ether, benzene, alcohol, carbon disulphide, carbon tetrachloride, etc, are also used to prepare solutions. A solution in which water acts as the solvent is called an aqueous solution while the one in which any other liquid acts as the solvent is called a non-aqueous solution.

(II) On the basis of physical state of solvent :

These are :

1. Solid solutions. In these solution, solid acts as the solvent.
2. Liquid solutions. In these solutions, liquid acts as the solvent.
3. Gaseous solutions. In these solutions, gas acts as the solvent.

1. Solid solutions. In solid solutions, a solid is the solvent while solute can be either a solid, liquid or a gas.

2. Liquid solutions. In liquid solutions, a liquid is the solvent while the solute can be either a solid, liquid or a gas.

3. Gas solutions. In gas solutions, gas is the solvent while solute can be either a solid, liquid or a gas.

(III) On the basis of Solubility :

Saturated solution : A solution which contains the maximum amount of solute dissolved in a given quantity of the solvent at the give temperature and which cannot dissolve any more solute at that temperature is called a saturated solution.

Unsaturated solution : If a solution contains solute less than the maximum that it can dissolve at the given temperature, the solution is said to be unsaturated. In other words.

A solution that can dissolve more solute in it at the given temperature is called an unsaturated solution.

Note : A saturated solution, however becomes unsaturated either on heating or on dilution.

Supersaturated solution : A solution which temporarily contains more solute than the saturation level (i.e., the maximum solute) at a particular temperature is called the supersaturated solution.

SOLUBILITY : The maximum amount of the solute which can be dissolved in 100 g (0.1 kg) of the solvent to form a saturated solution at a given temperature.

Suppose "w" of a solute dissolved in "W" of a solvent to make a saturated solution at a fixed temperature and pressure. The solubility of the solute will be given by :

$$\frac{\text{Mass of the solute}}{\text{Mass of the solvent}} \times 100 = \frac{w}{W} \times 100$$

VARIOUS METHODS OF EXPRESSING THE CONCENTRATION OF A SOLUTION :

The concentration of a solution can be expressed in a number of ways. The important methods are :

(i) **Mass percentage or percent by mass** : It is defined as the amount of solute in grams present in 100 grams of the solution.

$$\text{Mass percentage of solute} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$= \frac{\text{Mass of solute}}{\text{Mass of solute} + \text{Mass of solvent}} \times 100$$

$$= \frac{\text{Mass of solute}}{\text{Volume of solution} \times \text{Density of solution}} \times 10$$

(ii) **Percent by volume** : It is defined as the volume of solute in mL, present in 100 mL solution.

$$\text{Percent of solute by volume} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

(iii) **Percent mass by volume** : It is defined as the mass of solute present in 100 mL of solution.

$$\text{Percent of solute mass by volume} = \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$

NOTE : V is not the volume of the solvent. V is actually the final volume after dissolving a definite quantity of solute in the solvent.

(b) **Effect of Temperature and Pressure on solubility of solids :**

The solubility of a solid substance in liquid generally increases with rise in temperature, but hardly changes with the change in pressure. The effect of temperature depends upon the heat energy changed which accompany the process.

(i) Effect of temperature on endothermic dissolution process : Most of the salts like sodium chloride, potassium chloride, sodium nitrate, ammonium chloride etc. dissolve in water with the absorption of heat. In all these salts the solubility increases with rise in temperature. This means that sodium chloride becomes more soluble in water upon heating.

(ii) Effect of temperature on exothermic dissolution process : Few salts like lithium carbonate (Li_2CO_3), Sodium carbonate monohydrate ($Na_2CO_3 . H_2O$), calcium oxide (CaO), Calcium acetate $(CH_3COO)_2Ca$, Calcium carbonate ($CaCO_3$), calcium sulphate ($CaSO_4$) etc. dissolve in water with the evolution of heat. This means that the process is of exothermic nature. In these salts the solubility in water decreases with rise in temperature.

(c) Effect of temperature on the solubility of Gases :

(i) The solubility of a gas in a liquid decreases with the rise in temperature.

(ii) The solubility of gases in a liquid increases on increasing the pressure and decreases on decreasing the pressure.

APPROXIMATE SOLUBILITY TERMS :

Solute Solubility (gram solute/100g H_2O Solubility term)	**Solubility term**
Less than 0.1	Insoluble
0.1– 1	Slightly soluble
1-10	Soluble
Greater than 10	Highly soluble

SUSPENSIONS : A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.

For example :

(i) Muddy water, in which particles of sand and clay are suspended in water.

(ii) Slaked lime uspension used for white-washing has particles of slaked lime suspended in water.

(iii) Paints in which the particles of dyes are suspended in turpentine oil.

Properties of a Suspension

1. A suspension is a heterogeneous mixture.
2. The solid particles of a suspension are so large in size (more than 10^{-5} cm or 10^{-7} m or 100 nm) that they are visible to the naked eye.
3. The particles of a suspension scatter a beam of light passing through it and makes its path visible.
4. The solid particles of a suspension settle down when it is allowed to stand undisturbed for sometime. In other words, a suspension is unstable.
5. The particles of a suspension cannot pass through a filter paper. Thus, when a suspension is filtered, the solid particles remain as a residue on the filter paper.
6. Suspensions are either opaque or translucent.

COLLOIDS : Solutions in which the size of the particles lies in between those of true solutions and suspensions are called colloidal solutions or simply colloids.

Due to relatively smaller size of particles, these mixtures appear to be homogeneous but actually they are heterogeneous. Since the colloidal solutions are heterogeneous in nature, therefore, to distinguish them from true solutions, the term "sol" is used in place of solution. The particles of the colloidal sol are called colloidal particles.

Dispersed Phase and Dispersion Medium : We have stated above that colloidal solutions are heterogeneous mixtures. This means that the constituents or components of a colloidal solution are not present in one single phase, but are actually present in two separate phases. These are called the dispersed phase and the dispersion medium. The solute-like component which has been dispersed or distributed throughout in a solvent-like medium is called the dispersed phase or the discontinuous phase while the solvent like medium in which the dispersed phase has been distributed or dispersed is called the dispersion medium or the continuous phase. The heterogeneous system thus obtained is called the colloidal system or the colloidal dispersion.

It may be noted here that the dispersed phase in a colloidal solution is comparable to solute particles in a true solution. Similarly, the dispersion medium is comparable to a solvent. However, there is one important difference between the true solution and the colloidal solution. In true solution, the solute and the solvent are present in one single phase but in colloidal solutions, they are present in two separate phases.

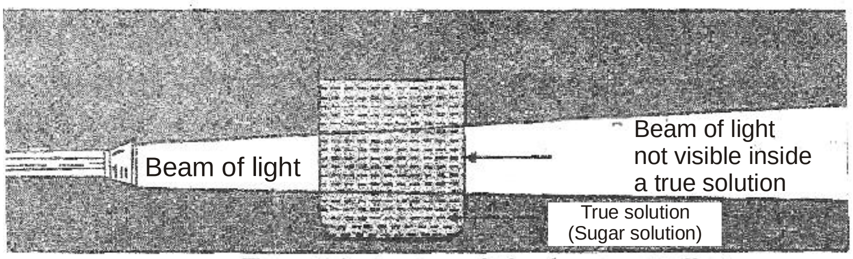
Disperesed Phase	Dispersion Medium	Type	Examples
Solid	Solid	Solid sol	Coloured glues, gem stones, pearls, some alloys
Solid	Liquid	Sol	Paints, starch, proteins, milk of magnesia
Liquid	Solid	Gel	Jellies, cheese, butter, boot polish
Liquid	Liquid	Emulsion	Milk, hair cream, emulsified oils, medicines
Solid	Gas	Solid Aerosol	Smoke, dust in air, smog
Liquid	Gas	Liquid Aerosol	Mist, Fog, clouds, insecticide sprays
Gas	Solid	Solid foam	Foam, pumice stone, ice-cream, rubber
Gas	Liquid	Foam	Soda water, whipped cream, froth etc.

Characteristic properties of colloids :

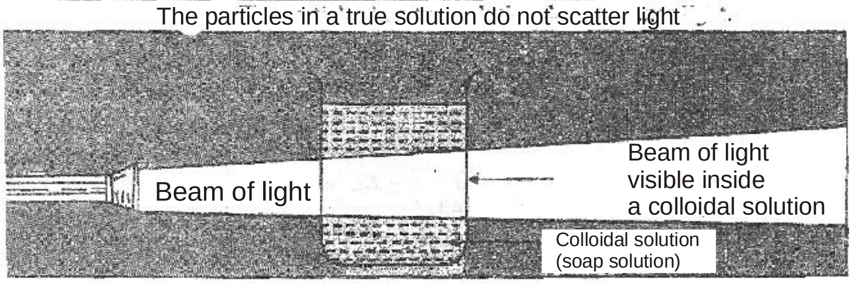
Brownian movement. When colloidal particles are placed under an ultramicroscope, they are seen to be continuously moving in a zig-zag path. Such a movement of pollen grains suspended in water was first observed by Robert Brown, an English scientist in 1827 and hence is called Brownian movement after his name. Thus, Brownian movement may be defined as continuous zig–zag movement of colloidal particles in a colloidal sol.

Tyndall effect : The colloidal particles are big enough to scatter light passing through it. As a result the path of the light becomes visible. This scattering of a beam of light by colloidal particles is called the Tyndall effect after the name of the scientist who discovered it.

When the beam of light from a torch is passed through a true solution of copper sulphate. Tyndall effect is not observed , i.e, the path of light is not visible. However, when the same light is passed through a mixture of water and milk. Tyndall effect is observed and the path of light becomes visible. The reason for this observation is that the particles of a true solution are so small that they do not scatter light and hence the path of light is not visible, i.e. Tyndall effect is not observed. In contrast, the particles of a colloidal solution are big enough to scatter light and hence path of light becomes visible, i.e. the Tyndall effect is observed. Thus, Tyndall effect can be used to distinguish between a true solution and a colloidal solution.



