

2

Separation of Substances



"Most of the things around us are not pure, but are mixture. We can use different components of mixture by separating them."



Do You Remember ?

- ★ You all know about mixture namkeen, it is a famous Indian snack. All variety of snacks is mixed in small quantities with fried nuts, puffed rice, dry fruits and fried grams in any quantity.
- ★ So, mixture is a substance that composed of two or more simpler substance in any proportion.

1. Introduction

Many things around us such as stones, wood, etc. are used as such. However, a large number of substances available in nature are mixed with certain other substances. Thus, in order to use them we separate them by various methods. On the separation of a mixture, some of its components may be useful or all components are useful.

Following examples will illustrate the above statement.

- (i) Milk is churned to separate butter.
- (ii) We gin cotton to separate seeds from the fibre.
- (iii) We took out chillies from poha or daliya.
- (iv) Pick out one kind of fruit from basket containing mangoes and guavas.
- (v) Tea leaves are separated from the liquid with strainer.



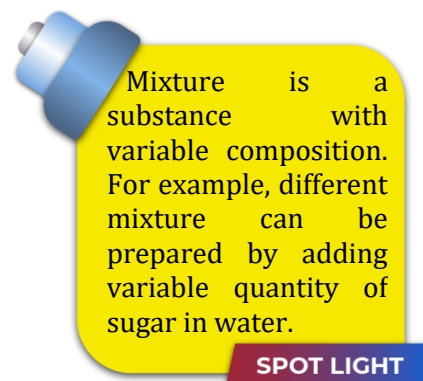
Lady churning butter from curd.

2. Mixtures

An impure substance, or a mixture, contains two or more substances in any proportion. Also, these substances can be separated from one another. A mixture may contain elements, compounds, or elements and compounds. A mixture should not be confused with a compound. The proportion of the constituent elements in a compound is fixed. But that of the components of a mixture is not.

For example, any amount of salt or sugar can be mixed with any amount of water to form a mixture.

Most materials that we use or come across are mixtures. Some of them are useful and others need purification (i.e., separation) before use.



Do You

Remember ?

- ★ The reason for which we need to separate mixture are following. Different component of a mixture are separated in order to either separated the un-required component from a mixture.
- ★ The solid tea leaves separated out from the tea by the process called filtration, it a common example which we see in our day to day life.

Some examples of naturally occurring and man-made useful mixtures are given below.

(1) Air

Air contains the elements nitrogen, oxygen and argon and the compounds carbon dioxide and moisture (water vapour).

(2) Natural water

Natural water contains dissolved air, which is essential for aquatic animals.

(3) Sugar solution and soft drinks

A solution of sugar or glucose in water is a mixture. Soft drinks (or fizzy drinks) contain carbon dioxide dissolved in water, to which are added some sweetening and flavouring agents. They are highly refreshing.

(4) Medicines

Most medicines are mixtures. On the label of a medicine bottle, you will find the substances or ingredients it contains.

(5) Alloys

An alloy is a metal mixed with other metal(s) or non-metal(s). The components are so thoroughly mixed that the whole thing appears to be a single substance. They are usually made by melting the components together and allowing the melt to solidify. Alloys are generally stronger than the metals they contain.

Steel, the most common alloy, contains iron with small amounts of carbon and manganese, **Stainless steel** is a special steel containing some chromium and nickel also.

Brass contains copper and zinc, whereas bronze contains copper and tin. Pure gold is not suitable for making jewellery. Pure gold is soft and gets reshaped by small pressures. So, the gold used for making jewellery is made stronger by alloying it with silver and copper.



Brass is used to make musical instruments because it produces good sound when vibrated.



Why do we need to separate different components of mixture? Give two examples.

Explanation

When two or more than two substances are mixed together, we call it a mixture. Sometimes, different components of a mixture are not useful or may be harmful. So, we need to separate different components of the mixture. For example,

- (a) After preparing tea, the tea leaves are not useful.
- (b) Small stones present in rice are harmful. So, we need to separate them.



