CHEMISTRY

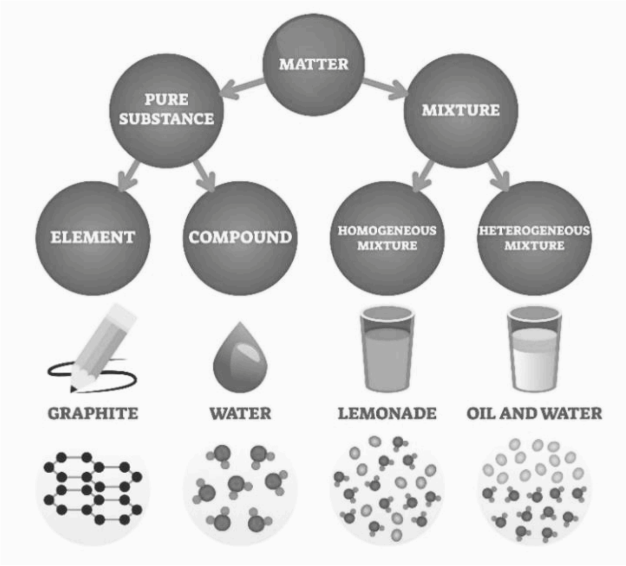
IS MATTER AROUND US PURE

Concepts Covered	▪ Matter, Chemical Classification of Matter, Types of Pure Substances, Compounds, Mixture, Solution, Solubility, Concentration of Solution, Suspension, Separating Methods (including all process), Physical and Chemical Changes etc.

Introduction:

(i) Matter (which is made up of atoms) around us is of two types: pure substances and mixture.
(ii) Pure substances are elements and compounds, as they contain only one kind of particles.
(iii) Homogenous mixtures of two substances form solutions in which particle size are minute.
(iv) If the size of particles is big enough to be seen with naked eyes, then suspension is formed.
(v) If particle size is between solution and suspension, then colloid formation takes place.
(vi) Separation of mixtures can be done by processes such as filtration, centrifugation, chromatography and distillation etc.
(vii) During changes, sometimes new substances are formed called chemical changes.
(viii) If new substances are not formed the change is called a physical change.

Chemical Classification of Matter:



Example:

Iron, sucrose (cane sugar), water, sodium chloride etc., are substances. The composition of a substance is the same throughout even including that at the atomic or molecular level.

Pure Substance: A homogeneous material which contains particles of only one kind and has a definite set of properties is called a pure substance.

Example:

Iron, silver, oxygen, Sulphur etc., are pure substances, because each one of them has only one kind of particles. However, if a substance is composed of two or more different kinds of particles combined together in fixed proportion by weight, then the substance is also regarded as pure substance.

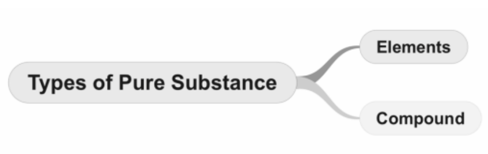
Characteristics of Pure Substances:

(i) A pure substance is **homogeneous in nature.**

(ii) A pure substance has a **definite set of properties**. These properties are different from the properties of **other substances.**

(iii) The composition of a pure substance **cannot be altered** by any physical means.

Types of Pure Substances:



Elements:

The word element was introduced for the first time by **Lavoisier, "An element is the simplest or the most basic form of a pure substance which cannot be broken into anything simpler, by physical or chemical methods**.

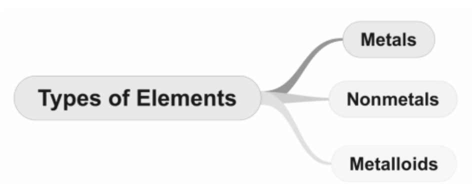
The common examples of elements are hydrogen, carbon, oxygen, nitrogen, Sulphur, copper, silver, gold etc.

(i) Although more than 115 elements are known, the **universe** is made mainly from the two. These are hydrogen (92%) and helium (7%) and the rest of the elements have a contribution of only 1% by mass.

(ii) Out of the known elements, only about 92 have been found to be present in nature, the rest of them have been synthesized by the scientists in the laboratory.

(iii) The **Man-made** elements are also known as **synthetic elements**.

Types of Elements:



(A) Metals:

Out of 92 elements nearly 70 elements belong to a particular class known as metals. In metals the atoms are very closely packed together and have special types of bonds known as **metallic bonds**. Because of very tight or close packing, the metals are quite hard.

Important Characteristics of the Metals:

(1) Solids at room temperature. Exception: Mercury (liquid at room temperature).

(2) Shining surfaces. Property as known as **lustre**.

(3) Good conductors of heat and electricity. example. Au, Ag Exception : Heat (Pb), Electricity (Hg).

(4) Quite hard. **Exception** : Sodium & potassium are soft.

(5) Malleable. E.g. Fine Al **foils** are used for wrapping different types of food.

(6) Thin foils of silver are used for **decorating sweets**.

(7) Ductile. All electric wires drawn from different metals are very fine.

(8) Sonorous. The sound produced on bending a tin foil is known as **'tin cry'**.

