Is Matter Around us Pure?

Chapter 2

Class 9 Science

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Introduction

Anything which occupies space and has mass is called matter. Matter can be divided in two categories.

(i) Pure Substance: It consists of single types of particles which are same in their chemical nature.

(ii) Mixtures: Mixture consists of two or more particles.

What is a mixture? Name the types of mixtures? What is the difference between them?

Answer: A mixture is a combination of two or more substances (elements or compounds) which is not done chemically.

Mixtures are two types Homogeneous Mixtures and Heterogeneous mixtures.

Homogeneous Mixtures: A Homogeneous mixture has a uniform composition of its components throughout its mass. It does not have visible boundaries of separation between the various components. For example a sugar solution or a salt solution.

Heterogeneous Mixtures: A Heterogeneous mixtures does not have a uniform composition throughout its mass also it has visible boundaries of separation between various components. For example mixture of sand and water.

Solution and its properties

A solution is a homogeneous mixture of two or more substances. Ex: Lemonade, soda water etc.

A solution has two components:

(i) Solvent
(ii) Solute

(i) Solvent: The component of the solution that dissolves the other component in it (usually the component present in larger amount) is called the solvent.

(ii) Solute: The component of the solution that is dissolved in the solvent (usually present in lesser quantity) is called the solute.

Properties of Solution:

1. A solution is a homogeneous mixture.

2. The particles of a solution are smaller than 1 nm (10^{-9}) in diameter which cannot be seen by naked eyes.

3. They do not scatter a beam of light passing through the solution that is they don't show tyndall effect. So, the path of light is not visible in a solution.

4. The solute particles cannot be separated from the mixture by the process of filtration.

5. The solution is stable and solute particles do not settle down when left undisturbed.

Concentration of a solution

(i) Saturated solution: When no more amount of solute can be dissolved in a solution at a given temperature, it is called a saturated solution.

(ii) Unsaturated solution: When more amount of solute can be dissolved in a solution at a given temperature, it is called a saturated solution.

(ii) Solubility: The amount of the solute present in the saturated solution at the given temperature is
called its solubility.

The concentration of a solution is the amount of solute present in a given amount (mass or volume) of solution. Also, the amount of solute dissolved in a given mass or volume of solvent is called concentration of solution.

Two methods of finding concentration of solution:

(i) Mass by mass percentage of a solution = (Mass of solute/Mass of solution) ×100

(ii) Mass by volume percentage of a solution = (Mass of solute/Volume of solution) ×100

What is a suspension? Write its properties.

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Answer: Suspension: A suspension is a heterogeneous mixture in which solids are dispersed in liquids. The solute particles in suspension do not dissolve but remain suspended throughout the medium. For example Paints, Muddy water chalk water mixtures etc.

Properties of a Suspension

- Suspension is a heterogeneous Mixture.
- The particles of a suspension can be seen by the naked eye.
- The particles of a suspension scatter a beam of light passing through it and make its path visible.
- The solute particles settle down when a suspension is left undisturbed, that is, a suspension is unstable. They can be separated from the mixture by the process of filtration.

What is a colloid? Write its properties.

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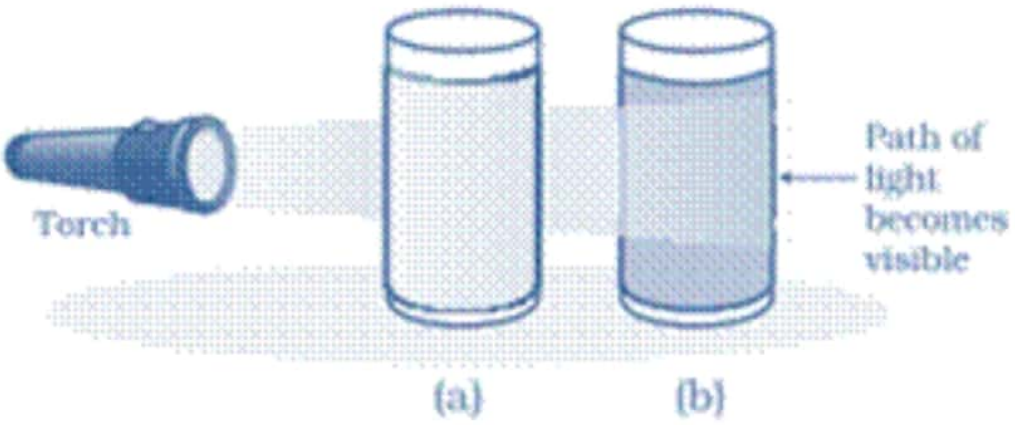
Answer: Colloid: A colloid is a heterogeneous mixture whose particles are not as small as solution but they are so small that cannot be seen by naked eye. When a beam of light is passed through a colloid then the path of the light becomes visible. For example milk, smoke etc.

