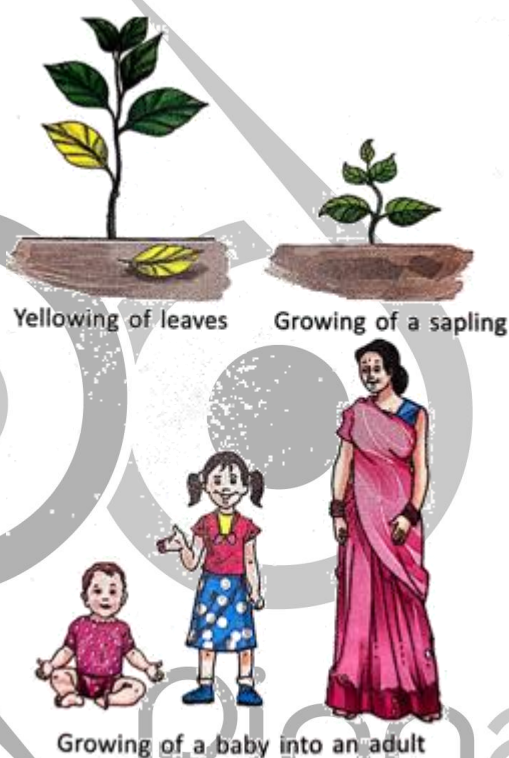


PHYSICAL AND CHEMICAL CHANGES

INTRODUCTION

Many changes are taking place around us. Growing of a seed into a sapling and a sapling into a plant, yellowing of leaves, growing of a baby into an adult, etc., are a few changes that we observed around us. We also observe changes like formation of curd from milk, rolling of chapatti from a ball of dough, burning of a candle, melting of ice, breaking of glass, rusting, dissolving carbon dioxide in water, burning a paper, etc.



CLASSIFICATION OF CHANGES

Changes may be classified in many ways. These are as follows:

- Fast and slow changes
- Desirable and undesirable changes
- Periodic and nonperiodic changes
- Reversible and irreversible changes
- Physical and chemical changes

Fast and slow changes

All changes take some time to occur. Some changes occur in a short time while others occur in a long time. changes which occur in a few seconds or minutes are called **fast changes**, e.g., lighting a matchstick, explosion of a cracker, etc., as shown in the Fig. 2.2.



Some more examples of fast changes are burning of a paper, burning of a cooking gas and cooking of food.

Some changes occur in hours, days, months or even years. Such changes which occur in a long time are called **slow changes**, e.g., yellowing of leaves, rusting of iron, etc., as shown in the Fig. 2.3.



Few other examples of slow changes are growing of a baby into an adult, ripening of fruits and growing of a seed into a sapling and a sapling into a plant.

Desirable and Undesirable changes

We have discussed many changes occurring around us. Are all the changes that occur around us useful or desirable?



Cooking of food



Burning of petrol

Changes that are useful to us are called **desirable changes**, e.g., cooking of food, making of food by green plants and ripening of fruits these changes may be brought about by man and nature both.

On the other hand, few changes that are harmful to us are called **undesirable changes**, e.g., burning of petrol produces many harmful gases and a lot of smoke. It is, therefore, an undesirable change. Rotting of vegetables and fruits, earthquakes, volcanic eruptions, floods, spoilage of food, rusting of iron and souring of milk are also undesirable changes.

Periodic and Non-periodic Changes

You know that the earth completes its one rotation in 24 hours and its one revolution in 365.25 days, while the pendulum of a clock completes its one oscillation in 1 second, sunrise and sunset, etc. The motion of these objects repeats itself after a fixed time. The change which repeats itself after a fixed period of time is called a periodic change.



Pendulum of a clock



Beating of a drum

There are some other motions which repeat themselves but not after a fixed period of time like beating of a drum or the heartbeat of a sick person. This type of change which repeats itself at irregular intervals of time is called a nonperiodic change. Eruption of a volcano, growing of a baby into an adult and growth of a plant, earthquake, etc., are also nonperiodic changes.

Reversible and Irreversible changes

The changes that occur around us can also be classified as reversible and irreversible changes. In order to understand these changes, let us do the following activities.

ACTIVITY 1

Aim: To observe change in a paper due to folding

Materials Required: A sheet of paper

Procedure: Take a sheet of paper and fold it to make a boat. Now, unfold the paper. What do you observe? Does the size of the paper change?

Observation: The size of the paper remains the same.

Conclusion: Folding of paper can be undone. So, It is a reversible change.