The particles in a true solution do not scatter light

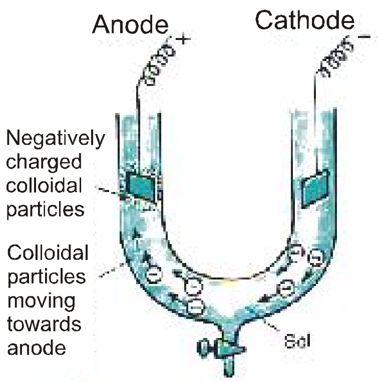


The particles in a colloidal solution (or colloid) scatter light

Colloidal particles carry charge. All the colloidal particles of a particular colloidal sol carry the same charge which may be either positive or negative while the dispersion medium has an equal and opposite charge. Since like charges repel each other, therefore, when a colloidal sol is left undistributed, the similarly charged colloidal particles do not come close and thus remain dispersed in the sol. In other words, the particles of the colloid do not settle down unlike the particles of a suspension and hence the colloidal sols are quite stable.

The nature of charge whether positive or negative on any colloidal sol can be determined by dipping two electrodes and connecting them to a battery. Under the influence of the electrical field, the particles of the colloid move towards the oppositely charged electrodes. On reaching the electrode, they lose their charge and combine together to form big particles which ultimately settle down. This phenomenon is called coagulation.

The movement of colloidal particles towards one of the electrodes under the influence of an electric field is called electrophoresis. Using this technique, the charge on colloidal particles can be determined. For example



Electrophoresis

(i) Positively charged sols. Haemoglobin and hydroxides of metals like iron, aluminum, chromium, calcium etc.

(ii) Negatively charged sols. Colloidal particles of metals like copper, silver, gold etc.; metal sulphides like arsenic sulphide, cadmium sulphide, etc.; gelatin, starch, clay, mud etc.

Coagulation : The process by which small colloidal particles lose their charge and combine together to form big sized particles which ultimately settle down is called coagulation.

The coagulation is generally carried out by addition of electrolytes like sodium chloride, barium chloride, alum, etc., When an electrolyte is added to a colloidal solution, the particles then start combining together to form particles of larger size which settle down. For example, bleeding from a cut can be immediately stopped by applying alum or ferric chloride. The reason being that the colloidal blood particles are negatively charged and hence get coagulated by positively charged ferric ions present in ferric chloride or positively charged aluminum ions present in alum. As a result of this coagulation, bleeding stops.

Similarly muddy water can be purified by adding alum. The reason being that muddy water contains negatively charged clay particles. These are neutralized by positively charged aluminum ions and settle down. The pure water can then be obtained by decantation.

Comparative study of : The main points of difference between true solution, colloidal solution and suspensions are given below :

Property	**True solution**	**Colloidal solution**	**Suspension**
1. Particle size	$< 10^{-7}$ cm (or 10^{-9} m or 1 nm)	Between $10^{-7} – 10^{-5}$ cm (10^{-9} to 10^{-7} m or 1 nm – 10 nm)	‘$> 10^{-5}$ cm (or 10^{-7} or 100 nm)
2. Appearance	Clear and transparent	Translucent	opaque
3. Nature	Homogeneous	Heterogeneous	Heterogeneous
4. Filtrability	Pass through ordinary filter paper as well as animal membranes (having pores smaller than filter paper)	Pass through ordinary filter paper but not through semipermeable membranes	Neither pass through filter paper nor through semi-permeable membranes
5. Setting of particles (stability)	Particles do not settle down on standing, i.e. true solutions are stable	Colloidal particles also do not settle on keeping i.e. colloids are also stable. However, they can be made to settle by centrifugation	Particles of suspension settle down on standing i.e., suspensions are unstable
6. Visibility	Solute particles are not visible even under a microscope	Particles themselves are invisible but their presence can be detected under an ultra microscope	Particles are generally visible to the naked eye.
7. Tyndall effect	Does not scatter light and hence does not show Tyndall effect	Shows Tyndall effect due to scattering of light	Shows Tyndall effect

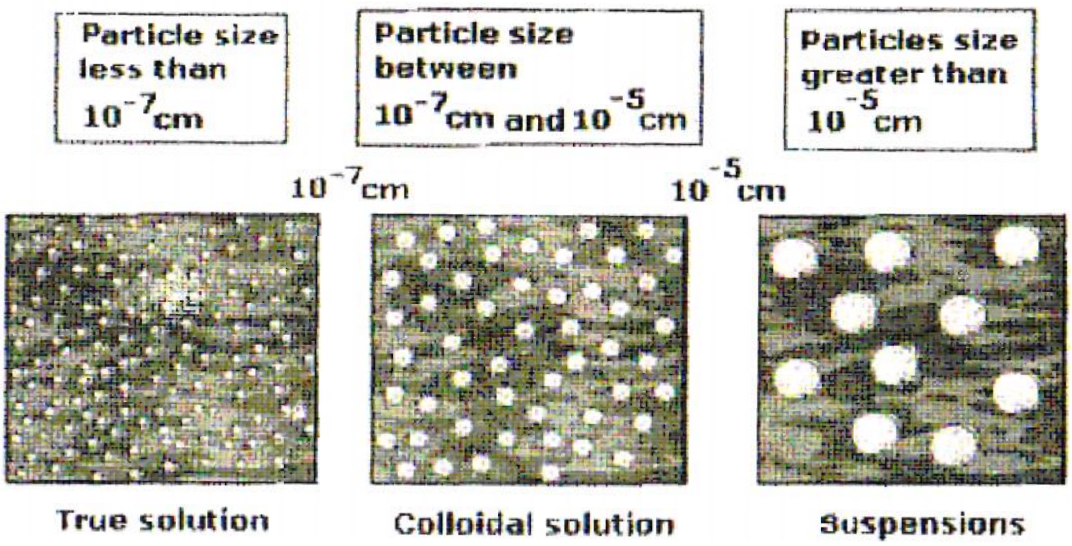


DIAGRAM SHOWING DIFFERENCE IN PARTICLE SIZE

SEPERATION TECHNIQUES :

(i) Sedimentation and decantation :

Sedimentation is the process by which insoluble heavy particles in a liquid, are allowed to settle down. This is a simple process that most people employ at home. This setting down of the particles in lower part of the container is called sedimentation.

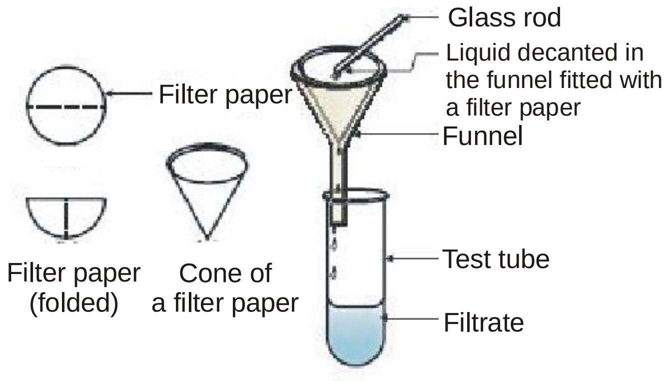
Decantation is the process by which, a clear liquid obtained after sedimentation, is transferred into another container, without disturbing the settled particles.

(ii) Filtration : Filtration is the process of separating the solid from liquids by passing through a filter.

For example :

Take a small quantity of the mixture of water and powdered chalk. Transfer it with the help of a glass rod to the filter paper cone, fixed to the funnel. You must take care to see that the level of water within the cone of the filter paper does not rise to more than three fourths of the filter paper.

The clear water that passes out through the filter paper (filtrate) is collected in a clean beaker.



FILTRATION

(iii) Evaporation : The process by which a soluble solid can be obtained from the solution by allowing the solvent to vaporize, is called evaporation. Many of you might be aware that for preparing salt, seawater is taken in large pan and water is allowed to evaporate, by the heat of the sun.

In the laboratory, salt can be obtained in a similar was, from an aqueous salt solution as under. Take the solution of salt and water in evaporating dish. Heat the dish carefully till the entire water in the dish gets evaporated. The white crust that remains as residue after evaporation, is salt .

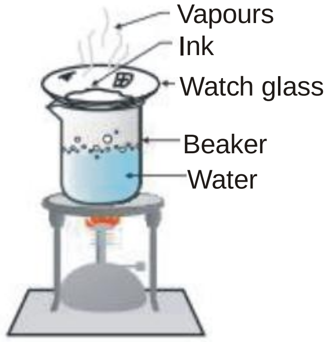
Similarly, sulphur can be separated from a sulphur and carbon disulphide. Keep the solution in a flat dish at room temperature, for some time. The carbon disulphide, being volatile, completely evaporates, leaving behind yellow crystals of sulphur.

HOW CAN WE OBTAIN COLOURED COMPONENT (Dye) from Blue or Black ink ?

Evaporation : Blue or Black ink is a homogeneous mixture of blue or black dye (solute) in water (solvent). The components of this mixture can be separated by the process of evaporation.

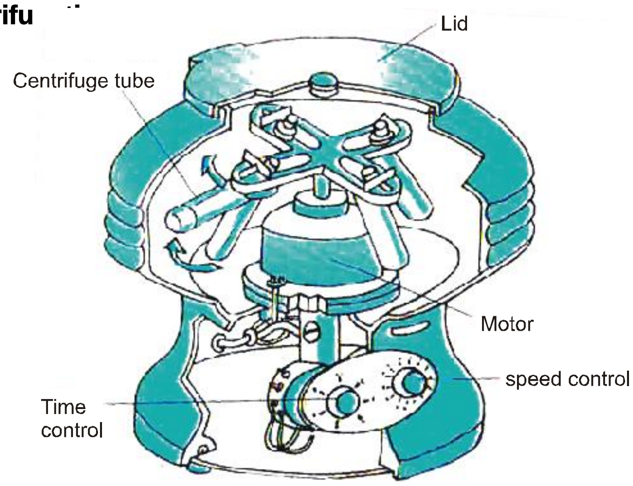
Put a few drops of blue (or black) ink on a watch glass and place it on a beaker half full of water . The water in the beaker is heated and the steam thus formed will, in turn, heat up the ink. The water present in the ink will evaporate and ultimately a blue (or black) residue will be left on the watch glass.

