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### 3.1 Introduction

We see many things around us. Some are living things while some are non-living. All these things are different from each other. Their shape, size, growth, nutrition, movement and other activities are also different from each other. The material by which these things are made up of is called matter. Some things, occupy space, has definite volume and mass. Some things are to be separated from other things before use.

For example, grain is separated from husk before use. How and why do these activities take place? We will learn in this chapter.

### 3.2 Classification of Things

Things are of two types – natural and man-made things. Trees, grass, birds, moon, stars, rivers, mountains, sea, etc. are natural things, and chair,

table, pencil, fan, book, etc. are man-made things. Some things are found in solid state, some in liquid and some in gaseous state. We classify these things in different groups like living or non-living, natural or man-made, big or small, solid, liquid or gas.

### 3.3 Classification

Separating materials on the basis of their similar quality is called classification. This classification is done on the basis of their similarities and dissimilarities. All the things in the world are divided in two parts : living and non-living. Some living and non-living things are shown in the table below.

Serial No.	Name of Thing	Classification
1.	Pen	Non-living thing
2.	Stone	Non-living thing
3.	Book	Non-living thing
4.	Buffalo	Living thing
5.	Bus	Non-living thing
6.	Fan	Non-living thing
7.	Chair	Non-living thing
8.	Goat	Living thing
9.	Tree	Living thing
10.	Comb	Non-living thing
11.	Lion	Living thing
12.	Cycle	Non-living thing
13.	Human beings	Living thing
14.	Pencil	Non-living thing
15.	Grass	Living thing

In our daily life, we see many things around us. These things are made up of different substances, which are made up of one or more elements.

For example, a chair is made up of wood, fevicol, nails, varnish. Varnish protects wood from termite. Many things are made from one substance only; like tumbler, mirror, window pane are made from glass.



Living and non-living things

### 3.4 Properties of Material

Materials have two types of properties :

- (i) Physical properties      (ii) Chemical properties

**Physical properties** – Mass, volume, weight, density.

**Chemical properties** – Reaction of water and gases, with different materials, which take place at atmospheric temperature and pressure.

(I) **Mass** – All materials have mass or weight. This is a natural quality. The magnitude of matter in any substance is called mass of that substance. Unless and until mass is not increased or decreased, it remains unchanged.

Mass of different things is different. For example, wood is lighter than iron. Similarly, iron is also heavier than aluminium. It means mass of iron is more than wood and aluminium. Units of mass are gram, kilogram, milligram, etc.

(II) **Volume** – Volume is an important property of material. All materials occupy definite space. Therefore, the amount of space occupied by a material is called its volume. Units of volume are litre, milli-litre, cubic meter, etc.

(III) **Weight** – When we throw anything upwards, it falls down on the earth. This happens due to the force applied by the earth, because earth pulls everything towards itself. This force is called gravitational force. Due to gravitational force, earth pulls everything towards its center. Thing which is more heavy is pulled with more force by the earth.

### Activity

Take one weighing scale, one book and one cricket ball. Feel the weight of each thing by taking it in your hand. Now balance all these things one by one on a weighing scale. When we put any thing on its tray, it will come down. This proves that every thing has some weight.

(iv) **Density** – The mass of unit volume of a thing is called its density. It shows how much space is occupied by an object of definite mass. Units of density are cubic meter and cubic centimeter.

### 3.5 Atoms and Molecules

**Atoms** – All things are made up of very small particles which are called atoms. Atoms are so small that we cannot see them with naked eyes. To see the atoms, we have to use a microscope.

**Molecules** – A molecule is a group of specific atoms. One molecule is made up of two or more than too atoms, chemically combined together. The physical property of a material is also present in each of its molecule.

### 3.6 Elements and Compounds

**Elements** – Material which is made up of only one type of molecules is called element. For example : oxygen, granite, etc. Both of these are made of one type of molecules.

**Compounds** – Materials which are made of more than one type of molecules are called compounds. It means compound is that material in which more than two elements are chemically joined together in a fixed ratio. For example, sugar is a compound. Each molecule of sugar is made of carbon, hydrogen and oxygen atoms.

