Chapter 4

Physical and Chemical Changes of Substances

Points to be studies

4.1 Physical Changes
4.2 Crystallisation
4.3 Chemical Changes
4.4 Corrosion of Iron

We observe different changes in our environment. Change means transformation. During rainy season water droplets present in clouds solidifies and convert into hails. These hails fall on earth and diminish after melting. During cooking at home water content of dal gets reduced due to evaporation. During winters water vapour present in the atmosphere cools down and gets converted into dew. Similarly water droplets in refrigerator cool down and convert into ice. All these processes come under **"changes"**. In day to day life we observe many changes like lighting of candle, formation of curd from milk, formation of soft drink by dissolution of lime juice and sugar in water. Some interesting incidents also take place during these changes. During eating vegetable stains on clothes and at the time of cleaning the yellow stain of turmeric changes into red. Colour of peeled surface of potato and apple change when it is kept in open atmosphere. Green colour of mehandi converts into red. During rainy season, windows and doors made of iron get rusty. You must have seen magicians lighting fire in glass filled with water and white smoke when he transfers the solution of one glass to another. You must have been surprised by these changes and enjoyed them.

In this chapter we will perform some activities and try to understand the nature of changes. Are all of these changes stable or unstable or reversible?

Let's Do and observe

Activity 1

Take some wax in one bowl and heat it gently. What do you observe? Remove the bowl from the flame and let it cool down. After some time you will see that the wax present in the bowl solidifies again. Hence we can say that melting of wax is an unstable change. Conversion of solids into liquids is called change of state of matter. Change of state of matter is an unstable change.

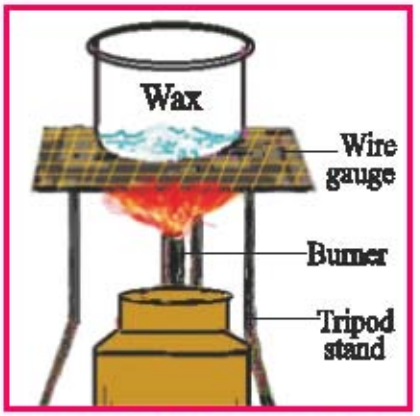
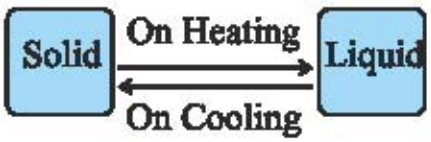


Fig. 4.1 Melting of Wax



Unstable Change

Activity 2

Take some water in a glass test tube. Cover this test tube with a funnel and heat it. Close the funnel. Water will get converted into water vapour. Water vapour will again get converted into water on coming in contact with the wall of the funnel. We can see this in the form of drops of water on the internal surface of the funnel. So we can say that conversion of water into vapour is an unstable change. The changes can be written in the following way.

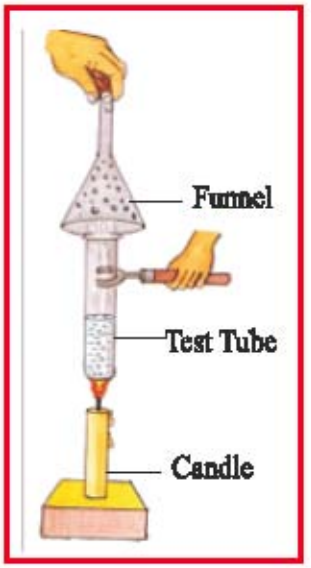
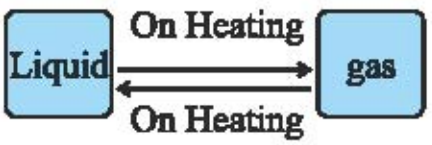


Fig. 4.2 The Change of State



Unstable Change

Similarly can you solidify the water formed by melting of ice ?

We can say that change of state of substance is an unstable change.

Activity 3

Take a square piece of paper. Fold it to make a boat, aeroplane or any other shape. Now unfold it. It regains its original state. This is also an unstable change. Take a rubber band and stretch it and release it. Does it regain its original shape? Regaining its original shape of a rubber band is an unstable change.

Fig. 4.3 The Change of State

Activity 4

Take a blade, hold it with the help of a fork and heat it till it gets red hot. Remove the blade from the flame and wait for a while. Its red colour disappears. Is this an unstable change?