Properties of a colloid

- A colloid is a heterogeneous mixture.
- The size of particles of a colloid is too small to be individually seen by naked eyes.
- Colloids are big enough to scatter a beam of light passing through it and make its path visible.
- They do not settle down when left undisturbed, that is, a colloid is quite stable.
- They cannot be separated from the mixture by the process of filtration. But, a special technique of separation known as centrifugation can be used to separate the colloidal particles.

What is a Tyndall effect?

Answer: This scattering of a beam of light by the particles of a colloid is called the Tyndall effect. When we apply torch light on a galss of milk then the path of the light becomes visible but it is not so in case of water because in milk light is scattered by its very fine particles. See the following diagram:



Tyndall effect can be observed when sunlight passes through the canopy of a dense forest. In the forest, mist contains tiny droplets of water, which act as particles of colloid dispersed in air. If is shown in the diagram below:

Some common examples of colloids (in the table)

Dispersed phase	Dispersing Medium	Type	Example
Liquid	Gas	Aerosol	Fog, clouds, mist
Solid	Gas	Aerosol	Smoke, automobile exhaust
Gas	Liquid	Foam	Shaving cream
Liquid	Liquid	Emulsion	Milk, face cream
Solid	Liquid	Sol	Milk of magnesia, mud
Gas	Solid	Foam	Foam, rubber, sponge, pumice
Liquid	Solid	Gel	Jelly, cheese, butter
Solid	Solid	Solid Sol	Coloured gemstone, milky glass

Separation of the components of mixtures

Different methods of separation are used to get individual components from mixture. Heterogeneous mixtures can be separated into their respective constituents by simple physical methods like **handpicking, sieving, filtration** etc.

What are the various methods for separating the components of a mixture?

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Answer:

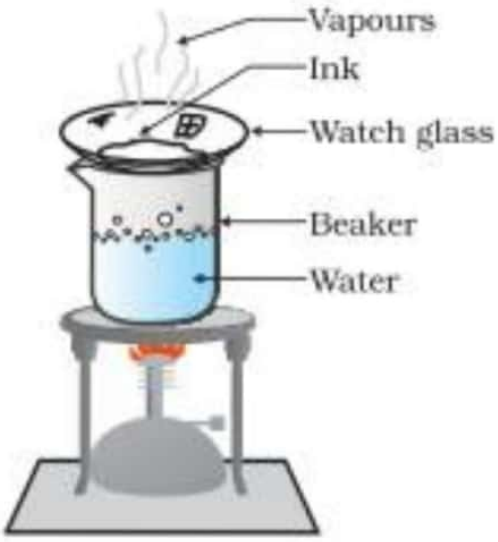
S No	Name of Method	Example
1	Evaporation	To get coloured component (dye) from ink.
2	Centrifugation	To separate cream from milk.
3	Use of Separating funnel	To separate two immiscible liquids like kerosene and water.
4	Sublimation	To separate a mixture of ammonium chloride and salt.
5	Chromatography	Separation of dyes in blue/black ink.
6	Distillation	To separate two miscible liquids like alcohol and water.