### 3.7 States of Matter

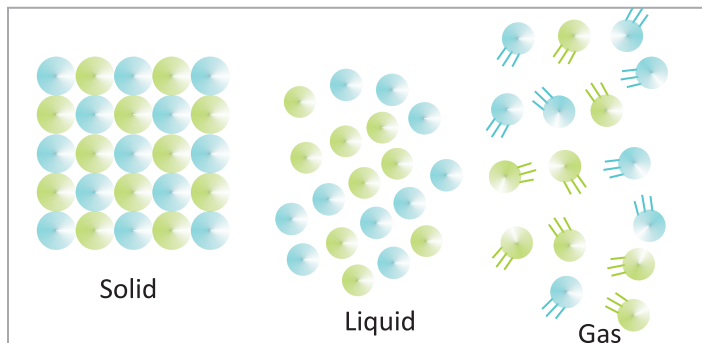
State of matter is an important property of any material. This state of matter is called physical property of a material. Three states of matter are solid, liquid and gas.

**Solid** – In solids, atoms are closely packed with each other. Force of attraction between these atoms is very high. This force keeps the atoms intact with each other. This is why solids remain fixed in one place. Solids have definite mass and volume.

**Liquid** – In liquids, atoms are loosely packed as compared to solids, that is why, force of attraction is

less. Therefore, liquid do not have definite shape but they have a definite volume.

**Gas** – Atoms of gas are very far from each other, therefore, there is no force of attraction amongst them. Therefore gases do not have a definite shape and volume.



States of solid, liquid and gas

### 3.8 Melting Point and Boiling Point of Substances

**Melting point** – Temperature at which solid changes into liquid is called melting point of that substance. For example, melting point of ice is  $0^{\circ}\text{C}$ .

**Boiling point** – Temperature at which liquid changes into gas is called boiling point. For example, boiling point of water is  $100^{\circ}\text{C}$ .

### 3.9 Properties of Matter

To classify different materials, some other properties are also considered. These properties are solubility in water, conduction of heat, magnetism, diffusion, etc.

**1. Solubility in water** – Water is a solvent. Some materials are completely soluble in water. This property of water is called solubility. Material obtained after the process is called solution. In the solution, the material which is dissolved is called solute and material in which it is dissolved is called solvent.

(I) **Soluble substances** – Common salt, sugar, potassium permanganate.

(II) **Insoluble substances** – Sand, wood, metal, chalk, wax, etc.

**Solubility of gases in water** – Some gases are soluble in water while some are insoluble.

(I) **Gases soluble in water** – Oxygen and carbon dioxide.

(II) **Gases insoluble in water** – Nitrogen, methane and hydrogen.

### Activity

#### Test of solubility of solids

Take two test tubes. Fill a little water in both the test tubes. Now add some salt in one test tube and wax in another test tube. After some time you will observe that salt is fully dissolved in the first test tube but wax is not dissolved in second test tube. This activity shows test of solubility.

#### 2. Conduction of heat

– Substances are of two types, good conductor and bad conductor or insulators of heat. Substances which allow the heat to pass through them easily from one



Pressure cooker

end to other are called good conductors of heat and the substances through which heat cannot pass easily are called bad conductors of heat. For example, wood, cloth, water and gases. Cooking utensils like frying pan and cooker have handles of wood or plastic.

**3. Conduction of electricity** – Substances through which electricity can pass easily are called good conductors of electricity. Generally, all metals are good conductors of electricity. For example- silver, bronze, mercury, etc.

Substances which do not allow electricity to pass through them easily are called bad conductors of electricity. For example, rubber, glass, wood, etc.



Electric wires

**4. Transparency** – Substances through which light can easily pass are called transparent substances. For example, glass. Substances through which light cannot pass through are called opaque substances. For example, metal, brick, etc.

**5. Evaporation** – Vaporization is used to separate soluble solids from liquid. For example, salt dissolved in water is separated by this method. Only common salt is obtained from salty water of sea by the method of vaporization. In the shallow areas, sea water gets deposited which is evaporated by heat of the sun and salt is left behind.



Preparation of salt by sea water

**6. Magnetism** – Iron, nickel and cobalt are magnetic materials. Substances which are attracted by magnet are called magnetic substances. Magnet attracts the things made of iron towards itself. This method is used to separate iron dust from sand.

**7. Diffusion** – Atoms of gas can move freely and these atoms react with different substances to form some natural things. Diffusion takes place very fast in gases. For example, when you open a bottle of perfume, the smell spreads throughout the room. Perfume evaporates and vapour mixes with the air. It spreads everywhere in the room along with the air. This intermixing of one substance with other is called diffusion.