Activity 5

In the following table 4.1 some changes are given. Fill in the table if these changes are stable or unstable.

Table 4.1 Incidents of Changes

S No	Incidents of Changes	Are these changes reversible?	Are these changes stable or unstable?
1.	Melting of ice	Yes	Unstable
2.	Formation of water vapour		
3.	Formation of curd from milk		
4.	Compressing of sponge		
5.	Glowing of bulb on switching ON		
6.	Corrosion of iron		
7.	Dry clothes getting wet		
8.	Burning of wood		
9	Chilling of Milk		
10	Mehandi getting red		

We see that by reversing the direction of a change some substances can be brought back to their original state while it is not possible with other. The changes that can undergo in reverse direction are known as **reversible changes.** Reversible changes are unstable.

In daily life experiences we have observed that formation of Milk into curd cannot be reversed in to formation of curd into milk. In this example curd is formed as a new product. This change is a stable change. So it is not a reversible change. Those changes which is not possible in both direction directions are called **irreversible changes.** Irreversible changes are stable in nature.

By above explanation the changes around us are basically classified in two types. First are those which are reversible and unstable and are called physical changes and the others which are irreversible and stable and are called chemical changes.

So, on the basis of nature of changes, they can be classified as follows:-

Physical changes and chemical changes.

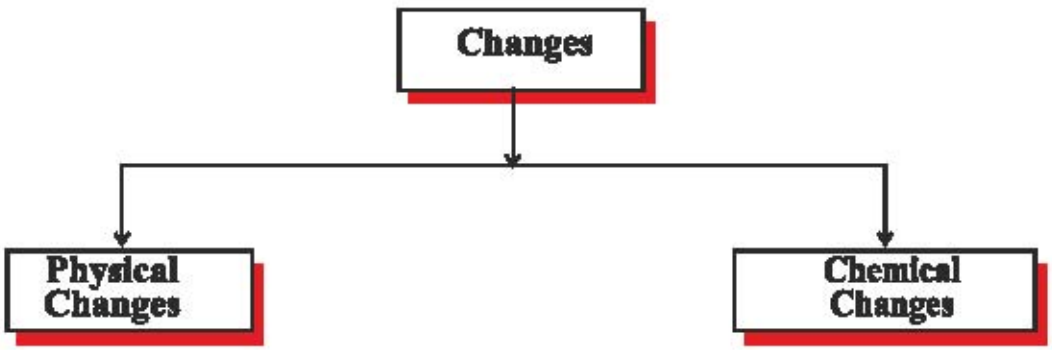


Fig. 4.4 Types of changes

4.1 Physical Changes:

Shape, size, state (solid, liquid, gas) temperature, pressure etc. of a substance are called physical properties. Changes in which physical properties of a substance are called are called **physical changes.** These are unstable and reversible. In these changes a new substance is not formed. Now you can easily identify melting of ice, dissolution of salt In water, glowing of bulb, heating blade on flame, formation of vapour from water, conversion of vapour into water etc. are physical changes.

Fig. 4.5 Lighting of Bulb is a physical changes

4.2 Crystallisation:-

Crystallisation- It is a physical change.

You have seen a white powder substance across the rivers and ponds. Women use this baking soda in making Dhoklas. Do you know how this baking soda is formed?

Activity 6

Take a beaker and fill it half with water. Add alum powder in it. Heat the above solution and add keep on adding alum powder till it gets dissolved completely in the solution. When dissolution stops, filter the solution with the help of filter paper. Let the solution cool down. Do not move the beaker at the time of cooling. Observe the solution after some time . Do you see the crystals of alum? If not then wait for some more time, you will see the crystals. The process of obtaining big and pure crystals from its solution is known as **crystallisation.** In this process new substance is not formed but crystals of same substance are formed, so crystallisation is the example of physical change.