It may be noted here that direct heating of ink is avoided because the blue or the black dye may decompose on direct heating.



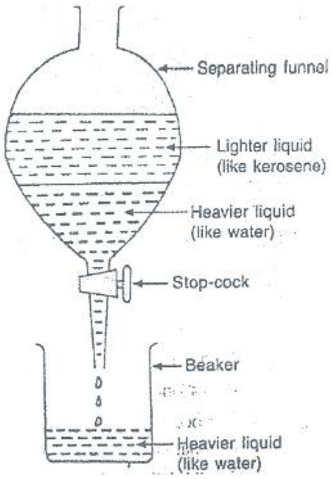
HOW CAN WE SEPARATE CREAM FROM MILK- Centrifu

Sometimes, the solid particles in a liquid mixture are very small and thus easily pass through a filter paper. Therefore, such particles cannot be separated by filtration technique. However, such mixtures can be easily separated by the technique of centrifugation. ***This technique is based upon the principle that when a mixtureis rotated as a high speed, the lighter particles stay on the surface of the liquid while the heavier particles are forced to the bottom of the liquid.***



Centrifuging machine

Seperation of two immiscible liquids : Kerosene oil and water do not mix. When these liquids are mixed, they form two separate layers. Such pairs of liquids which do not mix with each other are called immiscible liquids. These liquids form heterogeneous mixtures. The individual components of such heterogeneous mixtures can be separated by using a separating funnel. The technique is based upon the principle that when a mixture of two immiscible liquids is allowed to stand they separate out in two separate layers depending upon their densities.



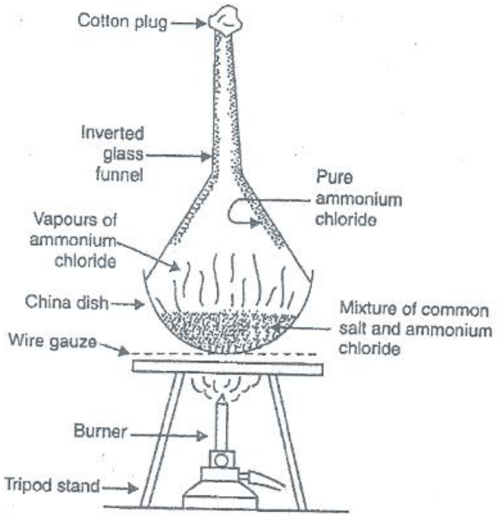
SEPERATION OF COMMON SALT AND AMMONIUM CHLORIDE :

Sublimation : On heating, ammonium chloride undergoes sublimation, i.e. it changes directly from solid to gaseous state without passing through the intermediate liquid state and vice-versa on cooling.

$$\text{SOLID} \underset{\text{Cool, sublimation}}{\overset{\text{Heat, sublimation}}{\rightleftharpoons}} \text{Vapours}$$

Some examples of substances which undergo sublimation are ammonium chloride, camphor, naphthalene, anthracene, benzoic acid, iodine etc.

Thus, the process of sublimation can be used to separate sublimable volatile component from the non volatile components of a mixture.



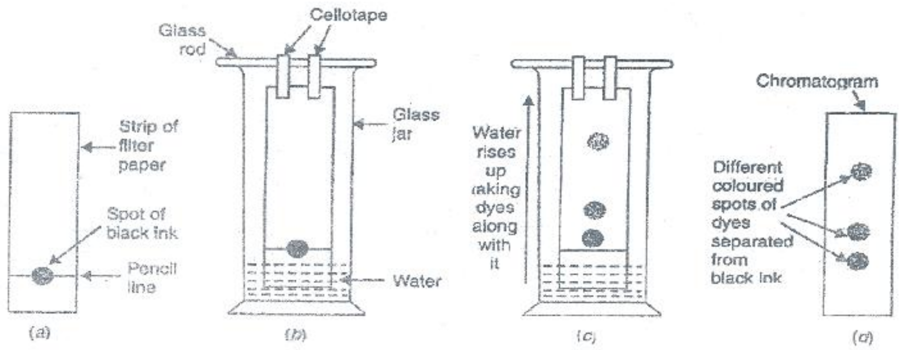
Separation of a mixture by sublimation. Here a mixture of common salt and ammonium chloride is being separated by sublimation

Chromatography : Chromatogaphy is the most modern and versatile method used for the separation, purification and testing the purity of inorganic and organic compounds. This method was first discovered by Tswett, a Russian botanist, in 1906. This technique was first used for separation of coloured substances (Plant pigments) and hence the name chromatography was given. **(Kroma in Greek means colour and graphy means writing.)**

Types of chromatography. With the advancement in technology, many types of chromatography such as column chromatography, thin layer chromatography (TLC), gas- liquid chromatography (GLC), high performance liquid chromatography (HPLC), etc. have been developed but the simplest form of chromatography is paper chromatography.

Usually the ink that we use is a solution of two or more different coloured dyes in water. With the help of paper chromatography, we can easily identify the different coloured dyes present in ink.

Theory, we know that two or more different substances may be soluble in the same solvent but their solubilities are usually different. Thus, when a solvent (say water) is allowed to pass over a mixture of such substances, the substance which is more soluble in the solvent moves faster and thus gets separated from the other substances in the mixture which move slowly. ***Thus, separation/identification of different components of a mixture by paper chromatography is based upon their different solubilities in the same solvent.***



Separation of the 'dyes' in black ink by paper chromatography.

Applications of chromatography. Chromatography is an important and powerful tool for chemical analysis. It is used :

(i) to separate coloured substances present in dyes and natural pigments.

(ii) to separate and identify the amino acids obtained by hydrolysis of proteins.

(iii) to detect and identify drugs present in the blood of criminals of forensic science.

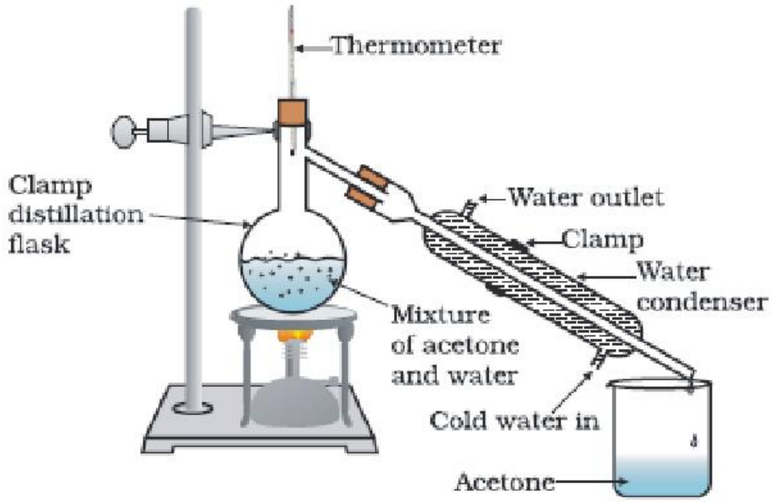
(iv) To separate small amounts of different products of a chemical reaction.

(v) to monitor the progress of a reaction.

Distillation : Distillation involves conversion of a liquid into vapours by heating followed by condensation of the vapours thus produced by cooling.

Distillation is used for the separation of components of a mixture containing two miscible liquids which boil without decomposition and have sufficient difference (30-50K) in their boiling points.

It is carried out in an apparatus as shown in fig.



Principle. The separation is based upon the principle that the boiling point (b.p.) of the more volatile (low boiling) liquid of the mixture, the vapours almost exclusively consist of the more volatile liquid. Likewise, at the b.p. of the less volatile (high boiling) liquid, vapours almost entirely consist of the less volatile liquid since the more volatile liquid has already distilled over. Thus, the separation of the liquid mixture into individual components can be achieved at their respective boiling points; the more volatile component distils over first while the less volatile component distils over afterwards.

Applications of distillation. The technique of distillation can be used to separate :

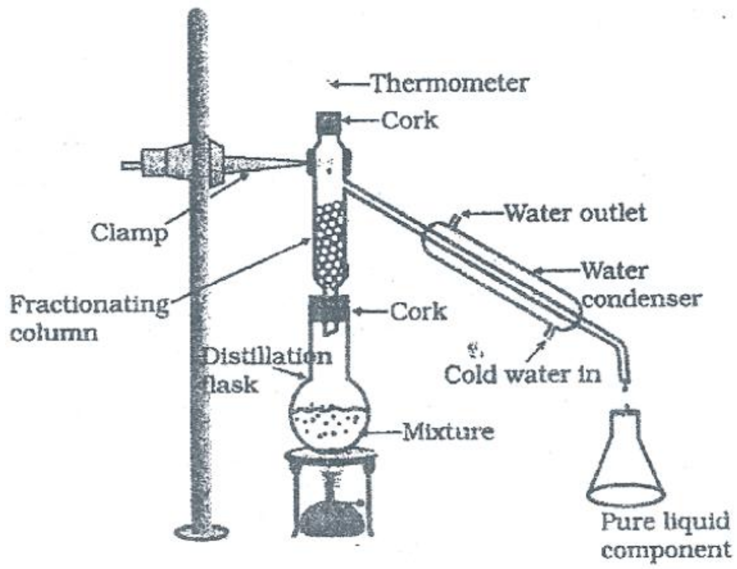
(i) a mixture of ether (b.p. 308 K) and toluene (b.p.384 K)

(ii) a mixture of hexane (b.p. 342 K) and toluene (b.p. 384 K)

(iii) a mixture of benzene (b.p.353 K) and aniline (b.p. 457 K) or nitrobenzene (b.p. 483 K).