(9) Generally, have **high melting and boiling points**.

(B) Non-Metals:

Non-metals as the name suggests are opposite to metals which means that their properties are quite different from the metals. **Important properties of Non-metals**

(1) Either gases or solids at room temperature. Exception: Bromine (liquid at room temperature)

(2) Non-metals vary in colour with generally **dull surfaces**. Exception: Diamond, Crystals of iodine have bright lustre.

(3) Mostly Poor conductors of heat and electricity. **Exception**: Graphite

(4) Quite Soft. **Exception**: Diamond

(5) Non-malleable and non-ductile.

(6) Not Sonorous.

(7) Very low melting and boiling point as compare to metals. **Exception**: Diamond, SiC

(C) Metalloids:

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

Compounds or Chemical Compounds:

A pure substance containing two or more elements which are combined together in a fixed proportion by mass. For Example, water (H_2O) consist of two elements, hydrogen and oxygen are present in the ratio of 2 : 16 or 1 : 8 by mass. Water may be obtained from a number of sources such as rain, river, sea, well, lake etc. But in the pure form any sources the two elements are present in the same fixed ratio i.e., 1 : 8 by mass. ________________

Characteristics of Compounds:

1. A **pure compound** is composed **of the same elements**.

2. A pure compound is **homogeneous** in nature.

3. A chemical compound is formed as a result of chemical reaction between the constituent elements.

4. Properties of the compound are altogether different from the elements from which it is formed.

5. Constituents of a chemical compound **cannot be separated mechanically**.

6. Formation of compounds involves energy changes.

Mixture

A mixture is that form of matter in which two or more substances (elements or compounds) are present in any proportion.

For example, air is a mixture of mainly oxygen, nitrogen, smaller amounts of CO_2, Other Gases and dust particles etc., are also present in the air.

Characteristics of a Mixture:

Mixture contain more than one substance, and show the following characteristics.

1. In mixtures, the constituents may be present in any proportion.

2. Mixture show the properties of all the constituents present their in. For example, a mixture containing sugar and salt will be salty-sweet.

3. During the preparation of a mixture, no energy such as, heat, light and electricity is absorbed or evolved.

4. Mixtures (except solutions) are heterogeneous.

5. The components of a mixture can be separated by simple physical methods.

Homogeneous Mixture:

- A mixture is said to be homogeneous if the different constituents or substances present in it exist in one single phase without any visible boundaries of separation in them.
- In a homogeneous mixture, the constituent's particles cannot be identified or seen without the help of powerful

Example:

All solutions, such as solutions of common salt, copper sulphate, sugar, etc., are examples of homogeneous mixture. Similarly, alloys such as brass and bronze are homogeneous solid solutions of metals.

Heterogeneous Mixture:

A mixture is said to be heterogeneous if it does not have a uniform composition and also has visible boundaries of separation between the constituents. In a heterogeneous mixture, these can be easily seen.

Type of Mixture	Homogeneous Mixture	Heterogeneous Mixture
1. Gas in gas	Air (mainly $O_2 + N_2$)	
2. Gas in liquid	Aerated water $(CO_2 + H_2O)$	
3. Gas in solid	Hydrogen in palladium	
4. Liquid in liquid	Ethyl alcohol + Water	Water + Oil
5. Liquid in solid	Mercury in amalgamated zinc	
6. Solid in liquid	Sugar in water	Chalk in water, Dust (fine sand) in water
7. Solid in solid	Alloys, eg., brass	Mixture such as, sand + iron filings; sand + ammonium chloride etc.

Types of Mixture:

- A mixture containing potassium nitrate, Sulphur and charcoal is called **gun powder.**

Difference between Compounds and Mixture:

Compounds	Mixture
In a compound, two or more elements are combined chemically.	In the mixture, two or more elements or compounds are simply mixed and not combined chemically.
In a compound, the elements are present in the fixed ratio by mass. This ratio cannot change.	In a mixture, the constituents are not present in fixed ratio. It can change.
Compounds are always homogeneous i.e., they have the same composition throughout.	Mixtures may be either homogeneous or heterogeneous in nature.
In a compound, the constituents lose their identities i.e., a compound does not show that characteristics of the constituting elements.	In a mixture, the constituents do not lose their identities i.e., a mixture shows the characteristics of all the constituents.
In the formation of a compound, energy in the form of heat, light or electricity is either absorbed or evolved.	No energy change is noticed in the formation of a mixture.
In a compound the constituents cannot be separated by physical means.	The constituents from a mixture can be easily separated by physical means.

Solution

A homogeneous mixture of two or more substances is called a solution Example is **sugar and water**. This means that if we take out 1 ml sample from different parts of this solution, it will have

- the same degree of sweetness, and
- the same concentration. It means all 1 mL sample of this solution will contain the same number of sugar and water molecules.

Dust-free air is a homogeneous mixture of many gases. The main gases present in the air are nitrogen (78.1%) and oxygen (20.9%).

Components of a Solution:

A solution basically has two components, i.e., **a solvent and a solute.**

(a) Solvent : The component of a solution which dissolves the other component in itself is called **solvent.** 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, the turpentine oil is the solvent.