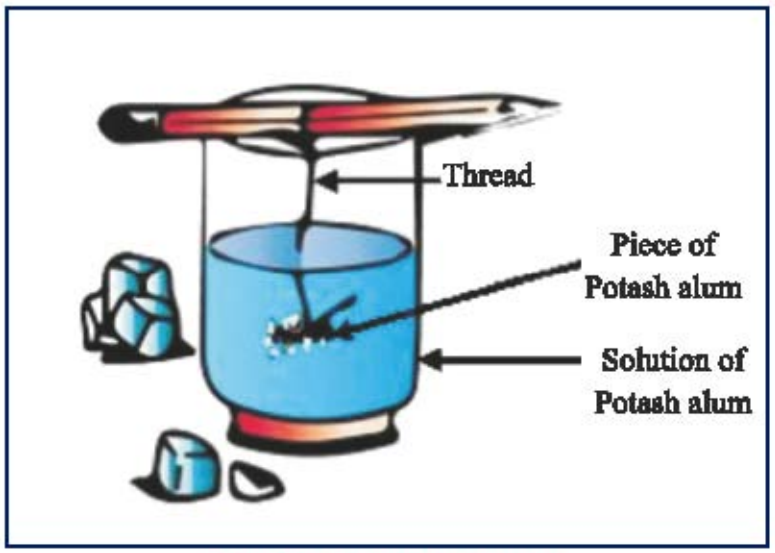


Fig. 4.6 Crystallisation

If you want crystals of bigger size, then tie a small crystal by a thread and hang it in a way that it will touch the solution. You will see many small size crystals stick around that small crystal and a big crystal is formed.

4.3 Chemical Changes

What are the chemical changes, Let us know-

Activity 7

Light a candle and keep it on the table. Take a funnel and according to diagram 4.7 join its one end with a rubber tube and the second end of rubber tube with a glass tube. Dip the glass tube in a beaker filled with lime water. Cover the flame of candle with funnel so that the gas formed by burning candle can go to the beaker containing lime water. You will see that the lime water turns milky.

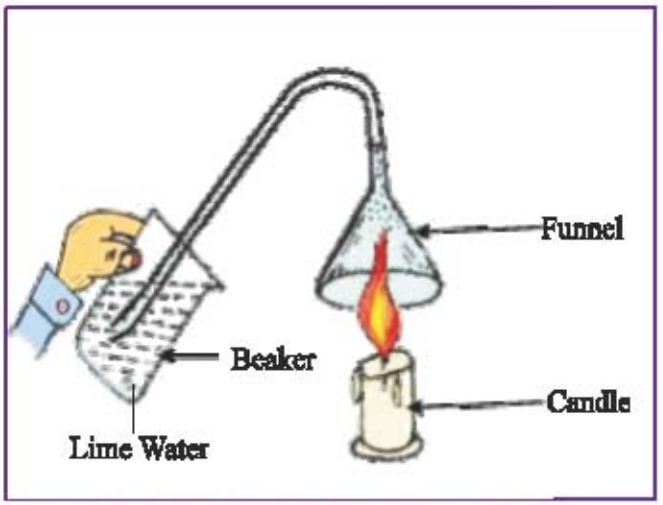


Fig. 4.7 Lime Water turns milky

Following reaction takes place in this experiment-

$$\text{Wax} + \text{Oxygen } (O_2) \xrightarrow{\text{Burning}} \text{Carbondioxide } (CO_2) + \text{Water Vapour}^{(\text{new substance})}$$

$$\text{Lime Water } [Ca(OH)_2] + \text{Carbondioxide } (CO_2) \rightarrow \text{Milky Lime Water } (CaCO_3)$$

From above reactions it is clear that new substances carbondioxide and water vapour are formed by burning of wax. When carbondioxide is passed into lime water a new substance $CaCO^3$ is formed.

We will study some more changes in which new substances are formed.

Activity 8

Cut a potato. Add few drops of iodine solution on the open surface of potato. The colour of surface becomes purple blue.

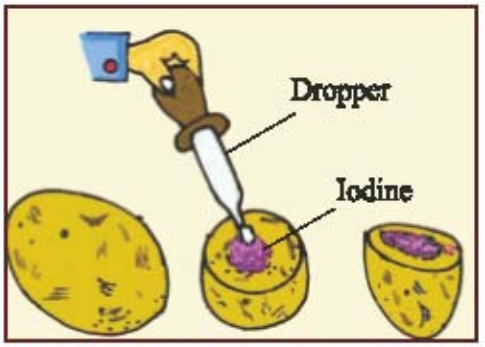


Fig. 4.8 The Colour of Potato becomes purple blue

$$\text{Starch (Potato)} + \text{Iodine} \longrightarrow \text{Purple Substance (new substance)}$$

You can see a new substance is formed in this reaction.