ACTIVITY 2

Aim: To show that salt can be obtained back from its solution in water

Materials Required: A glass, water, a burner, salt and a bowl

Procedure: Take some salt in a glass of water. Stir it until the salt dissolves completely. Now, pour this mixture in a bowl and heat it over a burner. What do you observe?

Conclusion: Salt can be obtained back from its solution by evaporation.

In these activities, we notice that the changes can be undone or reversed.

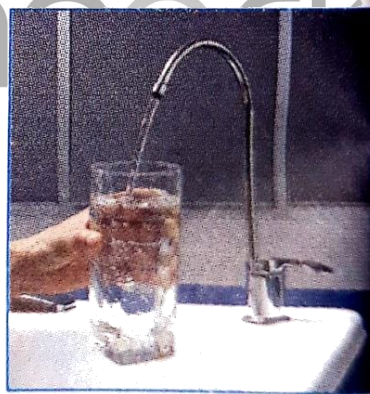
Thus, a change which can be undone or reversed is called a reversible change. A reversible change is a temporary change.

ACTIVITY 3

Aim: To study the changes when a solid and a liquid are heated



Ice cubes



Water

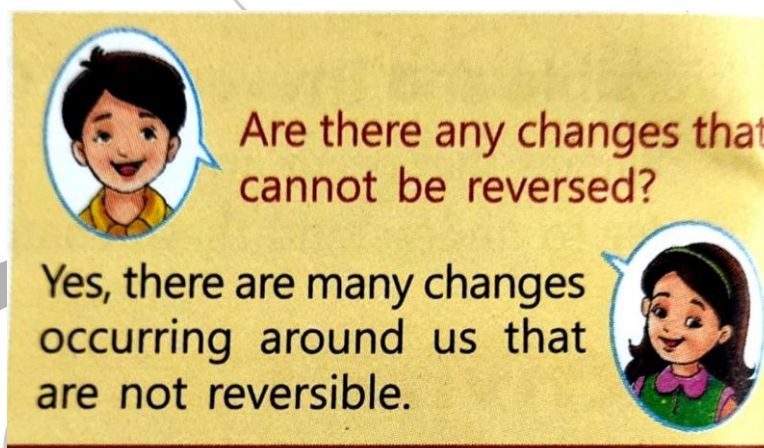
Materials Required: Ice cubes, a glass and water

Procedure: Take some ice cubes and a little amount of water. Heat both the substances. What do you observe? Can you get these substances back when you cool them?

Observation: When we heat ice cubes. They melt to form water. But, when this water is cooled in a refrigerator, it changes back into ice cubes. Similarly, when water is heated, it changes into water vapour and when this water vapour comes in contact with some cold surface, it again changes into liquid water.

Conclusion: Thus, we conclude that the changes can be undone or reversed. Therefore, we can say that a reversible change is a temporary change. In these changes, melting, freezing, evaporation and condensation are involved.

Thus, we see that in activities 1, 2, and 3, folding, dissolving, melting, freezing, evaporation and condensation all are reversible change.



But, all the changes are not reversible. There are many changes that are not reversible.

ACTIVITY 4

Aim: To show that the change is not reversible, i.e., irreversible

Materials Required: Flour, cement and water

Procedure: Take a little amount of flour, cement and water. mix flour and cement with water. Is a new material made when flour or cement is mixed with water? Can you recover flour from water and cement from water?

Observation: We observe that when flour, cement and water are mixed, a new substance is formed. This substance gets not reversed into flour and cement.

Conclusion: Thus, we conclude that it is not reversible, i.e., irreversible

ACTIVITY 5

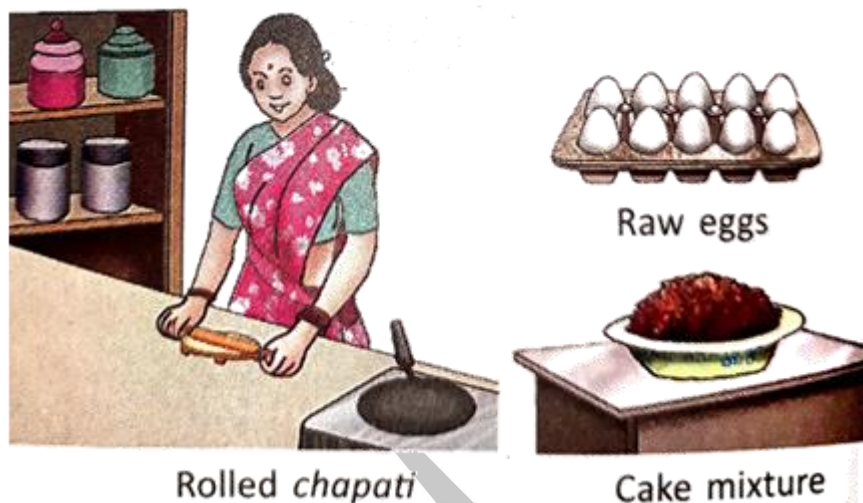
Aim: To show that these following changes are not reversible changes

Materials Required: Rolled chapatti, raw eggs and cake mixture

Procedure: First, rolled chapatti is baked and raw egg is boiled. Then, cake mixture is baked. What do we observe?