(b) Solute : The component of the solution which dissolves in the solvent is called **solute.** Usually, solute is the **smaller component** of the solution. For example, in the solution of common salt in water, the common salt is the solute. Similarly, in carbonated drinks (soda water), carbon dioxide gas is the solute.

Saturated and Unsaturated Solutions:

(a) Saturated Solution: - A solution, which at a given temperature dissolves as much solute as it is capable of dissolving, is said to be a **saturated solution.**

(b) Unsaturated Solution: - When the amount of solute contained in a solution is less than saturation level, the solution is said to be an **unsaturated solution.**

(c) Super Saturated Solution: **-** A solution which contains more of the solute than required to make a saturated solution, is called a **super saturated solution.**

Solution and Its Characteristics:

(a) True solution : A solution in which the particles of the solute are broken down to such a fine state, that they cannot be seen under powerful microscope is called a **true solution**.

In a true solution, the particles of the solute are broken down to a diameter of the order of 10^{-8} cm or less.

(b) Characteristics of True Solution:

(1) A true solution is always clear and transparent, i.e., light can easily pass through it without scattering.

(2) The particles of solute break down to almost molecular size and their diameter is of the order of 1 nm (10^{-9} m) or less.

(3) A true solution can completely pass through filter paper as particle size of solute is far smaller than the size of pores of filter paper.

(4) A true solution is homogeneous in nature.

(5) In a true solution, the particles of solute do not settle down, provided temperature is constant.

(6) From a true solution, the solute can easily be recovered by evaporation or crystallization.

(7) A solution in which water acts as the solvent is regarded as an aqueous solution, while the one in which any other liquid is the solvent is known as non-aqueous solution.

Example:

Solution of salt in water is an aqueous solution. Solution of bromine in carbon tetrachloride is non-aqueous solution.

Solubility

The maximum amount of a solute which can be dissolved in $\mathbf{100\ g}$ of a solvent at a specified temperature is known as the solubility of that solute in that solvent (at that temperature). While expressing the solubility of a substance, we must have to specify the temperature.

(A) Solubility of solids in liquids:

Solubility of solids in liquids is affected by two factors.

(a) Effect of temperature: As the temperature goes on increasing, the solubility of solids in liquids goes on increasing because as the temperature increases, the kinetic energy of the molecules increases which increase the space between them so that more solids can be dissolved.

(b) Effect of pressure: There is no effect of pressure on the solubility of solids in liquid.

(B) Solubility of Gases in Liquids:

Solubility of gases in liquids is also affected by temperature and pressure.

(a) Effect of temperature: As the temperature goes on increasing, the solubility of gases in liquids goes on decreasing because as the temperature increases, the kinetic energy of the molecules goes on increasing and gas comes out so the molecules come closer. Hence the solubility decreases.

(b) Effect of pressure: As the pressure increases, the solubility of gases in liquids goes on increasing.

Example:

5 g of solute is dissolved in 50 g of water to form saturated solution at $25°C$. Calculate the solubility of solute.

Solution:

$$\textbf{Solubility (in saturated solution)} \ \frac{\text{Mass of solute}}{\text{Mass of solvent}} \times 100$$

Mass of solute $= 5$ g; Mass of solvent $= 50$ g

$$\textbf{Solubility (in saturated solution)} = \frac{5g}{50g} \times 100 = 10g$$

Concentration of a Solution:

- The quantity of solute dissolved in a given mass or volume of the solution or the solvent is called concentration of the solution. **Measuring the concentration of a solution**
- The concentration of a solution is measured as the amount of the solute present in a given amount of the solvent or solution. It is normally expressed as mass percent or as volume percent.

(A) Mass Percent:

Mass percent of a solution may be defined as:

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

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

$$\textbf{Mass percent of } A = \frac{W_A}{W_A + W_B} \times 100$$

$$\textbf{Mass percent of } B = \frac{W_B}{W_A + W_B} \times 100$$

Both, the mass of solute and that of the solution must be expressed in the same mass units, viz, both in gm or both in kilograms.

Example:

A solution has been prepared by dissolving 5 g of urea in 95 g of water. What is the mass percent of urea in the solution?

Solution:

(A) Mass percent (Mass $\%) = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

Mass of urea $= 5$ g; **Mass of water** $= 95$ g

$$\textbf{Mass percent of urea} = \frac{5}{(95+5)} \times 100 = \frac{5}{100} \times 100 = 5\%$$

(B) Volume Percent:

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

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

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

Suspension:

"A heterogeneous mixture of insoluble particles of solute, spread throughout a solvent, is called **suspension.**

1. Muddy water, in which particles of sand and clay are suspended in water.

2. Slaked lime suspension used for white-washing has particles of slaked lime suspended in water.

3. Paints in which the particles of dyes are suspended in turpentine oil.

Characteristics of Suspensions:

1. The size of particles is more than 10^{-5} cm in diameter.

2. The particles of suspension can be separated from solvent by the process of filtration.

3. The particles of suspension settle down, when the suspension is kept undisturbed. The process of settling of suspended particles under the action of gravity is called **sedimentation.**

4. A suspension is heterogeneous in nature.

5. An excessive amount of scattering takes place in suspensions, because of bigger size of particles.

Properties of Suspensions:

Following are the characteristic properties of suspensions:

(a) Heterogeneous nature: A suspension is a heterogeneous system.