7	Crystallisation	To obtain pure solid from impure samples like salt from sea water.
8	Winnowing	To separate food grains from the husk.
9	Filtrations	To separate sand from the water.
10	Sedimentation	To remove the heavier impurities present in liquids.

How can we obtain the coloured component (dye) from a ink?

How can we obtain the coloured component (dye) from a ink?

Answer: Put a watch glass on the mouth of the beaker as shown in the given figure. Put few drops of ink on the watch glass. Now start heating the beaker. We do not want to heat the ink directly. You will see that evaporation is taking place from the watch glass. Continue heating as the evaporation goes on and stop heating when you do not see any further change on the watch glass. Now we will observe that the water get evaporated from the watch glass and residue is left in the watch glass. This residue is the coloured component (Dye). In this way evaporation can used to obtain volatile component from its solution.



Explain the use of separating funnel.

Explain the use of separating funnel.

Answer: A separating funnel can be used to separate the components of the mixture of immiscible liquids. How this can be done? To understand this let us perform a following activity.

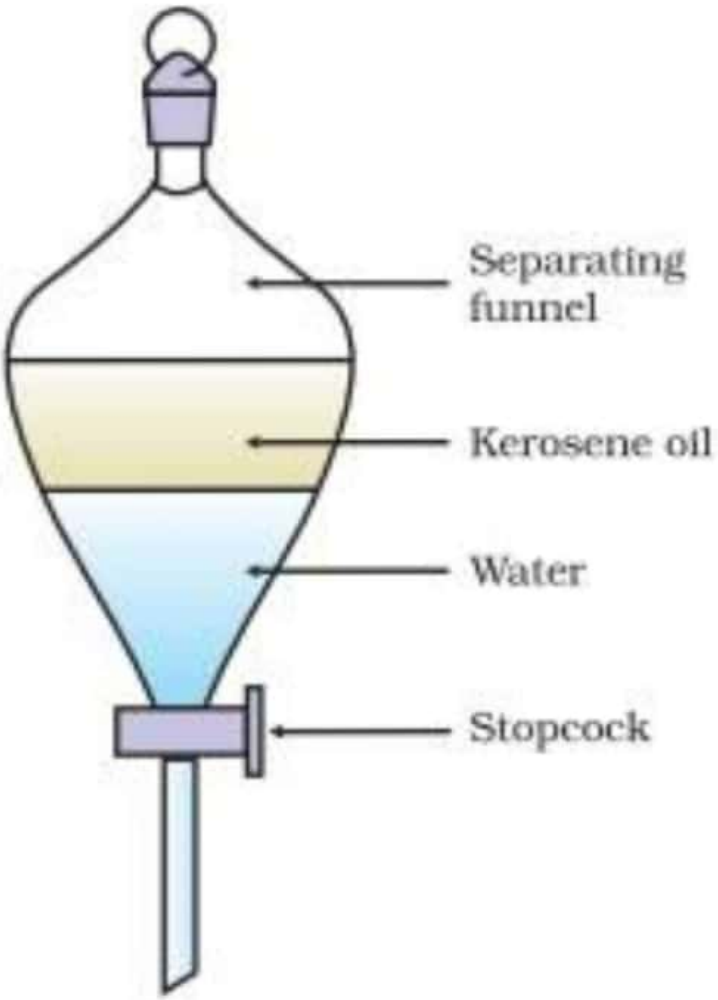
Let us try to separate kerosene oil from water using a separating funnel.

Pour the mixture of kerosene oil and water in a separating funnel.

Let it stand undisturbed for sometime so that separate layers of oil and water are formed. Open the stopcock of the separating funnel and pour out the lower layer of water carefully. Now close the stopcock of the separating funnel as the oil reaches the stop-cock.

Applications

- To separate mixture of oil and water.
- In the extraction of iron from its ore, the lighter slag is removed from the top by this method to leave the molten iron at the bottom in the furnace.



Explain sublimation.