### 3.10 Pure Substances and Mixture

The substances which are made up of one type of atoms are called pure substances. All elements and their compounds are pure substances.

When two or more than two substances are mixed with each other in fixed or any ratio, the solution thus obtained is called mixture.

### 3.11 Types of Mixture

Mixtures are generally of two types :

1. Homogeneous mixture
2. Heterogeneous mixture

**1. Homogeneous mixture** – Mixture which is made of two or more elements but these elements cannot

be separated easily is called homogeneous mixture. For example, sugar solution, stainless steel, etc.

Homogeneous mixture are impure substances. They look like as if they are made from one material only but actually they are made from more than one substances. Homogeneous mixture can be solid, liquid or gas.

**2. Heterogeneous mixture** – Mixture in which all components can be seen separately is called heterogeneous mixture. For example, mixture of wheat and maize, mixture of different types of coins. Particles of mixture are quite big and can be clearly seen. That is why they can be easily separated.

Examples of Mixture		
S.No.	Mixture	Components of Mixture
1.	Sea water	Different types of salts and water
2.	Jaggery	Sugar and different salts
3.	Air	Oxygen, nitrogen, carbon di-oxide, water vapour, dust particles, etc.
4.	Crude oil	Petrol, kerosene, diesel, etc.
5.	Vinegar	Water and acetic acid
6.	Brass	Zinc and bronze
7.	Rock salt	Fine sand and common salt
8.	Smoke	Air and particles of carbon
9.	Pond water	Soil, sand and different impure elements
10.	Cooking gas	Butane and propane

### 3.12 Separation and Need of Separation

Properties of mixture and their need of separation can be understood as follows :

**1. Separating unwanted components** – Very fine suspended particles of clay and sand are present in river and pond water. They must be removed before using water because these impurities are very harmful.

**2. To obtain pure substance** – Substances used for medicines must be free from impurities. These impurities are removed in chemical laboratories. Pure substances are used in the preparation of medicines.

**3. To obtain useful substance** – We get sodium chloride from sea water. Sodium chloride is used as common salt. Our aim is to obtain only sodium chloride from sea water.

4. **To remove harmful components** – Smoke coming out of the chimney contains unburnt carbon and ash which are very harmful. These impurities must be removed from smoke before letting it to be mixed with air.

5. **To know the ratio of various elements in a mixture** – It is very important to know the ratio of various elements in a mixture. That is why mixtures are also separated in its constituents.

### 3.13 Physical Methods of Separation

Methods of separation depends upon the physical property of the constituents of mixture. In it, no chemical reaction is involved.

### 3.14 Separation of Solids

1. **Winnowing** – This method is used when one element is so light that it can be blown away by the wind.

This method is used by the farmers to remove husk from the grain. In this method, the wheat grains containing husk are allowed to fall down from some height. The lighter husk particles are carried away by the wind and heavier wheat grains fall on the ground.



Winnowing

2. **Hand picking** – This method is used to separate one component from other, when the components of a mixture are of different shape and colour. In this method, particles must be large enough to be picked. This method is used to remove stone from rice, wheat and pulses.

3. **Sieving** – This method is used to separate components which are of different shapes or sizes. Mixture is separated by using a sieve. The fine particles pass through the sieve while bigger particles remain on

the sieve. The size of the holes of the sieve depends upon the size of particles, which are to be removed.



Removing stones from grain (hand-picking)



Sieving grains

4. **Threshing** – Threshing is used to separate grain from bundles of wheat and paddy stalks. In this process, stalks are beaten on rocks to free the grain seeds. Sometimes, threshing is done with the help of bullocks. Machines are used to thresh large quantities of grain.

5. **Separation through magnet** – Magnet attracts the items made of iron. This property of magnet is used to separate different materials from iron. This method is called magnetic separation.

6. **Washing** – This method is used to separate light impurities by use of water. Light substances can be removed by using water. For example, when wheat is washed, light husk and hollow wheat comes up which can be easily removed.

7. **Sublimation** – This process is used when on heating a solid, it directly changes to gaseous state. Gaseous state of a substance is cooled and pure solid substance is obtained. For example, camphor, iodine, etc.

Solid  $\longrightarrow$  Gaseous state  $\longrightarrow$  Solid

### 3.15 Separation of Insoluble Solids from Liquids

**1. Sedimentations and Decantation** – When we mix sand in water, then after some time, sand settles at the bottom of the vessel because sand is heavier. Therefore the process in which heavier insoluble particles settle down is called sedimentation and pouring out the liquid without disturbing the settled material is called decantation.