Aim

To know the need of separation of substances.

Method

- (i) Separate stone from rice.
- (ii) Churning milk to obtain butter.
- (iii) Separate tea leaves from liquid.

| Separation process | | | Purpose for which we do the separation | | What do we do with the separated components? |
|--------------------|--------------------------------|-----|---|-------|--|
| (1) | Separate stones from rice | (a) | To remove impurities or harmful components. | (i) | We throw away the impurities. |
| (2) | Churning milk to obtain butter | (b) | To separate two different, but useful components. | (ii) | We use both the components. |
| (3) | Separate tea leaves | (c) | To remove non-useful components. | (iii) | We throw away the solid component. |

Observation

We need to separate harmful or non-useful substances that may be mixed with it. Sometimes we need to use them separately.

3. Need of separation

As we know that many naturally occurring as well as man-made mixtures are desirable. But there are many mixtures which are undesirable and cannot be used as such. The constituents of mixtures need to be separated for the following reasons.

(1) To remove the undesirable constituents

For example, we need to separate impurities from ordinary water to make it **potable** (safe for drinking). We must remove husk, stones and dirt from food grains before we cook them.

(2) To obtain desirable substances

For example, we obtain common salt from sea water, which contains many substances including salt. Similarly, we separate petrol, kerosene and diesel from petroleum (crude oil).

(3) To obtain highly pure substances

For example, from ordinary water, we obtain highly pure sample of water for medicinal purposes.

4. Methods of separation

Methods of separation are based on the properties of materials, present in a mixture. The constituents of a mixture retain their properties, so they can be separated easily. Some of them are,

(1) Hand-picking

If a constituent of a solid mixture is big and visibly different, it can be separated by hand-picking.

For example, stones can be separated from rice and wheat or the seeds of different varieties of pulse get mixed up, they are separated by hand-picking. Plucking rotten grapes from a bunch is nothing but hand-picking. For picking, forceps can also be used.

However, hand-picking is useful only if you need to separate a small amount of constituents from a mixture. This is because, the process is time-consuming.



Separating rotten grapes by hand



Aim

To show the process of hand-picking material required - A packet of food grain.

Method

- (i) Bring a packet of food grain.
- (ii) Spread the grain on a sheet of paper.

Observation

We observed that pieces of stone, husks, broken grains and particles of other grains are also present in it.

Conclusion

As pieces of stone and other grain are slightly larger sized and visibly different can be separated by hand picking.



Hand picking of stones from grains

(2) Threshing

The process used to separate grains from the stalks is called threshing.

Bundles of paddy (rice) or wheat stalks are kept in the fields after harvesting the crop.

These stalks are dried in the sun before the grain is separated from them. These grains cannot be separated from stalks by hand picking. The farmers make small bundles of these stalks and then hit it against the hard wall of mud or hard substances. In doing so the grain separates from the stalks.

These days there are mechanical threshers which hammer the stalks and separate grains from them.



Threshing

(3) Winnowing

Lighter solids are separated from heavier ones by wind is called winnowing. Farmers use this method to separate chaff (the covering of grain) from grain. A mixture of chaff and grain is made to fall from a height. The lighter chaff drifts away and the heavier grain falls vertically on the ground. Wind helps in winnowing by blowing away the chaff more easily.



Winnowing

If there is no wind, the winnower moves slowly through a length of about five metres while letting the mixture fall. The movement of the winnower stirs the air, which helps the chaff drift. If some chaff falls on the grain, it can be blown away.

You can mimic winnowing. Take some roasted groundnuts on your palm and peel the nuts. Blow air at them. The nuts will remain on your palm, while the outer covering will be blown away.



Quick Tips

- ★ We can apply hand picking separation technique where the component of a mixture have different shape, size colour.
- ★ We can apply threshing process when we want to separated out grain from the stalks.
- ★ We can apply winnowing process where we have a mixture of heavy and light (that easily blown away by wind) particle.