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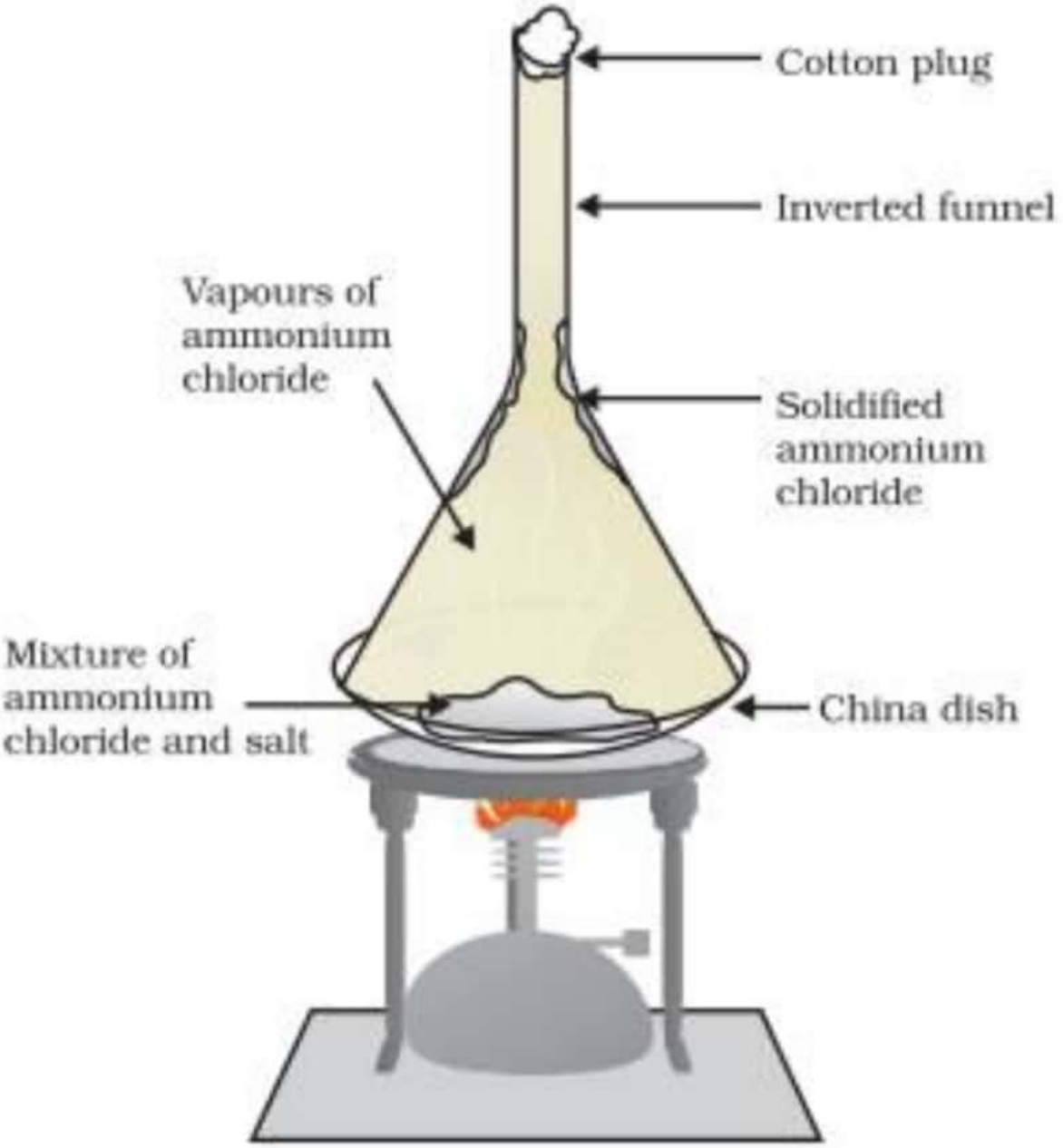
Answer: Sublimation is the property of substance in which they are converted directly from solid to gas or vice versa. Such substances are known as sublime. Some examples of solids which sublime are ammonium chloride, camphor, naphthalene and anthracene. Let us perform an activity to separate a mixture of ammonium chloride and salt.