Fractional distillation : ***If the boiling points of the two miscible liquids of the mixture are very close to one another, i.e. less than 25 K or so, the separation cannot be achieved by the simple distillation method as described above. This is due to the reason that at the b.p. of the more volatile liquid of the mixture there will be sufficient vapours of the less volatile liquid as well. As a result, both the liquids of the mixture will distil together and the separation cannot be achieved.***

The separation of such a liquid mixture into individual components can, however, be achieved by fractional distillation, which involves repeated distillations and condensations. Fractional distillation is carried out using a fractionating column. It usually consists of a long glass tube with a wide bore packed with glass beads or small stones or porcelain pieces. The actual purpose of the fractionating column is to increase the cooling surface area and to provide hurdles or obstructions to ascending vapours and descending liquid.



Fractional distillation

Application of fractional distillation. (i) The process of fractional distillation has been used to separate crude oil in petroleum industry into various useful fractions such as gasoline, kerosene oil, diesel oil, lubricating oil etc.

(ii) Fractional distillation of liquid air is used to separate gases of the air.

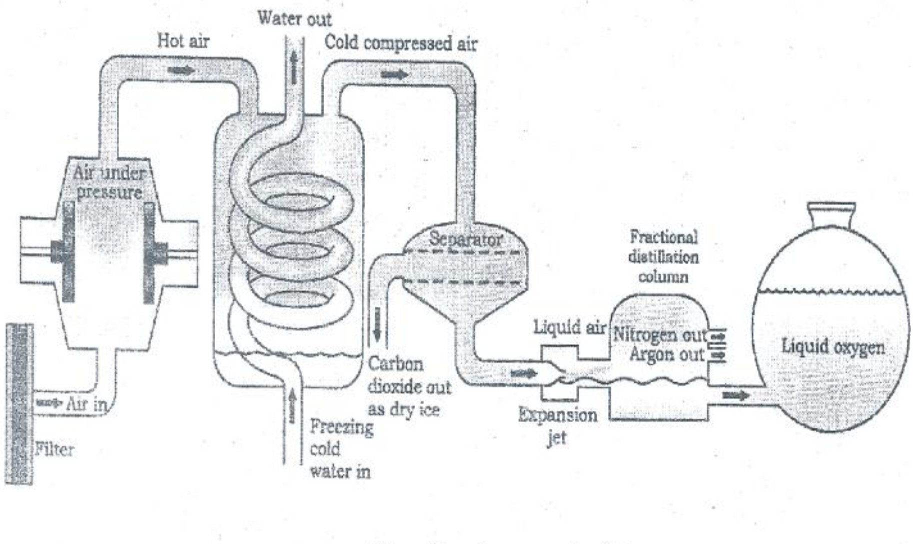
(iii) Fractional distillation has been used to separate a mixture of acetone (b.p. 329K) and methyl alcohol (b.p. 338K) from pyroligneous acid obtained by destructive distillation of wood.

Limitations of fractional distillation.

The components of constant boiling mixtures called azeotropes cannot be separated by fractional distillation. For example, rectified spirit consists of 95% alcohol (b.p. 78°C or 351 K) and 5% water (b.p. 100°C or 373 K). Its components cannot be separated by fractional distillation because they form a constant boiling mixture (azeotrope) even though their boiling points differ by 22°C.

SEPARATION OF GASES FROM AIR : Air is a homogeneous mixture of a number of gases such as nitrogen, oxygen, inert gases (argon is the major component along with small amounts of helium, neon, krypton and xenon), carbon dioxide etc. These can be separated from air by fractional distillation. For this purpose, air is first compressed by increasing the pressure and then cooled by decreasing the temperature. Under these conditions, carbon dioxide of the air gets converted into dry ice which is separated while the remaining gases of the air get condensed to form liquid air. The liquid air is then subjected to fractional distillation (or allowed to warm up slowly in a fractional distillation column) when gases gets separated according to their boiling points : the gas with lower boiling point gets distilled first.

Since the boiling point of nitrogen (78.1% of air by volume) is the lowest, i.e. –196°C, or 77 K, therefore, it gets distilled first of all, followed by argon (0.9% of air by volume) with a boiling point of –186 °C or 87K while oxygen (20 – 9% of air by volume) has the highest boiling point (–183°C or 90 K), therefore, it gets distilled last of all.



Separation of components of air

Crystallisation : Crystals are the purest form of a substance having definite geometrical shapes. The process by which an impure compound is converted into its crystals is known as crystallization.

This is one of the most commonly used techniques for purification of inorganic/organic solids. This is based upon the principle that when a crystal is formed, it tends to exclude the impurities which remain in the solution.

ADVANTAGE OF CRYSTALLISATION OVER EVAPORATION.

Crystallisation is a better technique than evaporation to purify a solid because of the following reasons:

(i) During evaporation, the solution is heated to dryness. During this heat treatment, some solids may decompose or some solids, like sugar, may get charged.

(ii) Both for evaporation or crystallization the solution of the impure solid is prepared in water or any other suitable solvent. this solution is then filtered to remove insoluble and suspended impurities. However, some soluble impurities may still be present even after filtration. Therefore, when such a solution is evaporated, the impurities get deposited along with the solid and thus contaminate the solid. In contrast, when the solution is allowed to stand for crystallization, crystals of the pure solid separate out leaving the impurities in the solution.

Application of crystallization.

(i) The salt that we get from sea water contains a number of impurities. To remove these impurities, the process of crystallization is used.

(ii) Crystallization can also be used to obtain pure alum (Phitkari), nitre (Potassium nitrate), etc. from impure samples.

SEPARATION BY A SUITABLE SOLVENT : In some cases, one constituent of a mixture is soluble in a particular liquid solvent whereas the other constituent is insoluble in it.

(b) Separation of a mixture of sugar and salt : Sugar is soluble in alcohol, but salt is insoluble in alcohol, so a mixture of sugar and salt can be separated by using alcohol as solvent.
Polar compounds (like sodium chloride) dissolve in polar solvents (like water), while non-polar compounds (like sugar) dissolve non- polar solvents (like alcohol).

(c) Separation of a mixture of sulphur and sand : Sulphur is insoluble in water and sand is also insoluble in water, so water cannot be used as a solvent to separate their mixture. Sulphur is, however, soluble in carbon disulphide, whereas sand is insoluble in carbon disulphide, therefore, a mixture of sulphur and sand can be separated by using carbon disulphide as solvent.

METHODS TO SEPARATE THE COMPONENTS OF A MIXTURE AT A GLANCE

METHOD	PRINCIPLE	APPLICATION
1. Evaporation	This method separates a volatile component (solvent) from its non-volatile solute	Separation of dye from water
2. Centrifugation	This method separates on the basis of density of particles, denser particles are forced to the bottom and lighter particles stay at the top when spun rapidly	Separation of cream from milk
3. Sublimation	This method separates a sublimable volatile component from a non-sublimable impurity (sublimation is the process by which a compound changes directly from solid-gaseous state)	Separation of a mixture of salt and ammonium chloride
4.Chromatography	This method used for the separation of those solutes that dissolve in the same solvent. On the basis of degree of solubility in water	Separation of colours in a dye, pigments from natural colours
5. Distillation	This method separates a mixture of two miscible liquids that boil without decomposition and have sufficient difference in their boiling points	Separation of different fractions from petroleum products
6. Fractional distillation	This method separates a mixture of two or more miscible liquids for which the difference in boiling points is less than 25 K	Separation of different gases from air Steps involved in the process AIR $\downarrow$ LIQUID AIR Allowed to warm-up slowly in fractional distillation column $\downarrow$ Gases separate at different heights depending upon their boiling points.
7.Crystallisation	This method separates a pure solid in the form of its crystals from a solution	Purification of salt from sea water, separation of crystals of alum from impure samples.

SOME SOLVED ILLUSTRATIONS

1. A Solution contains 40 g of common salt in 320 g of water. Calculate the concentration in terms of (i) mass by mass percentage of the solution (ii) mass by mass percentage of the solvent.

SOL. Mass of common salt (solute) = 40 g

Mass of water (Solvent) = 320 g

$\therefore$ Mass of the solution = Mass of the solute + Mass of the solvent

= 40 + 320 = 360 g

Thus (i) mass by mass percentage of the solution

$$= \frac{\text{Mass of the solute}}{\text{Mass of solution}} \times 10 = \frac{40}{360} \times 100 = 11.1\%$$

(ii) Mass by mass percentage of solvent

$$= \frac{\text{Mass of the solute}}{\text{Mass of solvent}} \times 100 = \frac{40}{320} \times 100 = 12.5\%$$

2. Calculate the mass of glucose and mass of water required to make 250 g of 25% solution of glucose.

SOL. Mass by mass percentage of solution = $\frac{\text{Mass of the solute}}{\text{Mass of solution}} \times 100$

Putting the values of the terms in the above relation, we have,

$$25 = \frac{\text{Mass of glucose}}{250\text{ g}} \times 100 \text{ or Mass of glucose} = \frac{25 \times 250\text{g}}{100} = 62.\ 5\text{ g.}$$

$\therefore$ mass of water = mass of solution – Mass of solute.

= 250 – 62.5 = 187. 5 g.

3. A solution contains 5 mL of alcohol in 70 mL of water. Calculate the volume by volume percentage of the solution.

SOL. Volume of alcohol (solute) = 5 mL

Volume of water (solvent) = 70 mL

$\therefore$ Volume of the solution= Volume of alcohol + Volume of water

= 5 + 70 = 75 mL

Thus, volume by volume percentage of solution = $\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$

$$= \frac{5}{75} \times 100 = 6.66\%$$

4. 2.5g of a solute are dissolved in 25 g of water to form a saturated solution at 298 K. Find out the solubility of the solute at this temperature.

SOL. Mass of the solute = 2.5 g

Mass of the solvent = 25 g

$$\therefore \text{ Solubility of the solute} = \frac{\text{Mass of the solute}}{\text{Mass of the solvent}} \times 100 = \frac{2.5}{25} \times 100 = 10\text{ g.}$$

5. Identify the constituent elements of the following compounds :

(i) Baking soda (ii) Ammonium Chloride

(iii) zinc sulphate (iv) Calcium nitrate

(v) silver chloride (vi) Ammonia

SOL.