(b) Visibility: The particles in a suspension can be seen with naked eyes or under a simple microscope.

(c) Particle size: In a suspension, the size of the particles is of the order of 10^{-7} m or larger.

(d) Sedimentation: The particles in a suspension have a tendency to settle down. Very fine particles, however, remain suspended in the medium.

(e) Separation by filtration: Larger particles in a suspension can be separated from the liquid or air by filtration.

Colloidal Solution or Colloids

(i) A heterogeneous solution in which the particle size is in between 10^{-7} cm to 10^{-9} cm, such that the solute particles neither dissolve nor settle down in a solvent is called **colloidal solution.**

(ii) The component present in smaller proportion is the **dispersed phase** while the one present in greater proportion is the **dispersion medium.**

Types of Colloidal Dispersion:

Dispersed phase	Dispersion medium	Common name / Type	Examples
Liquid	Gas	Liquid aerosol	Fog, Liquid sprays etc.
Solid	Gas	Solid aerosol	Smoke, Dust etc.
Gas	Liquid	Foam	Soap lather, Fire extinguisher foam
Liquid	Liquid	Emulsion	Milk, Water-in-oil or oil-in-water emulsion
Solid	Liquid	Sol	Metallic dispersions, Toothpaste, Milk of magnesia, Mud
Gas	Solid	Foam	Expanded polystyrene
Liquid	Solid	Gel	Opal, pearls
Solid	Solid	Solid sol	Pigmented plastics, Coloured glasses

Properties of a Colloid:
Some characteristic properties of a colloid are described below:

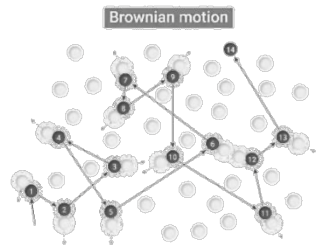
(a) Heterogeneous nature: A colloid (or sol) is heterogeneous in nature. The particles in a colloid can be seen only with a powerful microscope.

(b) Particle size: The size of particles in a colloid lies between 10^{-9} m and 10^{-7} m.

(c) Separation of colloidal particles by centrifugation: Therefore, colloidal particles cannot be separated by ordinary filtration.

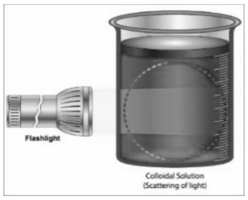
(d) Stability: Colloids are unstable unless stabilized by adding suitable stabilizer. The colloidal particles tend to come together and settle down.

(e) Brownian movement of colloidal particles: When seen under a microscope, the colloidal particles in a colloid are seen to be moving in a random (zig-zag) fashion. **This zig-zag motion of particles in a colloid is called Brownian motion.**



(f) Light scattering by colloidal particles - Tyndall effect: The scattering of light by the particles in a colloid is called Tyndall effect.

(g) Electrophoresis: The movement of colloidal particles under the influence of electric field is called electrophoresis.



Application of Colloids:

(a) Most of the applications of the colloidal solutions are because of the removal of charge or neutralization of charge on the colloidal particles. The process of neutralization of charge on the colloidal particles by the addition of certain oppositely charged species is known as **coagulation.**

(i) Bleeding from a cut can be immediately stopped by applying alum or ferric chloride.

(ii) Delta is formed when river water comes in contact with sea water for a long period.

(iii) Sky appears to be blue in colour

(b) In our food: Many items in our food contain colloidal materials. For example, milk, starch, proteins, fruit-jellies are colloidal in nature.

(c) In medicines: A large number of medicines and pharmaceutical preparations are colloidal in nature. Such colloidal medicines are easily absorbed by the body tissues and, therefore, are more effective. For example, colloidal gold, calcium, silver is used in medicines or as ointments.

Differences between a True Solution, a Colloid and a Suspension:

True solution	Colloid	Suspension
1. A true solution is a homogeneous mixture of two, or more than two substances.	A colloid is a homogeneous looking but heterogeneous mixture.	A suspension is a heterogeneous mixture of a solid dispersed in a liquid, or a gas.
2. In a true solution, solute cannot be seen even with a microscope.	In a colloid, the dispersed particles can be seen only with a powerful microscope.	In a suspension, the particles can been with the naked eyes.
3. In a true solution, the size of particle is about 10^{-10} m.	In a colloid, the size of particles is between 10^{-7} and 10^{-9} m.	In a suspension, the size of particles is greater than 10^{-7} m.
4. The constituents of a true solution cannot be separated by ordinary filtration.	The constituents of a colloid cannot be separated by filtration they are separated by ordinary centrifugation.	Can be separated by ordinary filtration.