Active Chemistry

3

Aim

To show the process of winnowing.

Material required

Mixture of dry sand with sawdust or powdered leaves.

Method

- (i) Take the mixture to an open ground and stand on a raised platform.
- (ii) Put the mixture in a plate or sheet of paper.
- (iii) Hold the plate or the sheet of paper containing the mixture at your shoulder height.
- (iv) Tilt it slightly, so that the mixture slides out slowly.

Observation

Both the compounds sand and sawdust (or powdered leaves) do not fall to the same place.

Conclusion

This method of separating components of a mixture is called winnowing. Winnowing is used to separate heavier and lighter components of a mixture by wind or by blowing air.



Check your Concepts

1

Multiple choice questions

1. Winnowing is the process that can be used to separate
 - (1) iron filings and stones
 - (2) stones and chaff
 - (3) potatoes and tomatoes
 - (4) sugar and salt

2. Separation of grains from stalk is called _____.
 (1) Winnowing (2) Threshing
 (3) Hand picking (4) All of these

True or False

3. (i) Solid mixture is big and visibly different can be separated by winnowing.
 (ii) Plucking rotten grapes from bunch is hand-picking.
 (iii) Grains from husk is separated by threshing.

(4) Sieving

If a solid mixture is stirred or shaken on a mesh, particles smaller than the holes in the mesh fall and the bigger ones remain on the mesh. Thus, particles are separated on the basis of their size.

This process is called **sieving** and the mesh (usually fitted into a frame) is called a **sieve**. Sieve is a shallow vessel having small holes at its bottom. The size of the holes of a sieve to be used, depends on the size of the particles of the material, to be separated from the mixture.

Small and fine sieves are used in the kitchen to separate bran and other impurities from flour. Coarse particles of flour are called wheat bran.

The impurities remain on the sieve and flour passes through. Bigger sieves are used at construction sites to separate stones from sand.



Some common type of sieves



(a) Cleaning of grain



(b) Sieving of sand



Aim

To show the purpose of separation by sieving.

Material required

Sieve, small quantity of flour and fine powder of chalk with bigger impurities.

Method

- (i) Pour the mixture of fine flour or chalk with bigger particles on sieve.
- (ii) Sieving allows the fine particles to pass through the holes of the sieve while the bigger impurities remain on the sieve.

Observation

We observed that both flour and powder of chalk particles are smaller than the holes in sieve, and fall. Bigger particles of impurities remained on sieve.

Conclusion

Sieving is used when components of mixture have different sizes.

(5) Magnetic separation

Iron is attracted by a magnet. So, if you move a magnet through a mixture of iron filings and sulphur, the iron particles cling to the magnet.

Sulphur is not attracted by a magnet and so the particles of sulphur are left behind.

This is how a mixture of iron and sulphur is separated. Such a method, in which a magnet is used to separate the constituents of a mixture, is called **magnetic separation**.

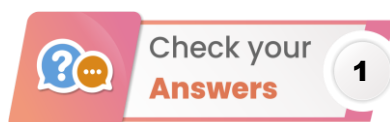


Scrap iron is picked up by huge magnets in scrapyards.



Iron particles stick to the magnet and sand is left behind.

Huge magnets, held by cranes, are used to pick up scrap iron in scrapyard.



1. (2)
2. (2)
3. (i) False (ii) True (iii) False

(6) Sedimentation and decantation

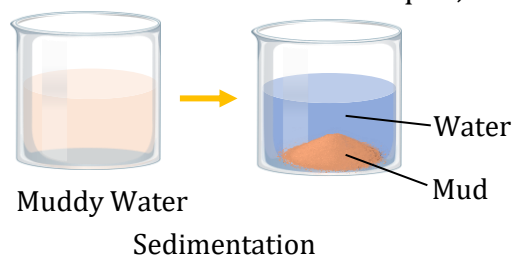
Suppose you have a solid - liquid mixture in which the solid is heavier than the liquid, for example, a mixture of sand and water.