Activity 9

Take a magnesium ribbon. Ignite its one end in candle flame . Magnesium ribbon burns with brilliant light and ash (magnesium oxide) is formed. A new substance is formed I in this process:-

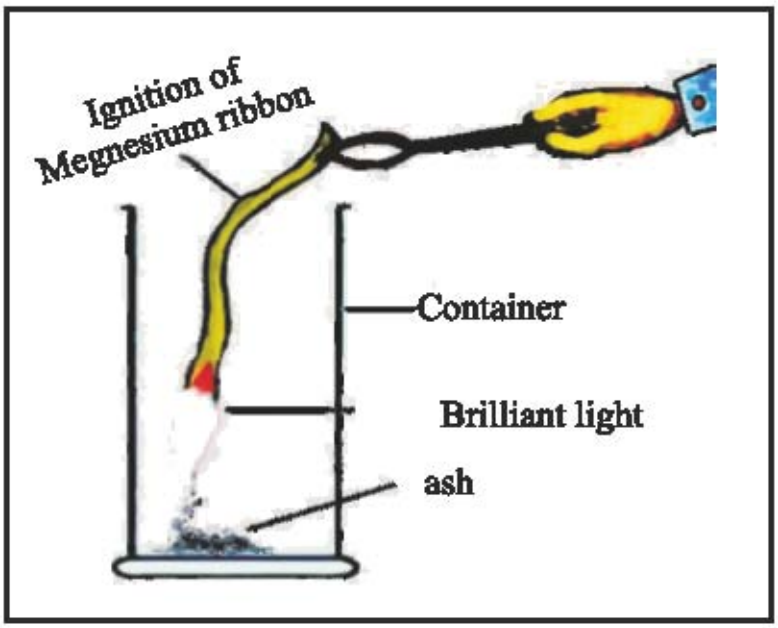


Fig. 4.9 Ignition of Megnesium ribbon

$$\text{Magnesium (Mg)} + \text{Oxygen } (O_2) \longrightarrow \text{Magnesium oxide (MgO)}\ ^{(\text{new substance})}$$

We can say that-

Those changes in which two or more chemical substances react to produce a new substance with a different set of properties of their internal composition also changes are called as **Chemical changes.** After chemical change, product could not change again into their original reactants. Thats why there changes are permanent of can be also termed as.**Ir-reversible changes**

Example:- Burning of candle, formation of curd, burning of tyres, digestion of food, rusting of iron, bursting of crackers on festivals, burning of magnesium ribbon etc.

4.4 Rusting of Iron

You are well acquainted with the process of rusting. you must have seen in the kitchen that wet 'Tava' is rusted when left in open air. In the same manner

spade, axe also got rusted in moist air. If we put an iron piece in open air it surface get converted into brownish layer known as Rust. This is a chemical process called as Rusting. Rust is not iron metal, in this process iron metal transformed into a new substance called **Rust** (Iron oxide Fe_2O_3) but it is formed due to a chemical process of iron with moist air of termed and Iron oxide (Fe_2O_3)

Process of Rusting

The process of rusting can be shown as –

$$\text{Iron (Fe)} + \text{Oxygen } (O_2) + \text{Water } (H_2O) \longrightarrow \text{Iron oxide } (Fe_2O_3)$$

Oxygen and water are two essential components for rusting of Iron.

Rusting destroys iron slowly. As iron is used to make the body of vehicles like ships, trucks, cycles etc. How can you protect this? To prevent iron from rusting, iron must be protected from the contact of water and oxygen (O_2).

Fig. 4.10 Iron Tower of Mehroli

Do You Know?

Charismatic Ancient iron tower

In Delhi near Qutub Minar in Mehroli, there is an ancient iron tower is situated which was built about 400 B.C. by Indian blacksmiths. Its height is 8 meter and weight is 6 ton (6000 kg). So many centuries has been passed but this iron pillar is still intact and not rusted at all. This is an evidence of advanced knowledge of our ancestors. Even at that time they had developed the technique of keeping, Iron rust free. It is known by researches the Mehroli Towers surface is coated with a thin layer of iron oxide (Fe_3O_4). So we can guess that to keep the tower rust free, so many steps must have taken by them. At the time of synthesizing it, phosphorus must has been mixed in it. It must have been painted with a mixture of various chemicals and it must have been heated up at a high temperature. Sun Temple (Kanark, Odissa), Mookambika Temple (Koloor, Karnataka) Dharmadhy Pradesh etc. also have the wonderful iron towers and display the excellent ancient story of Indian metallurgy.