Separating the Components of a Mixture:

Some most commonly used methods for separating the constituents of a mixture are

* Handpicking
* Sieving
* Winnowing
* Sedimentation
* Evaporation
* Crystallisation
* Filtration
* Sublimation
* Chromatography
* Gravity method
* Distillation
* Fractional distillation
* Magnetic separation method
* Centrifugation or Churning

Separating the Coloured Components of a Mixture:

The coloured components of a mixture can be separated by a technique called as **chromatography.**

(a) To separate the coloured components (called dyes) present in black ink.

Technique: Chromatography

Principle: Distribution.

Materials required: Strip of filter paper, a large size glass jar, jar cover, clips, cotton thread.

Procedure: Take a strip of filter paper ($\mathbf{20\ cm} \times \mathbf{3\ cm}$).

- Draw a line with a pencil about 2-3 cm from its lower end.
- Place this paper strip on a smooth surface (may be table top) and put a small drop of black ink with the help of a fountain pen or a capillary tube. Let it dry up. Place another drop of ink at the same spot and let it dry up.
- Now suspend the filter paper strip in a jar containing little water, so that the ink spot is slightly above the level of water. Cover the jar and leave it undisturbed for some time. Record your observation.

Observations: Two or more coloured spots are seen at different distances from the reference line. The coloured component which is more soluble in water rises faster than the others.

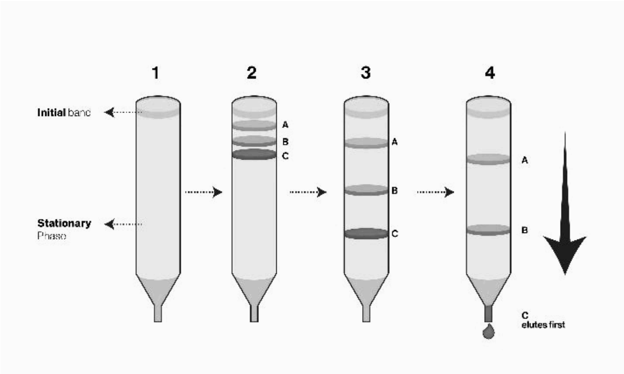
Conclusion: The black ink is a mixture of .... dyes.

Application:

(i) To separate colours in a dye

(ii) To separate pigments from natural colour

(iii) To separate drugs from blood



Use of Chromatography in the Separation of Constituents from a Mixture:

(i) word chromatography implies writing in colour.

(ii) Technique was initially used to separate coloured components from pigments and dyes.

(iii) Wide range of applications.

(iv) Chromatography is of a number of types such as absorption, thin layer.

(v) The paper chromatography is very simple and is commonly used in the laboratory.

(b) To separate cream from milk

Technique: Centrifugation

Principle: The denser particles a forced to the bottom and the lighter particles at the top when spun rapidly.

Materials required : Full-cream milk, churner, jug

Procedure: Take fresh cold milk (un-boiled) in a jug. Churn the milk with a churner. What do you observe after some time? The separated cream floats over the milk, and can be removed.

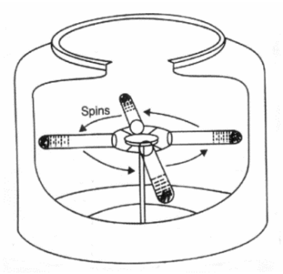
Application of this method (Centrifugation)

(1) Used in washing machines to squeeze out water from the wet clothes.

(2) Used for separating cream from milk and butter from curd in dairies or at home.

(3) Used in diagnostic laboratories for testing blood/urine.

A centrifuge is used to separate suspended solid particles from a liquid, quickly. When the centrifuge is switched on, the test-tubes (containing suspension) held in it swing out and spin (or rotate) at high speed. The centrifugal force acts on suspended particles which forces them to go to the bottom of test tubes and clear liquid remains on top (This sketch shows four test-tubes spinning at the same time).

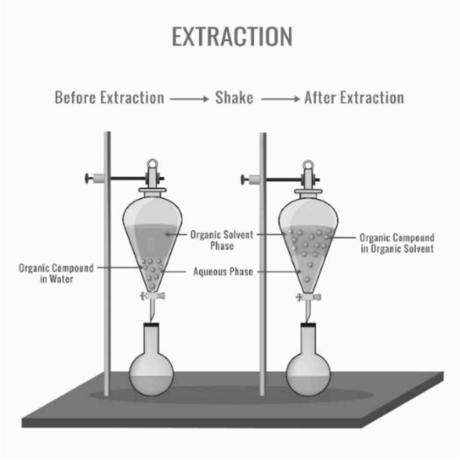


(c) To separate the mixture of two immiscible liquids

Principle: Immiscible liquids separate out in layers depending on their densities. The liquids which do not dissolve in each other are called **immiscible liquids**.

Materials required : Separating funnel, iron stand, beaker, oil and water.

Procedure: The mixture containing oil and water is taken in a separating funnel. The separating funnel is clamped on an iron stand and allowed to stand for some time. After a while oil and water separate to form two layers. Oil being lighter than water forms the upper layer. Water forms the lower layer. Open the stopcock and collect the water in a beaker. Oil is left behind in the separating flask.