If you allow the mixture to stand for some time, the solid will settle at the bottom of the container and the liquid will remain over it. This process is called **sedimentation**, and the solid layer at the bottom is called the **sediment**.

The liquid above the sediment is known as the **supernatant liquid**.

We can pour out the supernatant liquid carefully into another vessel, leaving behind the sediment. The process is called **decantation**.

However, if you have a solid-liquid mixture containing a solid lighter than the liquid, For example, a husk-water mixture, sedimentation and decantation will not work.



Aim

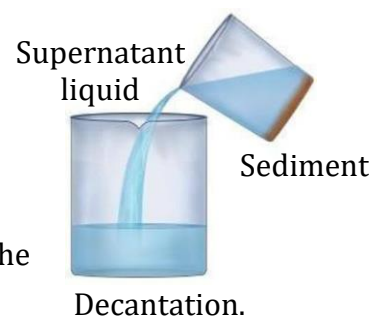
To separate a mixture of sand and water by sedimentation and decantation.

Method

Half fill a beaker with water and mix a little sand in it. Allow the mixture to stand for a few minutes.

Observation

The heavier sand particles will settle down at the bottom of the beaker as sediment. Carefully pour the water into another beaker using a glass rod. Do not disturb the beaker. Sand is collected at the bottom.



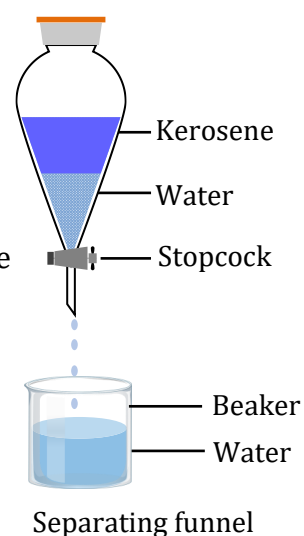
How will you separate a mixture of kerosene and water?

Explanation

Kerosene and water are two immiscible liquids. The mixture can be separated by using a **separating funnel**.

The mixture of kerosene with water form two distinct layers of liquids. Kerosene being lighter will form a top layer.

On opening the stop cock water will be collected in beaker leaving the kerosene in the separating funnel.



Loading

Loading helps sedimentation. You may have seen that water obtained from natural sources like wells and rivers is muddy, especially in the rainy season. Very fine, solid particles do not sink to the bottom they remain **suspended** in water. If the particles join some other particles, they become heavier and sink. We then say that the particles are loaded.

Suspended solid particles in water are loaded by the addition of alum.



Potassium alum is commonly used at our home by the name phitkari

(7) Filtration

By decantation, a liquid is not completely separated from an insoluble solid. **Filtration** is a better method. The process of removing insoluble solid from a liquid by using a filter paper is called filtration.

Filtration in the laboratory**Aim**

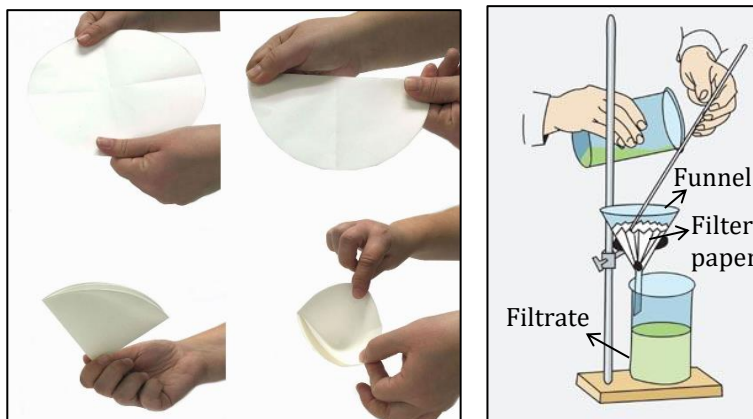
To compare the filtration and decantation method to separate mud from water.