Observation: Thus, we observe that baked chapatti, boiled eggs and baked cake cannot be reversed back.

Conclusion: Thus, we conclude that these changes are not reversible changes.



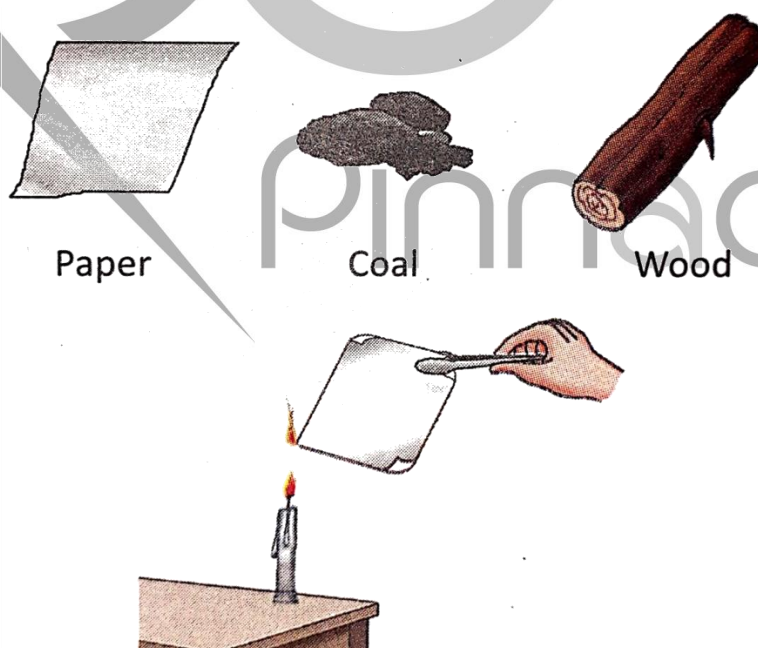
ACTIVITY 6

Aim: To show that burning of substances is not reversible.

Materials Required: A piece of paper, coal, wood and a matchstick

Procedure: Take a piece of paper, three or four small pieces of coal and a log of wood. Burn them with the help of a matchstick. What do we observe finally?

Observation: we observe that burnt substances cannot be reversed back. i.e., smoke and ash cannot be reversed back into paper, coal and wood.



Conclusion: Thus, we conclude that these substances are not reversible

In the activities 4, 5 and 6, we observe that the change cannot be undone or reversed.

Thus, a change which cannot be undone or reversed is called an irreversible change. An irreversible change is a permanent change.

Thus, in activities 4, 5, and 6, mixing of a substance, heating of a substance, baking of a substance and burning of a substance are irreversible change.

The difference between reversible and irreversible changes is given in the Table:

Reversible change	Irreversible change
<ul style="list-style-type: none"> A reversible change can be undone or reversed. 	<ul style="list-style-type: none"> An irreversible change cannot be undone or reversed.
<ul style="list-style-type: none"> A reversible change is a temporary change 	<ul style="list-style-type: none"> An irreversible change is a permanent change.
<ul style="list-style-type: none"> Dissolving, melting, folding, etc., of substances are reversible changes. 	<ul style="list-style-type: none"> Mixing, burning, baking, heating, cooking, etc., of substances are irreversible changes

CHECK POINT 1

Write true or false.

1. A reversible change can be undone.
2. Burning of paper is a slow change.
3. Rusting of iron is a desirable change.
4. Cooking of food is an undesirable change.
5. Baking a chapatti is an irreversible change.

Physical and Chemical changes

Changes occurring around us can also be classified as physical or chemical changes.

PHYSICAL CHANGE

A change in which a substance undergoes a change in shape, size or state is called a physical change. The properties such as size, shape, colour and physical state of a substance are called its physical properties. No new substance is formed in a physical change. Most physical changes are reversible. Let us understand a physical change with the help of few activities.

ACTIVITY 7

Aim: To study a physical change (size and shape change)

Materials Required: A spring

Procedure: Take a rubber band and stretch it. Do you observe a change in its size and shape? Now, release the spring gently. Observe its size and shape again. Is it the same as before? Was any new substance formed when you stretched and released the spring?