**2. Loading** – Alum is soluble in water. When alum is added to the water, the small and soluble substances settle quickly at the bottom of the water. Water is poured into other vessel. The process of increasing the rate of sedimentation in a suspension by adding some chemical is called loading.

**3. Filtration** – This process is used to separate insoluble solids from liquids. In this process, filter is used. With these filters, solid and liquid particles are separated. Examples of filter are piece of cloth, filter paper.

**4. Centrifugation (Churning)** – In this method, fine suspended particles of a substance in a liquid are separated by rotating the liquid in a machine called centrifuge.

Therefore separation of small and insoluble solid substances from liquid is called centrifugation.

In dairies, cream is separated from milk by centrifugation. When the milk is churned for some time, the lighter cream particles float to its top surface from where they are taken out.

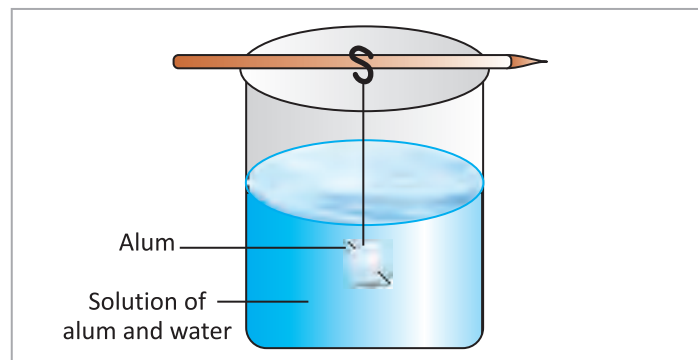


Centrifugation

### 3.16 Separation of Soluble Solids from Liquids

**1. Crystallization** – This method is used to separate pure particles of soluble solids from a solution.

Fill half of the beaker with water. Dissolve alum in it. Keep on dissolving alum till it stops dissolving in it. Heat this solution and dissolve some more alum in it. Now cool this solution. You will get crystals of alum. This process is called crystallization. To obtain big crystal of alum, suspend one small crystal of alum in the solution.



Crystallization

#### Activity

Take a beaker and fill it half with the water. Add some alum powder in it and heat the solution. Keep on dissolving alum in it till it stops to dissolve in it. This solution is called saturated solution of alum in water. Now with the help of filter paper, filter the hot solution in the other beaker. Allow the beaker to cool. We will see crystals of pure alum are formed in the solution. Separate the crystals, and dry them with the help of filter paper.

This activity shows the process of crystallization. Suspend a piece of alum in the solution with the help of thread. In two-three days, big crystal of alum will be formed.

**2. Distillation** – Pure water can be obtained by the process of distillation. Distillation is the process in which evaporation is followed by condensation. This process is used to separate impurities from a liquid.

Distillation apparatus has three parts :

- (I) Distillation flask
- (II) Condenser
- (III) Receiving flask

This process is also used to separate two miscible liquids, whose boiling points are different. Impure solution is taken in a flask. When it is heated, liquid is evaporated, which passes through the condenser, where vapours are cooled into liquid. The liquid is collected in the receiver flask. The solid matter or other liquid is left behind in the distillation flask.

### Methods of separation of some mixture

S. No.	Types of components of a mixture	Method of separation
1.	Light and heavy solid particles	Winnowing, washing
2.	Solids of different shapes	By using sieve
3.	Magnetic and non-magnetic substances	Magnetic separation
4.	Soluble solids in liquid	Vaporization, crystallization
5.	Volatile and non-volatile solids	Sublimation
6.	Insoluble solids in liquid	Decantation, filtration, centrifugation
7.	Soluble solids in liquid	Distillation
8.	Immiscible liquids	Decantation, filtration
9.	Miscible liquids	Fractional distillation

**Unsaturated solution** – Put one spoon of sugar in water. It will dissolve in it. Now put one spoon of sugar in it if . It will also dissolve. So, this solution is called unsaturated solution.