Material required

Muddy water, filter paper, beaker.

Method

- (i) Take muddy water in a glass and leave it without disturbing for some time.
- (ii) Pour the water from the top into another glass.
- (iii) Now filter the water through a piece of cloth/filter paper.
- (iv) A filter paper folded in the form of a cone is fixed onto a funnel (Fig. 9). A circular filter paper is folded along its diameter into two semicircles. It is once again folded into four quarter-circles. Now, a cone is opened by holding three quarter-circles on one side. This cone is fitted into the cone of a funnel and moistened with water so that the filter paper adheres to the funnel.
- (v) The mixture is then poured on the filter paper. The supernatant liquid is slowly poured along a glass rod into the funnel. The solid collects on the filter paper (**residue**), whereas the liquid passes through. The clear liquid thus obtained is called the **filtrate**.



Folding of filter paper and Filtration

Observation

After decantation we observed that water in the second glass is still muddy or brown in colour. In a piece of cloth, small holes or pores remain in between the woven threads. These pores in a cloth can be used as a filter. A filter paper is one such filter that has very fine paper in it. Solid particles in the muddy water do not pass through it and remain on the filter.

You can easily separate a mixture of sand and water or chalk and water by filtration.

**Quick
Tips**

- ★ We can apply sieving separation technique where we have solid-solid mixture and the size of the component are not equal, so we can separate out on the basis of their size.
- ★ We can apply magnetic separation technique where one component is magnetic in nature but other component of the mixture are non-magnetic.
- ★ We can apply sedimentation and decantation separation techniques where we have insoluble solid and liquid mixture, kept in mind that insoluble solid is heavier in nature that it settle down at bottom when we put it in liquid.
- ★ We can use alum to coagulate suspended particles.
- ★ We can apply filtration separation technique to separate any insoluble solid component from the liquid.

(8) Churning

Fruit salad has cream in it. But do you know how cream is obtained? It is obtained by churning milk. When milk is churned, cream is separated from it. As cream is lighter than milk, it floats over the liquid. Churning is done either manually or by using an electric churner. In a washing machine also, the dirt separated from the cloth by a similar action.



We carry out the process of filtration at home in straining tea.



Washing machine follows the technique of churning.



Electric blender



In villages milk or curd is churned to separate the butter by using a device. Can you explain this technique in a scientific manner?

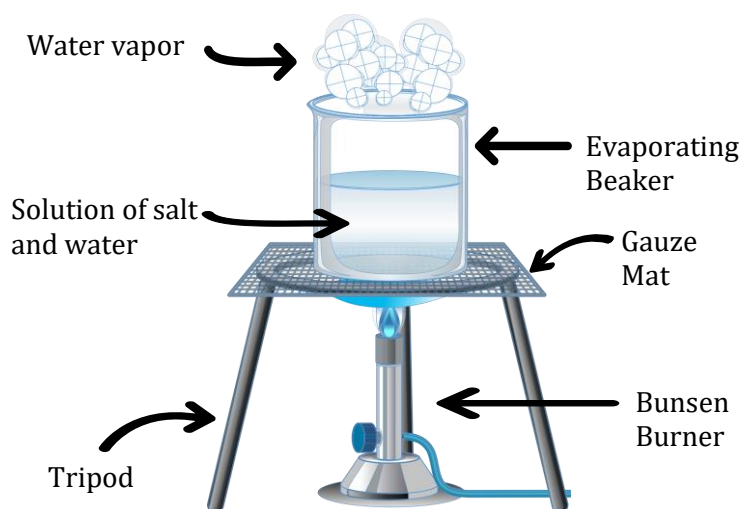
Explanation

This method of separation is known as centrifugation. It is used for separating particles suspended in milk. When the mixture is rotated (churned) at a high speed, the lighter particles collect at the centre and float at top (butter). The denser particles move outwards and settle at the bottom. These days a mixer grinder is used for this separation method.