Take a mixture of ammonium chloride and salt in a china dish cover it inverted conical transparent funnel. At the other end of the funnel put a cotton plug so that vapour could not come out. Now place china dish on a burner. As the ammonium chloride is sublime after heating it will directly converted into vapour and this vapour will again condense at the upper colder part of funnel to form solid ammonium chloride. In this way the mixture ammonium chloride and salt can be separated by the sublimation method.



Explain Centrifugation.

Explain Centrifugation.

Answer: Sometimes the solid particles in a liquid are very small and pass through a filter paper. For such particles the filtration technique cannot be used for separation. Such mixtures are separated by centrifugation. The principle is that the denser particles are forced to the bottom and the lighter particles stay at the top when spun rapidly.

Separation of cream from milk

• The process of **centrifugation** is used to separate the cream from milk. It is a method of separating the suspended particles of substance from a liquid.

• This process is carried out by the machine called centrifuge.

• Sometimes, the solid particles in a liquid are very small and pass through a filter paper. For such particles the filtration technique cannot be used.

• The mixture is rotated rapidly so that the heavier particles in the mixtures settle down to the bottom.

• The basic principle of centrifugation is that the denser particles are forced to the bottom and the liquid being lighter remains at the top.

Explain Chromatography

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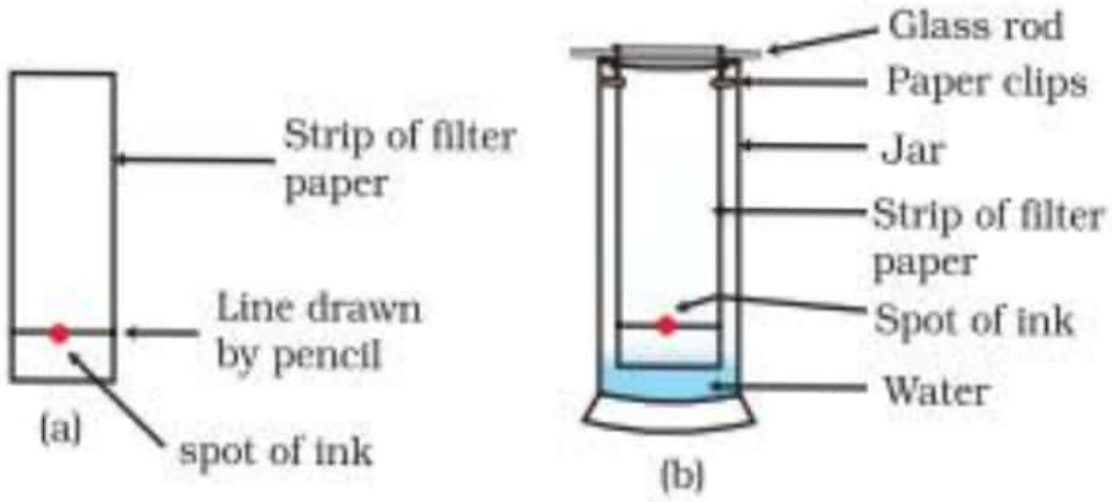
Answer: Chromatography is the technique used for separation of those solutes that dissolve in the same solvent.

To understand how this technique can be used let us perform an activity.

Take a thin strip of filter paper. Draw a line on it using a pencil, approximately 3 cm above the lower edge as shown in figure(a). Put a small drop of ink (water soluble, that is, from a sketch pen or fountain pen) at the centre of the line. Let it dry. Lower the filter paper into a jar/glass/ beaker/test tube containing water so that the drop of ink on the paper is just above the water level, as shown in Fig(b) and leave it undisturbed.

Watch carefully, as the water rises up on the filter paper. Now observe that the coloured component that is more soluble in water, rises faster and in this way colours get separated.



Applications of Chromatography

To separate

- colours in a dye
- pigments from natural colours
- drugs from blood.

Explain the method of simple distillation.