S.No	Compound	Formula	Constituent elements
1	Baking soda	$NaHCO_3$	Sodium, Hydrogen, Carbon, Oxygen
2	Ammonium chloride	NH_4Cl	Nitrogen, Hydrogen, Chlorine
3	Zinc sulphate	$ZnSO_4$	Zinc, Sulphur, Oxygen
4	Calcium nitrate	$Ca(NO_3)_2$	Calcium, Nitrogen, Oxygen
5	Silver Chloride	$AgCl$	Silver, Chloride
6	Ammonia	NH_3	Nitrogen, Hydrogen

6. A solution contains 50 mL of alcohol mixed with 150 mL of water. Calculate concentration of this solution.

SOL. This solution contains a liquid solute (alcohol) mixed with a liquid solvent (water), so we have to calculate the concentration of this solution in terms of volume percentage of solute (alcohol). Now, we know that :

Concentration of solution : $\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$

Here, Volume of solute (alcohol) = 50 mL

And volume of solvent (water) = 150 mL

So, Volume of solution = Volume of solute + Volume of solvent

= 50 + 150 = 200 ml

Now, putting these values of 'Volume of solute' and 'Volume of solution' in the above formula we get:

Concentration of solution = $\frac{50}{200} \times 100 = \frac{50}{2}$ = 25 percent (by volume)

Thus, the concentration of this alcohol solution is 25 percent or that it is a 25%.

7. A solution contains 30 g of sugar dissolved in 370 g of water. Calculate the concentration of this solution by mass percentage method.

SOL. Concentration of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

Mass of solute (sugar in this case) = 30 g

Mass of solvent (water) = 370 g

$\therefore$ Mass of solution = (30 + 370) = 400 g

So, concentration of solution = $\frac{30}{400} \times 100$

Thus, the concentration of this sugar solution = 7.5%

8. If 2 ml of acetone are present in 45 ml of its aqueous solution, calculate the concentration of this solution.

SOL. This solution contains a liquid solute (acetone) mixed with a liquid solvent water (because it is an aqueous solution), so

Concentration of solution = $\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$

Volume of solute = 2ml

Volume of solute + Volume of solvent = Volume of solution = 45 ml

So concentration of solution = $\frac{2}{45} \times 100 = 4.4\%$

Thus, the concentration of this acetone solution is 4.4%

9. Classify the following as chemical or physical changes :

(i) Cutting of trees, (ii) Melting of butter in a pan,

(iii) rusting of almirah (iv) boiling of water to form steam

(v) passing of electric current through water and the water breaking down into hydrogen and oxygen gases

(vi) dissolving common salt in water

(vii) making a fruit salad with raw fruits, and

(viii) burning of paper and wood

SOL. (i) Cutting of trees is a chemical change since all chemical reactions stop and we cannot get back the original tree from the wooden pieces.

(ii) Melting of butter in a pan is a physical change since there is no change in the chemical composition of butter, only the physical state from solid to liquid

(iii) Rusting of almirah is a chemical change since during rusting, a new chemical compound called hydrated iron oxide (rust) is formed

(iv) Boiling of water to form steam is a physical change because during this change only change of state occurs from liquid water to steam (gaseous) without any change in its chemical composition.

(v) Passing of electric energy through water to form hydrogen and oxygen is a chemical change since the properties of hydrogen (combustible gas) and oxygen (supporter of combustion) are altogether different from those of water which is neither combustible nor a supporter of combustion but it actually extinguishes fire.

(vi) Dissolution of common salt in water is a physical change since sugar can be easily recovered by evaporation water.

(vii) Making a fruit salad with raw fruits is a physical change since there is no change in the chemical properties of the fruits but only the physical appearance has changed.

(viii) Burning of paper and wood is a chemical change since carbon dioxide, water vapours, smoke and ash which are the products of combustion cannot be converted back into paper or wood by any physical method.

10. Which separation techniques will you apply for the separation of the following ?

(i) Sodium chloride from its solution in water. (b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride. (c) Small pieces of metal in the engine oil of a car. (d) Different pigments from an extract of flower petals. (e) Butter from curd, (f) oil from water, (g) tea leaves from tea (h) Iron pins from sand (i) wheat grains from husk (j) fine mud particles suspended in water.

SOL.

(a) Evaporation	(b) Sublimiation
(c) filteration	(d) chromatography
(e) centrifugation	(f) separating funnel
(g) filtration	(h) using a magnet
(i) blowing air or sieving	(j) using alum

11. How will you confirm that a colourless liquid given to you is pure water?

SOL. If the boiling point and freezing point of the given liquid comes out to be 100°C (or 373 K) or 0°C (273K) respectively under one atmosphere pressure, it confirms that the given liquid is pure water.

12. Paints often need to be stirred thoroughly before use. Why?

SOL. Paints are colloidal solutions. On keeping for longer periods, they tend to settle down. Therefore, to bring the settled particles in the colloidal state, paints are often stirred thoroughly before use.

13. A substance when heated in excess of air forms carbon dioxide as the only product. Is the substance an element or a compound?

SOL. A compound always contains at least two elements in a fixed ratio. If on heating in air, only carbon dioxide is produced, the substance must be an element, i.e. carbon.

14. State one instance where water undergoes a physical change and one in which it undergoes a chemical change.

SOL. **Physical change**. Freezing of water into ice or boiling of water to form steam.

Chemical Change . Electrolysis of water to form hydrogen and oxygen gas.

15. Is air a mixture or a compound? Give three reasons.

SOL. (i) The properties of a mixture are in between those of its constituents. The two major components of air are : oxygen (20.9% by volume) and nitrogen (78.1% by volume). In oxygen, any fuel burns brightly but in nitrogen it gets extinguished. In contrast, in air the fuel burns slowly.

(ii) The components of a mixture can be separated by simple physical methods. For example, the components of air can be separated by fractional distillation of liquid air.

(iii) The composition of a mixture is variable. The composition of air is also variable. It has more oxygen in the country side than in big cities.

16. Can physical and chemical changes occur together? Illustrate your answer.

SOL. In some cases, physical and chemical changes occur together. One such example is burning of candle. The solid wax present in the candle first changes into liquid state and then into the vapour state. Both these changes are physical changes. The wax, vapours then combine with oxygen of the air to form a mixture of carbon dioxide and water. This involves a chemical change. The unburnt wax vapours again change first to the liquid state and finally to the solid state. This interconversion of states is a physical change. Thus, burning of candle involves both physical and chemical changes.

17. Can an element be distinguished from a compound by examination of its physical properties only ? Explain.

SOL. No, both compounds and elements have definite and unchanging properties. A compound can be chemically decomposed, however, but an element cannot.

18. Why is solution not heated to dryness to get crystals?

SOL. Heating the solution to dryness will not remove the soluble impurities and crystals of very poor quality are obtained.

19. In the process of attempting to characterize a substance, a chemist makes the following observations : The substance is a silvery white, lustrous metal, It melts at 649°C and boils at 1105°C. Its density at 20°C is 1.738 g/cm^3. The substance burns in air, producing an intense white light. It reacts with chlorine to give a brittle white solid. The substance can be pounded into thin sheets or drawn into wires. It is a good conductor of electricity. Which of these characteristics are physically properties, and which are chemical properties?

SOL. Physical properties ; Silvery white; lustrous' melting point =649°C; boiling point =1105°, density at 20°C = 1738 g.ml; pounded into sheets; drawn into wires' good conductor. Chemical properties; burns in air; reacts with Cl_2.

20. A beaker contains a clear, colourless liquid. If it is water, how could you determine whether it contained dissolved table salt? Do not taste it!

SOL. First heat the liquid to 100°C to evaporate the water. If there is a residue, measure the physical properties of the residue, such as colour, density and melting point. If the properties match those of NaCl, the water contained dissolved table salt. If the properties don't match, the residue is a different dissolved solid. If there is no residue, no dissolved solid is present.

21. Here are some of the properties of potassium metal. It has a lustrous silvery appearance. It melts at 336.8 K. It reacts with chlorine gas to give a compound whose formula is KCl. Its density is 0.862 g/mL. It is soft enough to cut with a knife. When added to water, it often bursts into flame. Which of these properties are physical properties, and which are chemical properties.

SOL. **Physical properties** : appearance, melting, point, softness, density

Chemical properties: reaction with chlorine and reaction with water.

22. If 110 g of salt is present in 550 g of solution, calculate the concentration of solution.

SOL. Here, mass of solute (Salt) = 110 g and mass of solution = 550 g

Now, we know that

Concentration of solution = $\frac{\text{Mass of solute}}{\text{mass of solution}} \times 100$

$= \frac{100}{550} \times 100 = \frac{1000}{5} = 20$ percent (or 20%)

Thus, the concentration of this salt solution is 20percent (or it is a 20% salt solution).

23. A solid white substance A is heated strongly in the absence of air. It decomposes to form a new white substance B and a gas C. The gas has exactly the same properties as the product obtained when carbon is burned in an excess of oxygen. Based on these observations, can we determine whether solids A and B and the gas C are elements or compounds? Explain your conclusions for each substance.

SOL. C is a compound; it contains carbon and oxygen. A is a compound, it contains at least carbon and oxygen. B is not defined by the data given; it is probably a compound because few elements exist as white solids.