(9) Evaporation

A solid can be recovered from its solution by evaporating the solvent. A solution of salt in water, when heated on a flame for some time, leaves a residue of the salt.

By improved, but similar processes, distilled water is prepared for laboratory and medicinal purposes.



Evaporation of water from salt solution

**Aim**

To separate salt from water by using evaporation.

Material required

Beaker containing salt and water.

Method

Heat the beaker containing salt and water.

Observation

After heating the mixture salt remain in the beaker.

Conclusion

We use the process of evaporation, to separate the mixture of water and salt.

**How is common salt obtained from sea water?****Explanation**

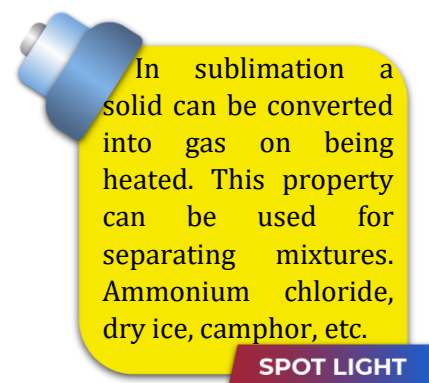
Sea water is collected in shallow pits dug on the seashore. The heat of the sun makes the water evaporate. Since, sea water contains salt, when enough water has evaporated, the solution becomes concentrated. Then the salt begins to crystallise. The salt is further purified and mixed with a chemical called sodium iodate. This mixture is **iodised table salt**. Sodium iodate contains iodine. The lack of iodine in our diet might cause the disease **goitre**.



Obtaining common salt from sea water.

**1. True or False**

- (i) The settling down of insoluble particles in a liquid medium is called loading.
- (ii) A mixture is an impure substance.
- (iii) Cream can be separated from milk by filtration.
- (iv) Chemical reaction does not take place in formation of a mixture.
- (v) Petrol can be separated from water by evaporation.



In sublimation a solid can be converted into gas on being heated. This property can be used for separating mixtures. Ammonium chloride, dry ice, camphor, etc.

SPOT LIGHT

2. Fill in the blanks

- (i) The settling down of a solid particle is known as _____.
- (ii) The method of separation of constituents depends upon their _____.
- (iii) Sand can be separated from oil by _____.
- (iv) Filtration is a method of separating solid particles from a _____ using filter paper.
- (v) The process of transferring the clear upper liquid layer without disturbing the settled solid particles is called _____.

3. Match the column

| Column-I | | Column-II | |
|----------|--|-----------|-------------|
| (i) | Separation of butter and curd | (a) | Loading |
| (ii) | Removing insoluble particles in a liquid | (b) | Sieving |
| (iii) | Making mud particles heavier by alum | (c) | Evaporation |
| (iv) | Separation of chaff from wheat flour | (d) | Filtration |
| (v) | Obtaining soluble salt from its solution | (e) | Churning |

(10) Dissolution, evaporation, and condensation

This method is useful when one constituent of a solid mixture is soluble in a solvent (water) and the other is not.

**Aim**

To separate a mixture of salt and sand by dissolution, evaporation and condensation.

Method

- (i) Take a mixture of salt and sand in a beaker.
- (ii) Keep this mixture in beaker and add water into this, leave the beaker aside for some time.

Now answer

- (a) Do you see, the sand settling down at bottom?
- (iii) Separate sand from mixture using decantation or filtration.
- (iv) Now, we need to separate salt and water from the decanted liquid. Transfer this liquid to a kettle and close its lid. Heat the kettle for some time.
- (v) Take a metal plate with some ice on it. Hold the plate just above the spout of the kettle.