Separation of two immiscible liquids by using a separating funnel

Application:

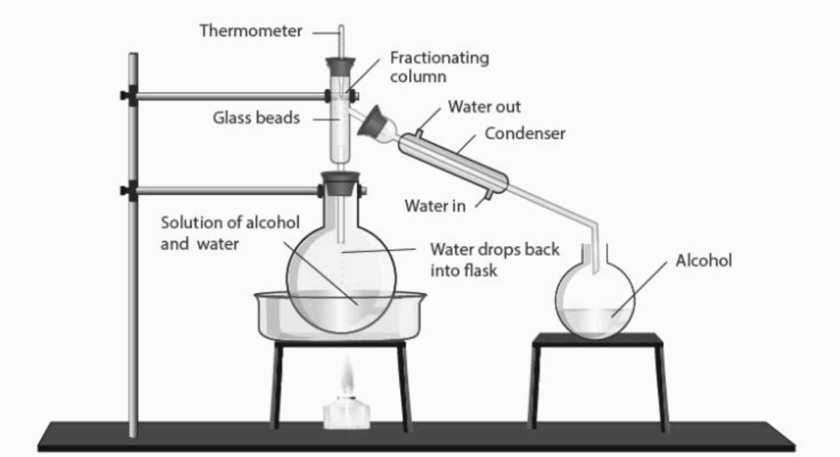
(i) Separate mixture of oil and water

(ii) Extraction of iron from its ore.

(d) To separate a mixture of two miscible liquids

Principle: Separation of two miscible liquids that boil without decomposition and have sufficient difference in their boiling points (Distillation).

To separate alcohol and water from their mixture, take the mixture in a distillation flask. Fit it with a thermometer. Heat the mixture slowly keeping a close watch at the thermometer. The alcohol vaporizes, condenses in the condenser and can be collected from the condenser outlet. Water is left behind in the distillation flask.



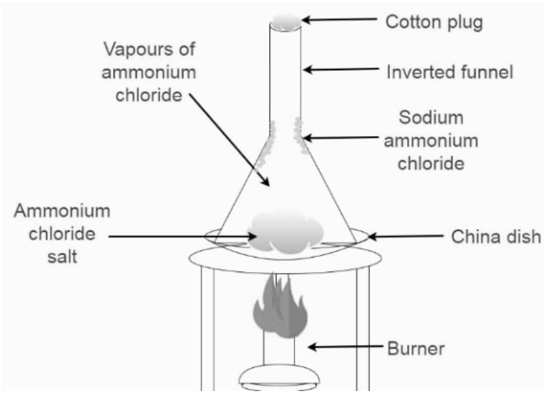
(e) To separate a mixture of salt and ammonium chloride

Technique: Sublimation

Principle: To separate mixture that contain a sublimable volatile component from a non sublimable impurity.

Materials required : China dish, funnel, asbestos sheet, tripod stand

Procedure : Take the mixture of common salt and ammonium chloride in a china dish. Place this china dish on a tripod stand and cover it with a perforated asbestos sheet. Place an inverted funnel on the perforated sheet. Plug the opening of the funnel with a cotton plug. Heat the china dish on a low flame. Observe the white fumes coming out of the mixture. What do you see? These white fumes start depositing as white solid on the inner wall of the funnel. After a few minutes, stop heating and allow it to cool. Now, remove the funnel. Scrape the white deposit of ammonium chloride with the help of a spatula. Common salt is left behind in the china dish.



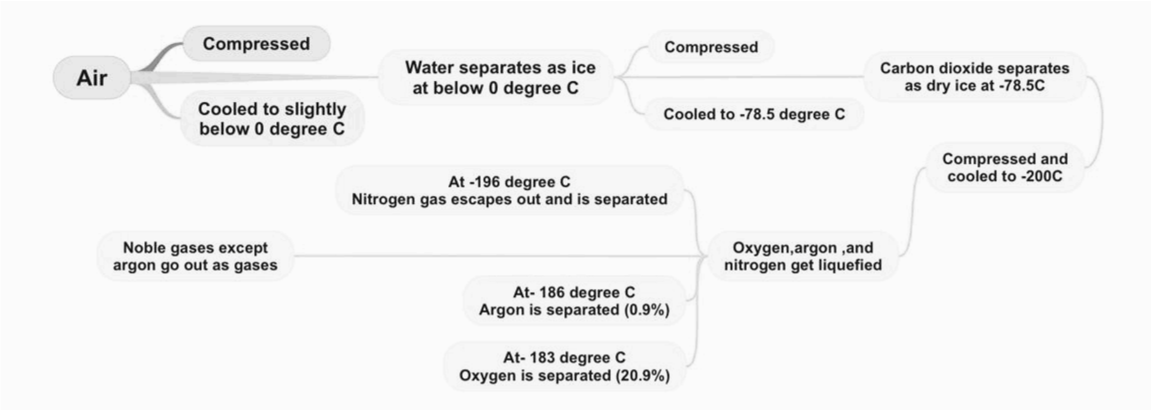
Separation of a mixture by sublimation. Here a mixture of common salt and ammonium chloride is being separated by sublimation.