24. A solution contains 30 g of sugar dissolved in 370 g of water. Calculate the concentration of this solution ?

SOL. This solution contains a solid solute (sugar) dissolved in a liquid solvent (water), so we have to calculate the concentration of this solution in terms of the mass percentage of solute(sugar). We know that

Concentration of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

Here, mass of solute (sugar) = 30 g

and mass of solvent (water) = 370 g

So, mass of solution = Mass of solute + Mass of solvent

= 30 + 370 = 400 g

Now, putting the values of 'mass of solute' and 'mass of solution' in the above formula,

we get :

Concentration of solution = $\frac{30}{400} \times 100 = \frac{30}{4} = 7.5\%$

25. A solution contains 50 mL of alcohol mixed with 150 mL of water. Calculate the concentration of this solution.

SOL. This solution contains a liquid solute (alcohol) mixed with a liquid solvent (water), so we have to calculate the concentration of this solution in terms of volume percentage of solute (alcohol). Now, we know that:

Concentration of solution = $\frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$

Here, volume of solute (alcohol) = 50 ml

and volume of solvent (water) = 150 ml

So, volume of solution = Volume of solute + Volume of solvent

= 50 + 150 = 20 ml

Now putting these values of 'volume of solute' and 'volume of solution' in the above formulae we get

Concentration of solution = $\frac{50}{200} \times 100 = \frac{50}{2} = 25\%$

26. Calculate the masses of cane sugar and water required to prepare 250 g of 25% cane sugar solution.

SOL. Mass percentage of sugar = 25

We know that

Mass percentage = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

So 25 = $\frac{\text{Mass of cane sugar}}{250} \times 100$

or Mass of cane sugar = $\frac{25 \times 250}{100}$ = 62.5 g.

Mass of water = (250 – 62.5) = 187.5 g.

27. When 400 g of 20% solution by mass was cooled 50 g of solute precipitated. Find the percent concentration of remaining solution

SOL. This solution contains solid solute dissolved in liquid solvent.

Hence concentration of solution will be in terms of mass percentage of solute.

Concentraton of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

$\frac{20}{100} = \frac{\text{Mass of solute}}{400\,\text{g}}$

Hence mass of solute = 80 g

Hence mass of solvent = 400 – 80 = 320 g

50 g of solute precipitated.

$\therefore$ Remaining solute = Initial solute – solute precipitated

= 80 g – 50 g = 30g

Mass of solution = mass of solute + mass of solvent

= 30 g + 320 g = 350 g

Hence concentration of final solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100 = \frac{30\text{ g}}{350\text{ g}} \times 100$

concentration of final solution = 8.57%

28. How much mass of sugar should be added to make 200 g of 25% solution by mass into 40% solution by mass.

SOL. This solution contains solid solute (sugar) dissolved in liquid solvent. Hence concentration will be in terms of mass percent of solute

Concentration of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

$\frac{25}{100} = \frac{\text{Mass of solute}}{200\text{ g}}$ $\therefore$ Mass of solute = 50 g

Hence mass of solvent = 200 – 50 = 150 g

Now, suppose we add x gm sugar

Total mass of solute = 50 + x

Total mass of solution = 200 + x

We want

Concentration of final solution to be 40%

concentration of final solution = $\frac{\text{Final mass of solute}}{\text{Final mass of solution}} \times 100$

$\frac{40}{100} = \frac{50+x}{200+x}$

40(2000 + x) = 100(50 + x)

8000 + 40 x = 5000 + 100x

60x = 3000

x = 50 g

Hence sugar to be added is 50 g.

29. A 300 ml solution contains 30 g of salt dissolved in water. Find

(a) concentration of solution (mass by volume) (b) concentration of solution (mass by mass)

Assume density of solution = 1 g/mL

(c) You want to make the concentration of solution (mass by volume) equal to 6%

How much water should be added ?

SOL. (a) Mass of solute = 30 g

volume of solution = 300 mL

Concentration of solution (Mass by volume) = $\frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100 = \frac{30\,\text{g}}{300\text{ mL}} \times 100$ = 10%

(b) Densityof solution = $\frac{\text{Mass of solution}}{\text{Volume of solution}}$ 7

$\frac{1\,\text{g}}{\text{mL}} = \frac{\text{Mass of solution}}{300\text{ mL}}$

Hence, mass of solution = 300 g

mass of solute = 30 g $\rightarrow$ given

Concentration of solution = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100 = \frac{30\text{ g}}{300\text{ g}} \times 100$ = 10%

(c) Concentration of final solution (mass by volume) = 6% $\rightarrow$ given

Mass of solute = 30 g $\rightarrow$ given

Concentration of solution (Mass by volume) = $\frac{\text{Mass of solute}}{\text{volume of solution}} \times 100$

$\frac{6}{100} = \frac{30\text{ g}}{\text{volume of solution}}$

$\therefore$ Volume of solution = 500 mL

Initial volume of solution = 300 mL

Hence water to be added = 500 mL – 300 mL = 200 mL

Therefore 200 mL of water should be added.

30. Give an example of each :

(1) Solid-solid Homogenous mixture (2) Solid-solid Heterogenous mixture

(3) Solid - liquid Homogenous mixture (4) Solid - liquid Heterogenous mixture

(5) Liquid - liquid Homogenous mixture (6) Liquid - liquid heterogenous mixture

SOL. (1) Brass, Steel (2) Amalgamated zinc

(3) salt solution, sugar solution (4) Muddy water, blood

(5) Gasoline, Diesel (6) Milk

QUESTION BANK

A. Fill in the blanks

1. A homogeneous mixture of two or more chemically non-reacting substance is called……………………………..

2. A suspension is a ………………………..mixture.

3. Starch solution is a ………………whereas muddy water is a ……………………..

4. A suspension can be separated by……………………………..

5. ……………………is a substance which cannot be split up into two or more simpler substances.

6. A colloid appears to be a ………………………mixture but is actually a ………..mixture.

7. …………….is the only metal which is a liquid at room temperature.

8. ………………is the lightest element.

B. (i) The components of liquid air may be separated by …………………..
(ii) Steel is a ……………mixture of iron and carbon.
(iii) Iodised salt is a …………….mixture of sodium chloride and potassium iodide.
(iv) The reaction between an aqueous solution of sodium chloride and silver nitrate is a ………… change.
(v) Soap solution is a colloidal solution in which the dispersed phase is a ………while the dispersion medium is a …………………….

C. (i) Pure substances can mix in either of two ways. If the mixture is composed of more than one phase, it is ………………….If there are two liquid phases, the liquid on top has the …………………density. If they mix in such a way that only one phase is formed, the mixture is…………………… Mixtures that result in one liquid phase are usually referred to as …………………These mixtures are distinguished from pure substances by their variable properties such as……………………..and ………………points and density. Density of liquids is measured with a device called a ………………..Mixtures of metals that result in one solid phase are referred to as ………………The percent composition of these mixtures relates the mass of a …………….to the total mass.
(ii) A solution is a …………………mixture of two more substances. The major component of a solution is called the ……….and the minor, the …………………
Colloids are ……………mixtures in which the particle size is too……………to the seen with the naked eye, but is big enough to scatter light.
Properties of a …………………are different from its constituent elements, whereas a…………shows the properties of its constituting elements.

D. State True/False.

1. A mixture shows the properties of all its constituents.
2. Metals are neither malleable nor ductile.
3. A compound is separated into its individual components by the method of chemical separation.
4. A heterogeneous mixture has a uniform composition throughout its mass.
5. Suspension are highly unstable.
6. A suspension is a heterogeneous mixture.

7. A colloidal solution is heterogeneous

8. Water is homogeneous substance.

9. Element is always metal.

10. Substance is always homogeneous.

11. In compound element combine in definite proportion.

12. Iodine can be purified by sublimation.

13. The components of a solution can be separated by filtration.

14. Melting of ice is a chemical change.

15. Mixtures are always combinations of the same compounds that are at different states.

16. We can separate all mixtures by filtration.

17. All mixtures are defined as “heterogeneous’.

18. Only specific compound can be combined to form mixtures.

19. All solutions are mixtures, but not all mixtures are solutions.

MATCH THE COLUMN

1.

COLUMN-I	**COLUMN-II**
(A) Sugar	(P) Carbon, hydrogen
(B) Lime water	(Q) Carbon, hydrogen, oxygen
(C) Kerosene	(R) Calcium, carbon, oxygen
(D) Marble	(S) Calcium, Hydrogen, Oxygen

2.

COLUMN-I	**COLUMN-II**
(A) Tyndall effect	(P) NaCl in water
(B) True solution	(Q) Calcium carbonate
(C) Heterogeneous mixture	(R) Starch in water
(D) Compound	(S) Sand in water

(More than one may be correct in this only)

3.

COLUMN-I	**COLUMN-II**
(A) Solution	(P) Shows the property of its constituents
(B) Suspension	(Q) Can be filtered by filter paper
(C) Colloid	(R) can’t be filtered by filter paper
(D) Mixture	(S) solute and solvent are mixed together

4.

COLUMN-I	**COLUMN-II**
(A) Bromine	(P) Metalloid
(B) Milk	(Q) Metal
(C) Germanium	(R) Compound
(D) Calcium	(S) Non-metal
(E) Common salt	(T) Colloidal solution

5.

COLUMN-I	**COLUMN-II**
(A) Solid -solid mix	(P) True solution
(B) Liquid solid mix	(Q) Aerated drinks
(C) Gas-solid	(R) Alloys
(D) Liquid-liquid	(S) Gaseous minerals
(D) Gas-liquid	(T) Hydrated salts

6.

COLUMN-I	COLUMN-II
(A) Gun powder	(P) Mixture
(B) Air	(Q) Compound
(C) Water	(R) Metalloid
(D) Diamond	(S) Element

7. Column-II gives method to separate phases mention in column-I match them correctly :

COLUMN-I	COLUMN-II
(A) Miscible liquid	(P) distillation
(B) Immiscible liquids	(Q) crystallization
(C) pure copper Sulphate from an impure sample	(R) sublimation
(D) salt and ammonium chloride	(S) funnel

Assertion & Reason

Instructions : In the following questions as Assertion (A) is given followed by a Reason (R). Mark your responses from the following options.

(A) Both assertion and Reason are true and reason is the correct explanation of 'Assertion.'

(B) Both assertion and Reason are true and Reason is not the correct explanation of 'Assertion.'

(C) Assertion is true but Reason is false.

(D) Assertion is false but reason is true.

1. Assertion : Fractional distillation is the process of separation of two or more miscible liquids.
Reason : Two or more miscible liquids boil at their respective temperature.