Observation

When the steam comes in contact with the metal plate cooled with ice, it condenses and forms liquid water. The water drops that you observed falling from the plate, were due to condensation of steam. The process of conversion of water vapour into its liquid form is called condensation. After, all water has evaporated, salt is left behind in kettle.

Conclusion

We have thus, separated salt, sand and water using processes of dissolution, evaporation and condensation.

**Quick
Tips**

- ★ Centrifugation is the principle used in process of churning separation technique.
- ★ We can apply evaporation process where the solid component of a mixture is soluble in liquid. It work on a principle that liquid vaporize easily while solid does not.
- ★ We can also apply two or more separation technique to separate out component of a single mixture.

**Building
Concepts**

5

While dissolving the salt in water, you heated the mixture. Is there a connection between temperature and the amount of solute that can be dissolve in a solution?

Explanation

Yes, there is. Only a certain amount of a solute can be dissolved in a given amount of a solvent at a particular temperature. This amount increases on increasing the temperature.

5. Water (An important solvent)

It is because of its property of dissolving a large number of substances that water is so essential for life.

- (i) Our body cannot absorb food substances unless they are soluble in water. In the process of digestion, food is reduced to simple substances that are soluble in water. They can then be dissolved in water and absorbed by the body.
- (ii) Several waste materials produced in the body are dissolved in water and excreted. A number of chemical reactions occur inside our body. They all occur in the presence of water.
- (iii) Plants can absorb nutrients from the soil only if they are soluble in water. Minerals from the roots and food from the leaves are transported to different parts of the plant in the form of solution in water.

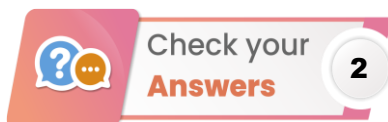


If the total amount of water on Earth were 100 litres, readily available fresh water would be only about one teaspoon.

SPOT LIGHT

(iv) Gases such as oxygen and carbon dioxide which are soluble in water are important for survival of aquatic life. Fish breathe through their gills. Aquatic plants use the carbon dioxide dissolved in water for photosynthesis. Carbon dioxide is dissolved in aerated drinks to give them their tangy taste.

The solubility of gases in water decreases with increase in temperature. Thus, dissolved gases escape from water when it is heated. This can easily be seen by gently heating water in a pot. You will see small bubbles coming out much before water starts boiling. These are bubbles of air dissolved in water.



1. (i) False (ii) True (iii) False (iv) True (v) False
2. (i) Sedimentation
(ii) Physical properties
(iii) Sedimentation and decantation
(iv) Liquid
(v) Decantation
3. (i) e (ii) d (iii) a (iv) b (v) c

Basic terminology

1. **Separate** - cause to move or be apart
2. **Churned** - shake (milk or cream) in a machine in order to produce butter
3. **Gin** - combing the fibre
4. **Strainer** - a device having holes punched in it for separating solid matter from a liquid
5. **Retain** - continue to have
6. **Pluck** - quickly or suddenly remove something
7. **Rotten** - very bad
8. **Stalks** - the main stem of a plant
9. **Harvesting** - gather (a crop) as a harvest
10. **Thresher** - machine that separates grain from corn or other crops by beating
11. **Husk** - the dry outer covering of some fruits or seeds
12. **Fodder** - food, especially dried hay or straw, for cattle
13. **Bran** - pieces of grain husk separated from flour
14. **Supernatant liquid** - liquid after a mixture of liquid and solid has been left to settle out
15. **Funnel** - a tube or pipe that is wide at the top and narrow at the bottom
16. **Woven** - form (fabric or a fabric item) by interlacing long threads passing in one direction with others at a right angle to them.
17. **Shallow pits** - hole in the ground of little depth
18. **Seashore** - an area of sandy, stony, or rocky land bordering and level with the sea
19. **Saturated** - unable to absorb or dissolve any more of a solute
20. **Bunch** - a number of things, typically of the same kind

Memory Map

Mixture
(is composed of two or more substances in any proportion)

Methods of separation