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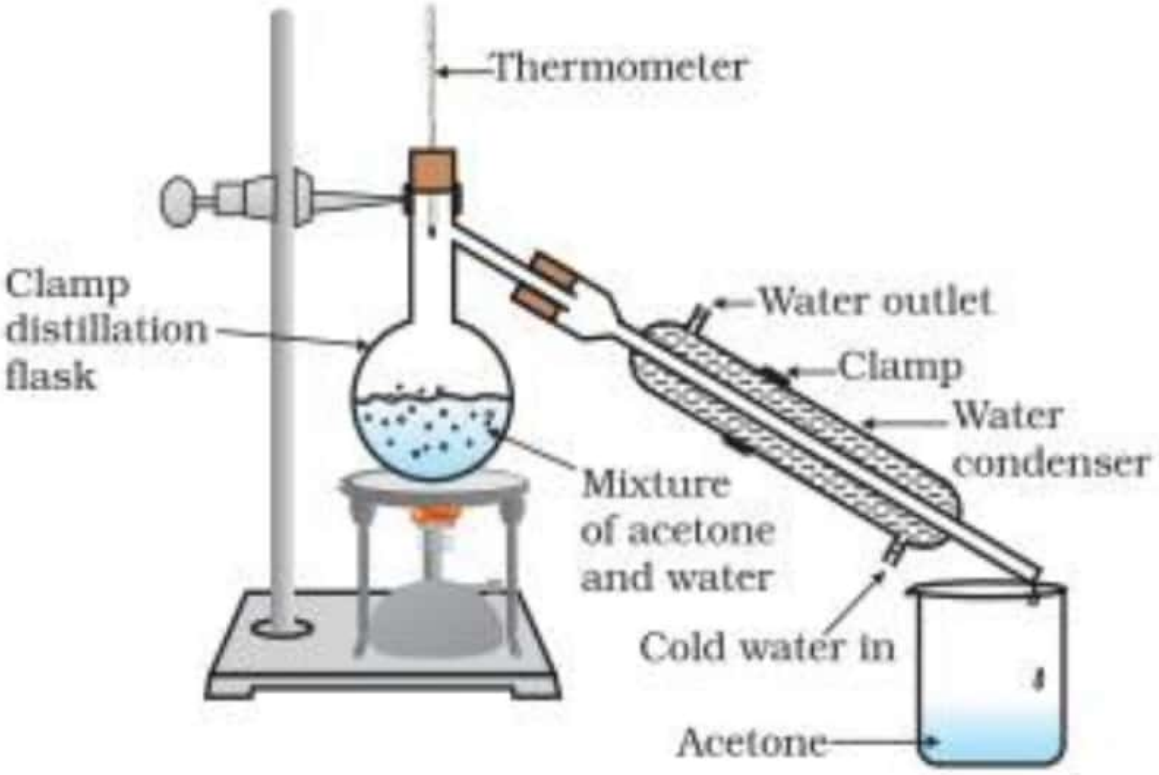
Answer: This method is used to separate the mixture of two miscible liquids where difference between their boiling points is at least 25 °C. Acetone and water are miscible liquids also the difference between their boiling point is more than 25 °C so they can be separated by the method of simple distillation. Follow the steps given below

(i) Take a mixture in the distillation flask fit it with the thermometer.

(ii) Arrange the apparatus as shown in the given figure.

(iii) Heat the mixture slowly keeping a close watch on thermometer.