2. Assertion : A colloid is a kind of solution in which size of solute particles is intermediate between true solution and suspensions.
Reason : Colloids scatter a beam of light passing through them.

3. Assertion : True solution do not exhibit Tyndall effect.
Reason : In true solution size of solute particles is small.

4. Assertion : A suspension can be separated by filtration.
Reason : Suspension are formed by substance which do not dissolve in water.

5. Assertion : Colloid appears to be homogeneous but actually it is heterogeneous.
Reason : Colloids are true solutions.

6. Assertion : Refining of petroleum involves fractional distillation.
Reason : Fractional distillation involves repeated distillation

7. Assertion : Colloidal solutions are stable but the colloidal particles do not settle down.
Reason : Brownian movement counters the force of gravity acting on colloidal particles

EXERCISE - I

1. A solution is defined as a:
(A) Homogeneous mixture of two or more substances
(B) Heterogeneous mixture of two or more substances
(C) Homogeneous mixture of liquid and solid components only
(D) Homogeneous mixture consisting water as one of the components.

2. Which of the following is an element :
(A) Calcium (B) Water (C) Sugar (D) Ammonium Chloride

3. Select the metal among the following
(A) Zinc (B) Bromine (C) Carbon dioxide (D) Soil

4. What are constituent element of wax ?
(A) Carbon and Oxygen (B) Carbon and Nitrogen
(C) Carbon and Hydrogen (D) None of these

5. The process used in milk divides to separate cream from milk.
(A) Distillation (B) Centrifugation
(C) Chromatography (D) None of these

6. Example of Gel is
(A) Gelatine (B) Sponge (C) Mist (D) Ink

7. The size of solute particles in suspension is
(A) Smaller than colloidal particles (B) bigger than colloidal particles
(C) Same of true solutions (D) None of these

8. The non-metal which is liquid at room temperature?
(A) Mercury (B) Helium (C) Gallium (D) Bromine

9. Which of the following is the property of non-metals?
(A) Brittleness (B) Lustrous (C) Hardness (D) Sonorous

10. Fog is an example of
(A) foam (B) emulsion (C) aerosol (D) gel

11. Which of the following is a pure substance ?
(A) Milk (B) Sea water (C) Soil (D) 24 carat gold

12. Which of the following is a heterogeneous mixture?
(A) Dust free air (B) Brass (C) Iodised salt (D) Steel

13. The size of colloidal particles lies in the range
(A) $10^{-8} - 10^{-7}$ cm (B) $10^{-7} - 10^{-5}$ cm (C) $10^{-5} - 10^{-3}$ cm (D) $10^{-7} - 10^{-6}$ cm

14. Which of the following is not a compound?
(A) Marble (B) Washing soda (C) Quick lime (D) Brass

15. Scattering of light occurs when a beam of light is passed though
(A) blood (B) water
(C) copper sulphate solution (D) Brine

16. Which of the following is not a colloid ?

(A) smoke (B) haemoglobin (C) latex (D) air

17. The element which is a liquid above 30°C is

(A) Gallium (B) Lithium (C) Sodium (D) Magnesium

18. Which of the following is not a physical change ?

(A) dehydrating milk to get milk powder (B) Sublimation of iodine

(C) Dissolving sugar in tea (D) burning of wax in a candle

19. Which of the following is not a chemical change ?

(A) rusting of iron (B) photosynthesis (C) dyeing a cloth (D) breaking a glass beaker

20. Filtration is used to separate

(A) one insoluble solid from another (B) an insoluble solid from a liquid

(C) two immiscible liquids (D) a solute from a solution

21. State which of the following is not likely to be an element?

(I) On heating gives off a gas and leaves a residue

(II) Burns in air to form carbon dioxide and water.

(III) Changes into solid at 273 K and to a gas at 373 K

(A) I and II (B) II and III (C) I and III (D) I, II, III

22. Which of the following processes involves fractional distillation ?

X. Separation of components of a liquid air.

Y. Separation of crude petroleum into useful fractions like gasoline, kerosene oil, diesel , etc.

Z. Separation of kerosene oil and water.

(A) X, Y, Z (B) X, Y (C) X, Z (D) Y, Z

23. The best method to separate the components of an ink is

(A) Chromatography (B) Evaporation (C) Sublimation (D) Filtration

24. Mixture of sand and sulphur may be best separated by-

(A) fractional crystallization from aqueous solution (B) Magnetic method

(C) Fractional distillation (D) Dissolving in CS_2 and filtering

25. Which of the following is a characteristic of both mixtures and compounds ?

(A) Their properties are the same as those of their components

(B) Energy is absorbed when they are made

(C) Their mass equals the sum of masses of their components

(D) They contain the components in a fixed proportion

26. Which of the following changes lead to the formation of compound ?

(A) Melting (B) Combustion (C) Filtration (D) Freezing

27. Which of the following is matter ?

(A) Sugar (B) Rocks (C) Water (D) All of these

28. A physical change

(A) can be reversed (B) can yield different compounds

(C) cannot be reversed (D) All of these

29. Explosion of atom bomb involves
(A) Physical change (B) Chemical change (C) Biological change (D) All of these

30. Which of the following is a physical change ?
(A) Rusting of iron (B) Sodium dissolved in water
(C) Magnesium wire is burnt (D) Iron is magnetized

31. Which of the following yields a chemical change ?
(A) Evaporation (B) Sublimation (C) Distillation (D) Oxidation

32. Which one is a homogeneous system
(A) concrete (B) Bread
(C) muddy water (D) A solution of sugar in water

33. Which is not a chemical change ?
(A) Burning of coke (B) Burning of LPG in kitchen
(C) Exposure of Na metal to atmosphere (D) Purification of water by ion exchange

34. How can you separate a mixture of acetone and water ?
(A) By distillation (B) By sublimation
(C) By evaporation (D) By crystallization

35. Evaporation of water is
(A) An exothermic change
(B) An endothermic change
(C) A process accompanied by chemical reaction
(D) A process where no heat change occurs

36. The difference in properties of a solution, a colloid and a suspension is due to
(A) different size of their solute particles (B) difference in their composition
(C) Their different boiling points (D) Their different melting points

37. A pressure cooker reduces cooking time for food because
(A) Heat is more evenly distributed in cooking space
(B) Boiling point of water involves in cooking is increased
(C) Higher pressure inside the cooker crushes food material
(D) Cooking involves chemical changes helped by rising in temperature

38. Which one is not a separation procedure?
(A) Evaporation (B) Sublimation (C) Chromatography (D) Dilution

39. Which of the following is a compound ?
(A) stainless steel (B) Bronze (C) graphite (D) Hydrogen sulphide

40. The process used to separate oil and water is
(A) Distillation (B) sublimation (C) Separating funnel (D) Chromatography

41. A mixture of common salt, sulphur, sand and iron filings is shaken with carbon disulphide and filtered through a filter paper. The filtrate is evaporated to dryness in a chine dish. What will be left in the dish after evaporation
(A) sand (B) Sulphur (C) Iron fillings (D) Common salt

42. Purity of solid substance can be checked by its characteristic :
(A) boiling point (B) melting point (C) solubility in water (D) solubility in alcohol.

43. The solubility of a substance is defined as the amount of solute in grams:
(A) present in 100 g of the solvent
(B) present in 100 g of the solution
(C) present in 100 ml of the solution
(D) present in 1 litre of the solution

44. A liquid and a solid together consisting a single phase is known as :
(A) Solution (B) Solute (C) Solvent (D) Emulsion

45. The zig-zag movement of dispersed phase particle in a colloidal system is known as :
(A) Transitional motion (B) Circular motion (C) Linear motion (D) Brownian motion

46. An emulsion is a colloidal system of :
(A) Solid dispersed in solid
(B) Liquid dispersed in liquid
(C) Gas dispersed in liquid
(D) Brownian motion

47. Milk is :
(A) Fat dispersed in water
(B) Fat dispersed in milk
(C) Fat dispersed in fat
(D) Water dispersed in milk

48. Scattering of light takes place in :
(A) Electrolytic solutions
(B) Colloidal solutions
(C) Electrodialysis
(D) Electroplating

49. Which of the following forms a colloidal solution in water ?
(A) Salt (B) Glucose (C) Starch (D) Barium nitrate

50. In colloidal state, particle size range from :
(A) 1 to 10 Å (B) 20 to 50 Å (C) 10 to 100 Å (D) 1 to 280 Å

51. Sol is :
(A) Solid dispersed in liquid
(B) Liquid dispersed in gas
(C) Gas dispersed in liquid
(D) Gas dispersed in solid

52. Liquid dispersed in gas is called :
(A) Aerosol (B) Solid sol (C) Sol (D) Solid foam

53. Which of the following statements is correct ?
(A) Compounds can be separated into constituents by physical processes
(B) The boiling points and melting points of compounds are not fixed
(C) The composition of compounds are not fixed
(D) The properties of compounds are entirely different from those of its constituents

54. Water is :
(A) A compound (B) A mixture (C) True solution (D) All of these

55. Milk of Magnesia is an example of :
(A) Emulsion (B) True solution (C) Colloid (D) Suspension

56. Solid foam is
(A) Solid dispersed in solid
(B) Liquid dispersed in solid
(C) Gas dispersed in solid
(D) Solid dispersed in liquid

57. Which of the following is not a compound ?
(A) Sugar (B) Common salt (C) Diamond (D) Plaster of paris

58. Which of the following is an example of a mixture ?
(A) Sugar (B) Brass (C) CO_2 (D) NO_2

59. Brass contains :
(A) Gold and copper (B) Copper and zinc (C) Zinc and silver (D) Copper and silver

60. Which of the following is not a chemical change
(A) Electrolysis of water
(B) Boiling of water
(C) Digestion of food
(D) Burning of magnesium ribbon in oxygen to form magnesium oxide

61. Which of the following statements is not true :
(A) True solutions are homogeneous in nature
(B) Suspensions are heterogeneous in nature
(C) Solute particles in a colloidal solution can be separated by filtration
(D) true solutions are transparent to light