**Saturated solution** – Keep on dissolving the sugar in

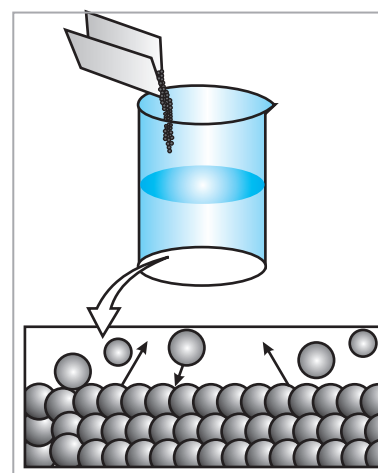
the solution till sugar stops dissolving in it. At this point when no more sugar can be dissolved in it, is called a saturated solution.

Saturation point can be increased by heating a mixture. Solubility is the property of dissolving any substance in a liquid. Some quantity of a substance is dissolved more in hot water than in cold water. This is because expansion of molecules take place on heating. Some other factors which increases the solubility are :

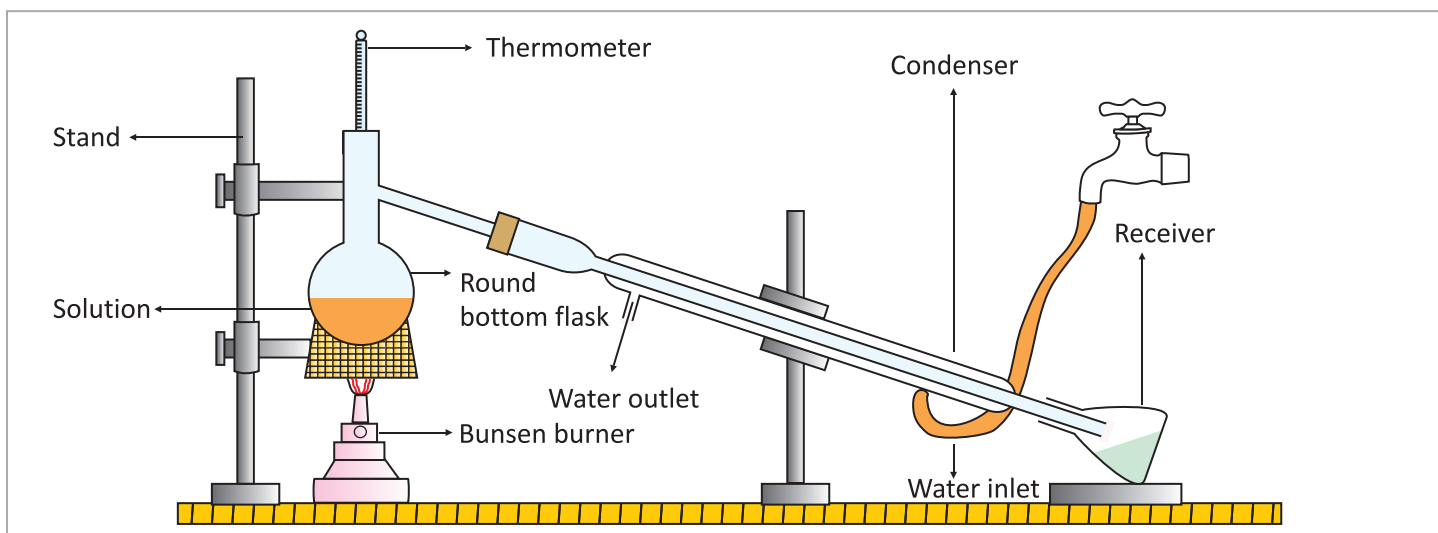
(I) On shaking, the rate of solubility increases. We can explain this by taking water in two glasses and then by adding one spoon of sugar in both the glasses. When we shake mixture of one glass and keeps one glass still, then we will observe that the sugar in the glass which we shook, dissolves easily.

(II) Powdered solute dissolves easily than solid solute. Take water in two glasses. In one glass add powdered sugar and in other glass, add sugar. We will observe that powdered sugar dissolves easily.

Different substances dissolve to different extent in water. Temperature also effects solubility.



Saturated Solution of sugar



Process of distillation

## Highlights

- Weight of the body is determined by the gravitational force exerted on the body.
- Substances made of same type of atoms and molecules are called pure substances.
- Substances made from different elements is an impure substance.
- The mass of unit volume of a thing is called its density.
- Ratio of elements in mixture is not same.
- Substance which are made of same type of atoms is called element.
- Substance which is made of more than one type of atoms is called compound.
- There are three states of matter : solid, liquid and gas.
- Pure substances have definite melting and boiling points and density.
- The substance in which a thing is dissolved is called solvent.
- Substances through which heat passes easily are called good conductors of heat.
- A solution may be homogeneous or heterogeneous.
- Components of a mixture can be separated by one or more methods.
- Methods of separating components of a mixture are winnowing, hand picking, sieving, distillation, decantation, sedimentation, vaporization and filtration.
- Some properties of components are considered during separation which are not present in other component.
- Solubility is not seen properly in unsaturated solution.