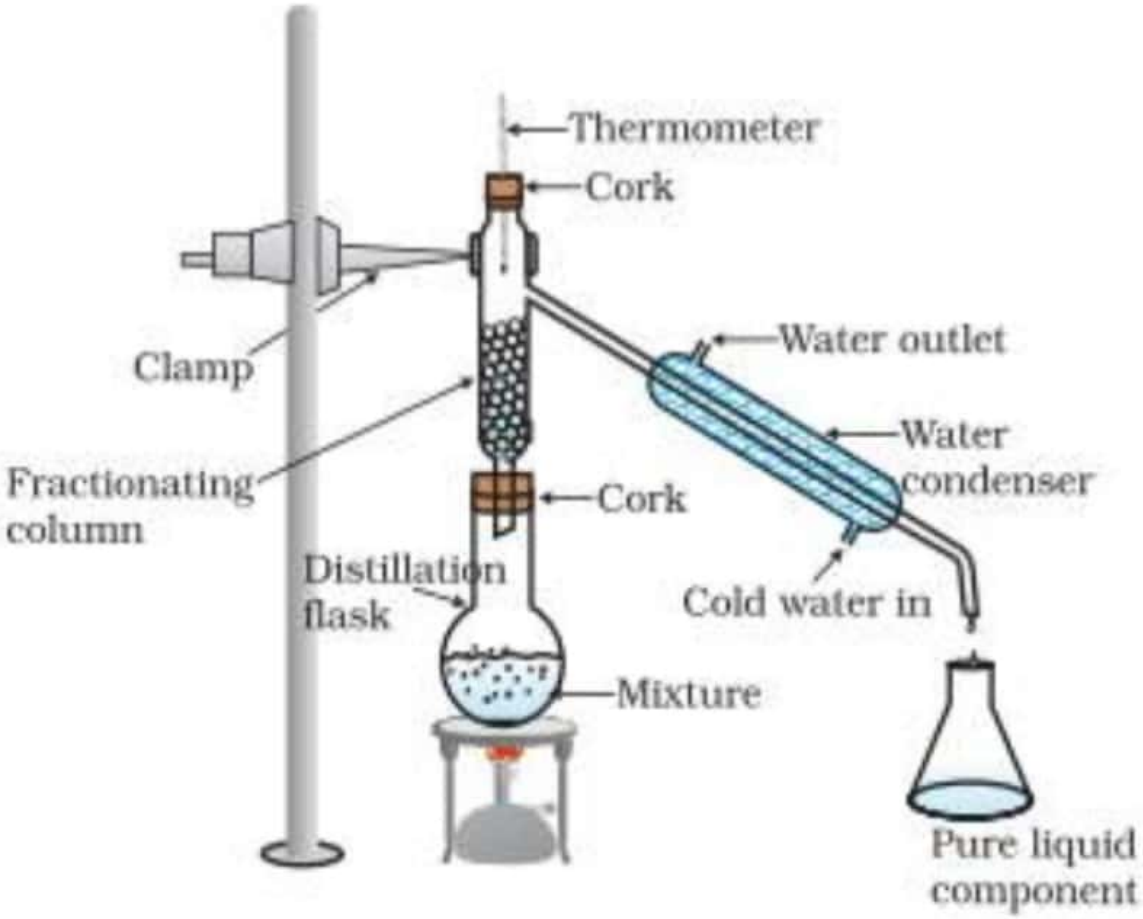
(iv) Since the acetone has lower boiling point starts vaporises and condenses in the condenser which is finally collected in the beaker.



Explain the method of fractional distillation.

Explain the method of fractional distillation.