62. Camphor can be purified by :
(A) Distillation (B) filtration (C) Sedimentation (D) Sublimation

63. Carbon burns in oxygen to form carbon dioxide. The properties of carbon dioxide are :
(A) Similar to oxygen
(B) Similar to carbon
(C) totally different from both carbon and oxygen
(D) Much similar to both carbon and oxygen

64. The process of cooling a hot, concentrated solution of a substance to obtain crystal is called :
(A) Fractional distillation (B) Distillation
(C) Crystallisation (D) Chromatography

65. A solution in which more quantity of solute can be dissolved without raising its temperature is called
(A) Unsaturated solution (B) Saturated solution
(C) Super saturated solution (D) Concentrate solution

66. A mixture of alcohol and water can be separated by :
(A) Separating funnel (B) Fractional distillation
(C) Distillation (D) Crystallisation

67. Which of the following statements are true for pure substances ?
(i) Pure substances contain only one kind of particles
(ii) Pure substance may be compound or mixtures
(iii) Pure substance have the same composition throughout
(iv) Pure substances may be elements or compound
(A) (i) and (ii) (B) (i) and (iii) (C) (iii) and (iv) (D) (ii) and (iii)

68. Rusting of an article made up of iron is called
(A) Corrosion and it is a physical as well as chemical change
(B) Dissolution and it is a physical change
(C) Corrosion and it is a chemical change
(D) Dissolution and it is a chemical change

69. A mixture of sulphur and carbon disulphide is
(A) Heterogeneous and shows Tyndall effect
(B) Homogeneous and shows Tyndall effect
(C) Heterogeneous and does not show Tyndall effect
(D) Homogeneous and does not show Tyndall effect

70. Tincture of iodine has antiseptic properties. This solution is made by dissolving
(A) Iodine in potassium iodide (B) Iodine in vaseline
(C) Iodine in water (D) Iodine in alcohol

71. Which of the following are homogeneous in nature ?

(i) Ice (ii) Wood (iii) Soil (iv) (Air)

(A) (i) and (iii) (B) (ii) and (iv) (C) (i) and (iv) (D) (iii) and (iv)

72. Which of the following are physical changes ?

(i) Melting of iron metal (ii) Rusting of iron

(iii) Bending of an iron rod (iv) Drawing a wire of iron metal

(A) (i), (ii) and (iii) (B) (i), (ii) and (iv) (C) (i), (iii) and (iv) (D) (ii), (iii) and (iv)

73. Which of the following are chemical changes ?

(i) Decaying of wood (ii) Burning of wood

(iii) Sawing of wood (iv) Hammering of a nail into a piece of wood

(A) (i) and (ii) (B) (ii) and (iii) (C) (iii) and (iv) (D) (i) and (iv)

74. Two substances, A and B were made to react to form a third substance, A_2B according to the following reaction $2A + B \rightarrow A_2B$

Which of the following statements concerning this reaction are incorrect ?

(i) The product A_2B shows the properties of substances A and B

(ii) The product will always have a fixed composition

(iii) The product so formed cannot be calssified as a compound

(iv) The product so formed is an element

(A) (i), (ii) and (iii) (B) (ii), (iii) and (iv) (C) (i), (iii) and (iv) (D) (ii), (iii) and (iv)

75. Which of the following is not a compoud ?

(A) Common salt (B) Water (C) Iron filings (D) Copper sulphate

76. A true solution is a

(A) Homogeneous mixture (B) Heterogeneous mixture

(C) Pure compound (D) Impure compound

77. Which of the following statements is true ?

(A) Homogeneous mixtures have non-uniform composition

(B) Homogeneous mixtures have uniform composition

(C) heterogeneous mixtures have uniform composition

(D) Sugar solution is heterogeneous mixture

78. Most element are

(A) Solids (B) Liquids (C) Gases (D) Mixture

79. Which is a homogeneous mixture ?

(A) It has a fixed composition (B) It has uniform composition

(C) It has non-uniform composition (D) It can not be broken down to simpler substances

80. Particles of which are visible by naked eyes

(A) Mixture (B) Colloidal solution (C) Suspension (D) None of these

81. $X + Y \rightarrow P$

Two chemical species X and Y combine together to form a product P which contain both X and Y. P cannot be broken into X and Y by chemical reaction. X and Y cannot be broken down into simpler substance by simple chemical reactions.

Which of the following concerning the species X, Y and P are correct ?

(i) P is a compound (ii) X and Y are compounds

(iii) X and Y are elements (iv) P has a fixed composition

(A) (i), (ii) and (iii) (B) (i), (ii) and (iv) (C) (ii), (iii) and (iv) (D) (i), (iii) and (iv)

EXERCISE-II

1. Colloid consists of dispersed phase and dispersion medium. Aerosol is one type of colloid. Aerosol is made up of which of the following combination ?

(I) Gas in liquid (II) Liquid in gas (III) Solid in gas

(A) II only (B) (I), (II) and (III) (C) (I) and (II) only (D) (II) and (III) only

2. Tyndall effect can be observed in a colloidal solution. Consider light scattering in the following :

(I) When sunlight passes through the canopy of a dense forest.

(II) When normal light passes through lead iodide solution.

(III) When monochromatic light passes through solution of $K_2SO_4(Al)_2SO_4 \cdot 24H_2O$.

Tyndall effect is observed in :

(A) (I), (II) and (III) (B) (I) only (C) (I) and (III) only (D) (III) only

3. Mixture of ethyl alcohol and water can be easily separated by using

(A) Separating funnel (B) Fractional distillation (C) Filter paper (D) None of the above

4. The property which is characteristic of an electrovalent compound is that

(A) It is easily vapourised (B) It has a high melting point

(C) It is a weak electrolyte (D) It often exists as a liquid

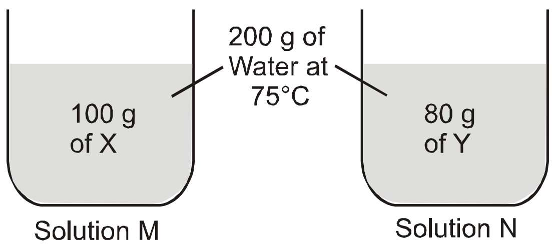
5. Cheese is a colloidal system of

(A) Gas in solid (B) Gas in liquid (C) Liquid in gas (D) Liquid in solid

6. The solubility of two substances, X and Y at 35°C and 75°C is given in the table.

Temperature (°C)	Maximum amount (g) that can dissolve in 100 g of water	
	Substance X	Substance Y
35	30	40
75	70	50

Two solutions, M and N are shown below :



If the temperature of solutions M and N is dropped to 35°C, then amount of X and Y crystallized out will be ____________ .

(A) 40 g, 30 g (B) 25 g, 80 g (C) 40 g, 0 g (D) 80 g, 55 g

ANSWER KEY

QUESTION BANK

FILL IN THE BLANKS-A

1.	Solution	**2.**	heterogenous	**3.**	colloid, suspension	**4.**	filltration
5.	element	**6.**	Homogenous, Heterogeneous			**7.**	Hg 8. H

FILL IN THE BLANKS-B

(i)	Fractional distillation	(ii)	homogeneous	(iii)	heterogeneous	(iv)	chemical
(v)	solid (soap), liquid (water)						

FILL IN THE BLANKS-C

1. Heterogeneous, lesser, homogeneous, solutions, melting, boiling, hydrometer, alloys, component.

2. Homogeneous, Solvent ,solute, **3.** Heterogeneous, small **4.** compound, mixture.

STATE TRUE/ FALSE.

1.	True	**2.**	False	**3.**	True	**4.**	False	**5.**	True.	**6.**	True	**7.**	True
8.	True	**9.**	False	**10.**	False	**11.**	True	**12.**	True	**13.**	False	**14.**	False
15.	False	**16.**	False	**17.**	False	**18.**	True	**19.**	True				

MATCH THE FOLLOWING

1. (A) –Q, (B) –S, (C) -P, (D) –R

2. (A) –R, (B) –P, (C) -S, (D) –Q

3. (A) –R,S, (B) –QS, (C) –R,S, (D) –P

4. (A) –S, (B) –T, (C) -P, (D) –Q, (E) -R

5. (A) –R, (B) –T, (C) -S, (D) –P, (E) -Q

6. (A) –P, (B) –P, (C) -Q, (D) –S

7. (A) –P, (B) –S, (C) -Q, (D) –R

ASSERTION & REASON

1.	A	**2.**	B	**3.**	A	**4.**	A	**5.**	C	**6.**	B	**7.**	A

EXERCISE - I

1.	A	**2.**	A	**3.**	A	**4.**	C	**5.**	B	**6.**	A	**7.**	B
8.	D	**9.**	A	**10.**	C	**11.**	D	**12.**	C	**13.**	B	**14.**	D
15.	A	**16.**	D	**17.**	A	**18.**	D	**19.**	D	**20.**	B	**21.**	A
22.	B	**23.**	B	**24.**	D	**25.**	C	**26.**	B	**27.**	D	**28.**	A
29.	B	**30.**	D	**31.**	D	**32.**	D	**33.**	D	**34.**	A	**35.**	B
36.	A	**37.**	B	**38.**	D	**39.**	D	**40.**	C	**41.**	B	**42.**	B
43.	A	**44.**	A	**45.**	D	**46.**	B	**47.**	A	**48.**	B	**49.**	C
50.	C	**51.**	A	**52.**	A	**53.**	D	**54.**	A	**55.**	A	**56.**	C
57.	C	**58.**	B	**59.**	B	**60.**	B	**61.**	C	**62.**	D	**63.**	C
64.	C	**65.**	A	**66.**	B	**67.**	C	**68.**	C	**69.**	D	**70.**	D
71.	C	**72.**	C	**73.**	A	**74.**	C	**75.**	C	**76.**	A	**77.**	B
78.	A	**79.**	B	**80.**	C	**81.**	D						

EXERCISE-II

1.	D	**2.**	B	**3.**	B	**4.**	B	**5.**	D	**6.**	C