Greasing and coating of paint are easy way to protect the iron from rusting coating of chromium and zinc can also protect iron from rusting. **Galvanization** is a process in which iron objects are coated with zinc to protect them from rusting. Mixing of carbon, manganese, nickel and chromium in iron metal gives us an hard and rust proof alloy **'Steel'** (stainless steel).

Let's know about some chemical changes:-

1. **Change in colour of apple** when left "Cut" in air. apple Contains Iron (Fe), due to this when it come in contact with air iron reacts with oxygen producing iron oxide (Fe_2O_3) which is reddish brown in colour.

2. **How does Henna dyes.** Heena contains chemical compounds such as Quinone. Napthoquinone and Lawsone. Lawsone is colourless but when it come in contact with air or sunlight it forms a red coloured compound.

3. **Truth of magicians** earlier in this chapter we talked about how a magician lit fire over a glass full of water and produces white fumes mixing two liquids in glass.

   1. **Lit fire over a glass** full of water in this trick the magician uses a sodium metal which he tricks into the glass of water.

      Sodium metal reacts rapidly with water to from a colourless solution of sodium hydroxide (NaOH) and hydrogen gas (H_2). The reaction is exothermic. During the reaction, the sodium metal may well become so hot that it catches fire and burns.

      $$2Na(s) + 2H_2O \longrightarrow 2NaOH(ag) + H_2(g) + Heat$$

   2. **Production of white fumes** in the trick the magician has one glass ammonium hydroxide solution and in other hydrochloric acid solution. when he mixes the 2 solution. The reaction between Ammonium hydroxide and Hydro chloric acid. Produces ammonium chloride and water. Ammonium chloride produced as white fumes.

      Ammonium Hydroxide + Hydrochloric acid ⟶ Ammonium chloride + water
      White fumes

What have you Learnt?

1. Some changes are permanent but some changes are temporary and reversible.
2. According to nature of changes, there are two types of changes – Physical change and chemical change.
3. Physical changes are temporary and reversible while chemical changes are permanent and ir-reversible.
4. In physical changes only physical properties of substances changes and no new product are formed in it. While new substances are formed in chemical change.
5. In the presence of Oxygen (O_2) and water rusting of iron occures.
6. To protect from rusting oiling, greasing and coating of metal on iron objects.
7. The process by which pure and big sized crystals of a compound can be obtained from its solution is known as crystallization.

Exercise

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Choose the correct option

1. Example of physical change is –
   a. Rusting b. melting of ice
   c. Formation of curd d. Browning of apple after cutting ( )
2. Example of chemical changes is –
   a. Lightening of bulb b. Milky change of lime water
   c. Water changes into water vapour
   d. Melting of Ghee. ( )
3. Why are doors painted in our house
   a. To protect from sun rays
   b. To make it dust proof
   c. To prevent from rusting
   d. To protect from birds. ( )

4. The chemical formula of rust is –

   a. Fe_2O_3 b. Fe

   c. FeO d. $FeSO_4$ ( )

5. Fill in the blanks

   a. To make the solution of sugar is ------ change.

   b. Generally physical changes are --------

   c. Conversion of wheat grain into wheat flour is ---------- change.

   d. When carbon dioxide passed in lime water, it turns milky, This is ---------- change

Match the following Column I & Column II

	Column I	Column II
1.	Lightening bulb	1. Chemical change
2.	Rusting	2. Physical change
3.	Getting crystals from alum	3. Crystallization

Short answer type question

1. Write the reaction of oxygen with magnesium?
2. What is crystallization?
3. Which factors are responsible for rusting?
4. What will be the colour of a product after reaction of starch and Iodin?
5. What kind of change tearing the paper is?

Long answer type questions

1. Explain the chemical change and physical change with proper examples.
2. Explain crystallization with the help of labelled diagram.
3. Explain the process of rusting and how could. it be prevented.
4. Write down four examples of physical and chemical changes from our daily life.

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