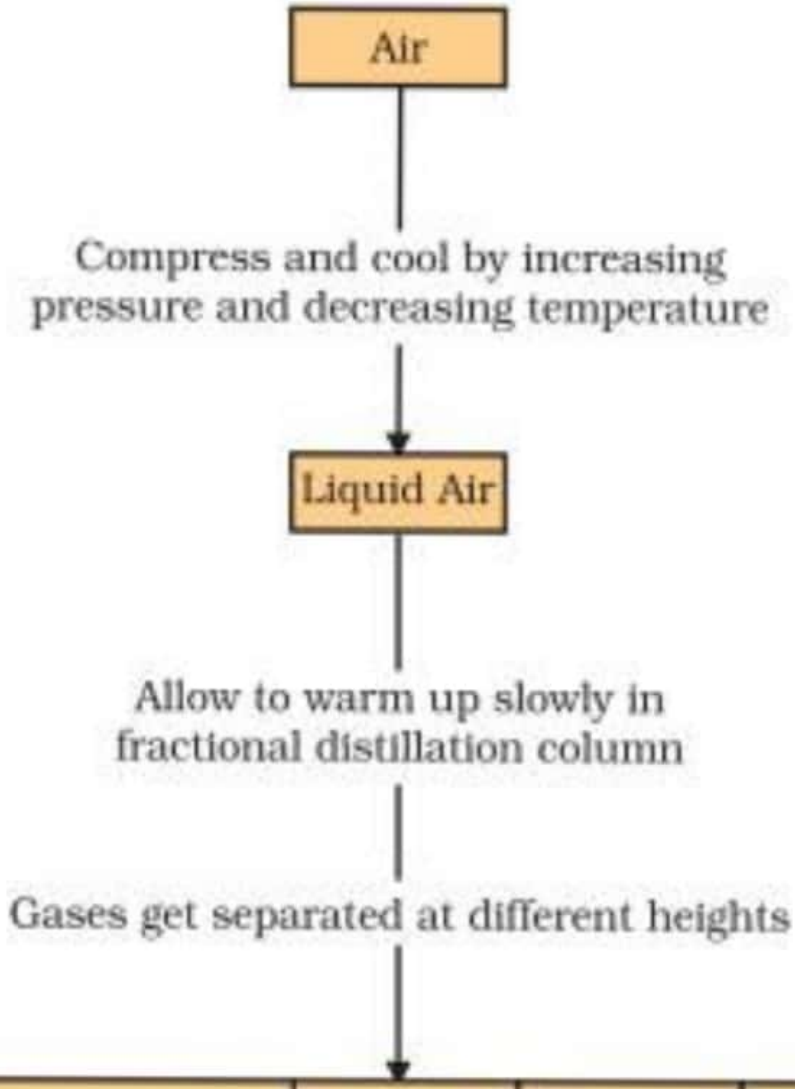
Answer: This method is used to separate the mixture of two miscible liquids where difference between their boiling points is less than 25 °C. Also to separate a mixture of two or more miscible liquids for which the difference in boiling points is less than 25 K, fractional distillation process is used, for example, for the separation of different gases from air, different factions from petroleum products etc. The apparatus is similar to that for simple distillation, except that a fractionating column is fitted in between the distillation flask and the condenser. A simple fractionating column is a tube packed with glass beads. The beads provide surface for the vapours to cool and condense repeatedly, as shown in following figure.



How can we obtain different gases from air?

How can we obtain different gases from air?

Answer: Air is a homogeneous mixture and can be separated into its components by fractional distillation. The flow diagram given under shows the steps of the process.



	Oxygen	Argon	Nitrogen
Boiling Point (°C)	-183	-186	-196
% Air by Volume	20.9	0.9	78.1

Explain Crystallisation.

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Answer: Crystallisationis a process that separates a pure solid in the form of its crystals from a solution. The crystallisation method is used to purify solids.

For example, the salt we get from sea water can have many impurities in it. To remove these impurities, the process of crystallisation is used.

Applications of crystallisation

- Purification of salt that we get from sea water.
- Separation of crystals of alum (*phitkari*) from impure samples.

What is a physical change? Give example.

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Answer: A change which occurs without a change in the composition and chemical nature of the substance is called a physical change. It means that there is a change only in the physical properties of the substance. Properties like colour, hardness, rigidity, fluidity, density, melting point and boiling point are known as physical properties. Melting of ice or boiling of water is a physical change because ice, water and water vapours are chemically the same substance that is H_2O.

What is a chemical change? Give example.

What is a chemical change? Give example.

Answer: A change in which a substance reacts with another substance to undergo a change in chemical composition. For example burning of a candle in which wax burns and converted into carbon dioxide and water.

Differences between Mixtures and Compounds

Compounds	Mixtures
1. Consist of a single substance	1. Consist of two or more substances
2. The elements in a compound is always in a fixed proportion	2. The proportion of each substance in the mixture does not matter
3. The properties are very different to those of the elements used	3. The properties are the same as those of the substances used
4. Very difficult to separate	4. Usually easy to seperate