(f) Separation of the constituents of the air

Principle: Separation of two miscible liquid for which the difference in boiling points is less than $25\ \mathrm{K}$ (fractional distillation)

Air is a homogenous mixture of oxygen (O_2), nitrogen (N_2), carbon dioxide (CO_2) and noble gases (He, Ne, Ar and Kr). These gases have different freezing and boiling points.

These gases, therefore, can be separated by liquefying and fractional distillation of the liquid air as shown below:



Application: Separation of difference products of petroleum.

(g) To obtain pure copper sulphate from an impure sample.

Technique: Crystallization

Impure copper sulphate can be purified by the method of crystallization to obtain pure copper sulphate. This is done as follows:

(i) Take about 10 grams of impure copper sulphate and dissolve it in minimum amount of water in a china dish to make copper sulphate solution.

(ii) Filter the copper sulphate solution to remove insoluble impurities.

(iii) Heat the copper sulphate solution gently on a water bath to evaporate water and obtain a saturated solution (This can be tested by dipping a glass rod in hot solution from time to time. When small crystals form on the glass rod, the solution is saturated). Then stop heating.

(iv) Allow the hot, saturated solution of copper sulphate to cooled slowly.

(v) Crystals of pure copper sulphate are formed. Impurities remain behind in the solution.

(vi) Separate the copper sulphate crystals from solution by filtration and drying.

The process of crystallization is used to purify a large number of water-soluble solids.

For example, the common salt obtained from sea-water is an impure substance having many impurities in it.

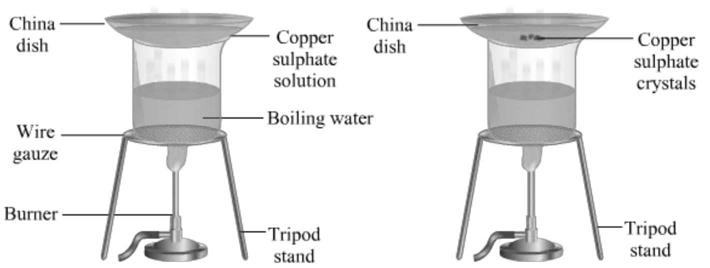
So, common salt is purified by the process of crystallization.

An impure sample of alum is also purified by crystallization.

Crystallization is a better technique than 'evaporation to dryness' because of the following reasons

(i) Some solids (like sugar) decompose or get charred on heating to dryness during evaporation. There is no such problem in crystallization.

(ii) The soluble impurities do not get removed in the process of evaporation. But such impurities get removed in crystallization.



(h) Separation of coloured components from a blue/ black ink by paper chromatography:

With the help of this technique we can identify the blue as well black components in a drop of the ink which is water soluble. In order to perform the experiment, take a strip of very fine filter paper (25×5 cm). Draw a fine line on the paper from one end approximately at a distance of 3 cm. With the help of a fine capillary tube, put a small drop of blue

Now, Suspend the strip in a jar containing a small amount of water so that the end of strip which has been marked dips in water to length of about $\mathbf{0.5}$ to $\mathbf{1\ cm}$. Allow the strip to stand undisturbed in the jar for about 20 to 30 minutes. Due to capillary action, water will rise upwards. Blue / black ink is actually a mixture of blue and black dyes. Both the components present in the mixture will rise upwards. The more soluble will move faster. In this way, the blue and black colours will get separated.

(i) To separate the mixture of common salt and water: Since common slat (sodium chloride) is soluble in water, it can be separated by crystallization. The process of distillation can also be used because sodium chloride is non-volatile in nature.

(j) To separate the mixture of Iodine and Sand: Sublimation process can be used. Iodine will sublime on heating while sand will remain unaffected.

(k) To separate the mixture of kerosene and water: The liquids are not miscible with each other. Separation can be done by using a separating funnel.

(l) To separate the mixture of sugar and sulphur : The mixture is dissolved in carbon disulphide in a beaker by stirring with a glass rod. Sulphur dissolves while sugar remains as such. On filtering, sugar separates as the residue. The filtrate upon concentration and cooling gives crystals of Sulphur.

(m) To purify impure sample of sugar containing impurity of some chalk:

The impure sample of sugar containing some chalk impurity represents a heterogeneous mixture. In order to purify the sample or to recover sugar from it, dissolve about $\mathbf{5\ g}$ of the sample in minimum volume of water in a beaker. Stir occasionally with a glass rod. Filter the solution formed through funnel as discussed filtrate will be a sugar solution in water. Transfer the solution in a china dish. Concentrate by heating so that the volume of the solution becomes nearly half. The solution will be saturated. Place the china dish over a beaker full of water and allow to remain undisturbed for some time. Pure crystals of sugar will appear in the dish.

Solved Examples

(1) **How can colloids and solution be distinguished from each other?**

Answer: Colloids and solution can be distinguished by using Tyndall effect.
The solution which scatter a beam of light passing through it and renders its path visible is a colloid. The solution which does not scatter a beam of light passing through it and does not render its path visible is a solution.

(2) **What is meant the statement that saying that metals are malleable and ductile?**

Answer: By the statement metals are malleable and ductile we mean that metals can be beaten into thin sheet with a hammer without breaking and can be drawn into wires.