## Exercise



### A. Tick the correct option.

- Things are :  
(a) natural  (b) man-made   
(c) (a) and (b) both  (d) None of these
- Properties of substance are :  
(a) physical  (b) chemical   
(c) (a) and (b) both  (d) None of these
- Place occupied by an object is called :  
(a) mass  (b) density   
(c) volume  (d) weight
- One solid thing is dissolved in water. Which method is used to separate solid from liquid?  
(a) Filtration  (b) Vaporization   
(c) Loading  (d) Sublimation
- Compounds are :  
(a) combination of atoms  (b) combination of ore   
(c) combination of elements  (d) None of these
- Gas soluble in water :  
(a) methane  (b) hydrogen   
(c) carbon dioxide  (d) nitrogen



7. Main property of substance is :
- |                               |                          |                   |                          |
|-------------------------------|--------------------------|-------------------|--------------------------|
| (a) sublimation               | <input type="checkbox"/> | (b) distillation  | <input type="checkbox"/> |
| (c) melting and boiling point | <input type="checkbox"/> | (d) None of these | <input type="checkbox"/> |
8. Transparent material is :
- |           |                          |           |                          |
|-----------|--------------------------|-----------|--------------------------|
| (a) wood  | <input type="checkbox"/> | (b) iron  | <input type="checkbox"/> |
| (c) paper | <input type="checkbox"/> | (d) glass | <input type="checkbox"/> |
9. In distillation, which process is followed by evaporation?
- |                 |                          |                    |                          |
|-----------------|--------------------------|--------------------|--------------------------|
| (a) Threshing   | <input type="checkbox"/> | (b) Centrifugation | <input type="checkbox"/> |
| (c) Decantation | <input type="checkbox"/> | (d) Condensation   | <input type="checkbox"/> |
10. Air, water, glass and soil are example of :
- |               |                          |              |                          |
|---------------|--------------------------|--------------|--------------------------|
| (a) substance | <input type="checkbox"/> | (b) property | <input type="checkbox"/> |
| (c) volume    | <input type="checkbox"/> | (d) energy   | <input type="checkbox"/> |

**B. Fill in the blanks :**

- Man-made things are \_\_\_\_\_, etc.
- Things are classified into two groups : \_\_\_\_\_ and \_\_\_\_\_.
- Soluble substances are \_\_\_\_\_.
- Best examples of transparent substances are \_\_\_\_\_.
- In winnowing, \_\_\_\_\_ is allowed to fall down from some height above the ground.
- Iron, \_\_\_\_\_ and \_\_\_\_\_ are magnetic substances.
- Bronze is \_\_\_\_\_ conductor of heat.
- Sieving is done to separate \_\_\_\_\_ from \_\_\_\_\_.
- \_\_\_\_\_ method is used to separate milk from cream.
- Best example of crystallization is the solution of \_\_\_\_\_.

**C. Very short answer questions :**

- When do we use the method of evaporation?
- Give example of three magnetic substances?
- Which substances are called good conductors of heat?
- By which method impurities of water are removed?
- When is the method of hand picking used?
- What type of impurities are removed by the method of decantation?

**D. Short answer questions :**

- Give definition of boiling and melting point.
- Give definition of sedimentation.
- What are pure substances?
- What are transparent substances?
- What are compounds? Give example.

6. Give example of homogeneous and heterogeneous mixtures.
7. What is mass?

**E. Long answer questions :**

1. Write a short note on loading.
2. Differentiate between pure substances and mixture.
3. Explain crystallization with example.
4. Explain centrifugation with example.
5. How are crystals of alum made?
6. Explain the method used for separating mixture of wheat, sugar and husk.
7. Explain physical properties of substances in short.
8. Differentiate between filtration and evaporation.



**Project Work**

- Make hole at the bottom of a pot. Fill some stones in it. Add some sand above the stones and keep the pot on a stand. Pour impure water in the pot. Does pure water come out of the hole of the pot?