(3) **Name the process associated with the following:**
(a) A potassium permanganate crystal is in a beaker and water is poured into the beaker with stirring.
(b) Settling of sand when a mixture of sand and water is left undisturbed for some time.
(c) Dry ice is kept at room temperature and at one atmospheric pressure.
(d) Fine beam of light entering through a small hole in a dark room, illuminates the particles in its paths.
(e) Milk is churned to separate cream from it.
(f) A drop of ink placed on the surface of water contained in a glass spread throughout
(g) An acetone bottle is left open and the bottle becomes empty.

Answer: (a) Dissolution/ diffusion
(b) Sedimentation
(c) sublimation
(d) Tyndall effect (Scattering of light)
(e) Centrifugation
(f) Diffusion
(g) Evaporation

(4) **What are the favourable qualities given to gold when it is alloyed with copper or silver for the purpose of making ornaments?**

Answer: Pure gold (24) karat) is soft and does not have strength. In order to give strength to gold silver and copper is alloyed to gold. An alloy that has 20 parts of gold and 4 parts of silver is known as 24 karat gold.

(5) **Give an example each for the mixture having the following characteristics given below. Suggest a suitable method to separate the components of these mixtures**
(a) A volatile and a non-volatile component.
(b) Two volatile components with appreciable difference in boiling points.
(c) Two immiscible liquids.
(d) One of the components changes directly from solid to gaseous state.
(e) Two or more coloured constituents soluble in some solvent.

Answer: It will be a pure substance because chemical structure of the sugar remains same despite of change in source of their extraction.

(6) **The teacher instructed three students ' A ', ' B ' and ' C ' respectively to prepare a 50% (mass by volume) solution of sodium hydroxide (NaOH). 'A' dissolved 50" " g of NaOH in 100" " mL of water, ' B ' dissolved 50" " g of NaOH in 100" " g of water, while 'C' dissolved 50" " g of NaOH in water to make 100" " mL of solution. Which one of them has made the desired solution and why?**

Answer: Student C because both B and A has made the solution of 150ml whereas student C prepared required quantity.
Student A and B prepare 150ml solution, so student c make desire solution because he adds water to make 100ml solution. and from calculation.
%w/v=100× weight of sub (solute)
volume of solution
∴%50=100× weight of sub 100ml weight of sub =50×100ml 100
∴ weight of sub =50" " g
Here the 50" " gNaOH requred for 50% w/v 100ml solution of NaOH

(7) **A child wanted to separate the mixture of dyes constituting a sample of ink. He marked a line by the ink on the filter paper and placed the filter paper in a glass containing water. The filter paper was removed when the water moved near the top of the filter paper.**
(i) What would you expect to see, if the ink contains three different coloured components?
(ii) Name the technique used by the child.
(iii) Suggest one more application of this technique.

Answer: **(i) If the ink contains three different coloured components. Then, we can observe three different bands on the paper**
(ii) Child uses the technique of paper chromatography
(iii) Paper chromatography is used to separate different pigments present in the chlorophyll.

(8) **(a) Under which category of mixtures will you classify alloys and why?**
(b) A solution is always a liquid. Comment.

Answer: (a) An alloy is a homogenous mixture of two or more elements. Elements can be two metals or a metal with a non-metal. An alloy is classified as a homogenous mixture because it shows properties of two or more elements it is made of. Its constituents are in varied composition. Ex: Brass is an alloy which shows characteristics of copper and Zinc and their composition varies from 20 to 35%.
(b) No, the solution cannot be always liquid

Exercise

OBJECTIVE TYPE QUESTIONS

(1) The major constituents of universe are:
(A) Hydrogen and helium (B) Hydrogen and oxygen
(C) Nitrogen and oxygen (D) Helium and neon

(2) The most abundant element in earth's crust is
(A) Carbon (B) Silicon
(C) Nitrogen (D) Oxygen

(3) Which of the following is a metalloid?
(A) Phosphorus (B) Nitrogen
(C) Bismuth (D) Lead

(4) Presence of impurities
(A) Lowers the melting point of solid (B) Increases the melting point of solid
(C) Increases the boiling point of liquid (D) Lowers the boiling point of liquid

(5) The element which is a liquid below $30^{\circ}\mathrm{C}$ is
(A) Cesium (B) Lithium
(C) Magnesium (D) Sodium

(6) Gold of which purity is normally used in making ornaments?
(A) 20 carat (B) 22 carat
(C) 24 carat (D) 18 carat

(7) Which out of the following is a heterogeneous mixture?
(A) Air (B) Brass
(C) Iodized table salt (D) Steel

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

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

(10) Size of colloidal particles in a solution is
(A) More than $100 \mathrm{~nm}$ (B) Less than $1 \mathrm{~nm}$
(C) Between 100 to $1000 \mathrm{~nm}$ (D) Between 1 to $100 \mathrm{~nm}$

Answer Key

OBJECTIVE TYPE QUESTIONS

(1)	(A)	**(6)**	(B)
(2)	(D)	**(7)**	(C)
(3)	(C)	**(8)**	(D)
(4)	(C)	**(9)**	(C)
(5)	(A)	**(10)**	(D)