Observation: On stretching, the size and shape of the rubber band change.



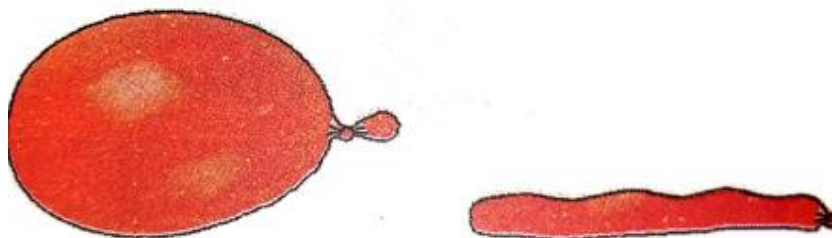
Conclusion: No new substance is formed on stretching or releasing the rubber band. The change is temporary or reversible.

ACTIVITY 8

Aim: To study a physical change (size and shape change)

Materials Required: A balloon

Procedure: Take a balloon and inflate it. What do you observe? Do the size and shape of the balloon change? Now, deflate the balloon. What do you observe now? Are you able to get back the original size and shape of the balloon? Is any new substance formed when you inflate or deflate the balloon?



Observation: On inflating the balloon, its shape and size change. On deflating the balloon, it regains its original size and shape.

Conclusion: No new substance is formed on inflating or deflating the balloon.

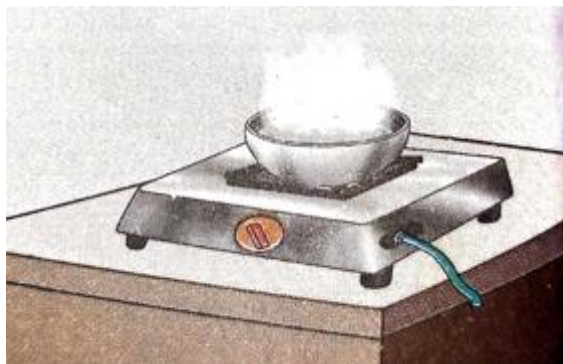
Therefore, the change is temporary or reversible.

ACTIVITY 9

Aim: To study a physical change (change in physical state)

Materials Required: water, a bowl, a burner and a plate

Procedure: Take some water in a bowl and heat it. Do you see steam rising? Steam is water in a different form. Now, hold a plate over the rising steam.



What do you observe? Is any new substance formed in this change?

Observation: Liquid form of water first gets changed into gaseous form and then back into liquid form.

Conclusion: Thus, we conclude that there is a change in state from liquid to gas and then back to liquid. Finally no new substance is formed.

ACTIVITY 10

Aim: To study a physical change (no change in mass)

Materials Required: A weighing balance, solid wax, beaker and a burner

Procedure: Place some solid wax in a beaker and weigh it. Note the mass.

Now, melt the wax and weigh the beaker containing molten wax. Note the mass.

Observation: There is no change in mass.

Conclusion: During a physical change, no change in mass occurs.

ACTIVITY 11

Aim: To study a physical change (change in colour)

Materials Required: A thin iron rod and a burner

Procedure: Hold the iron rod from one end and start heating strongly the other end using the burner. Iron rod becomes red hot and glows. Remove it from the burner.

Observation: Iron rod changes the colour but regains the colour on cooling.

Conclusion: There is a change in colour but it is a reversible change and no new substance is formed.

Characteristics of a Physical Change

Some important characteristics of a physical change are given below:

- In a physical change, no new substance is formed.
- The chemical composition of the original substance does not change.
- Most physical changes are temporary or reversible changes.
- A physical change is usually accompanied by a change in shape, size or state.
- In a physical change, no change in masses of the substances involved in changes taking place.

- Usually, no loss or gain of energy occurs in a physical change.

More Examples of a Physical Change

Some more examples of physical changes are as follows:

- Stretching a rubber band
- Dissolving of sugar in water
- Cutting of paper
- Drying of wet clothes

Prepare a list of few physical changes occurring around us and are given in the beginning of the chapter in the following table.

S. No.	Physical changes

Uses of physical changes

Few important uses of physical changes are as follows:

- Water exists in all three physical states which is responsible for forming ice at home, taking steam bath, running steam engines, formation of rain, collecting salt from sea, etc.
- Solidifying carbon dioxide to form dry ice is used to keep the temperature low for ice creams, medicines, etc.
- Liquid gels are present in ice packs which can be frozen and used in joint pains, etc.

CHECK POINT 2

Fill in the blanks.

1. On freezing, water changes into _____.
2. No new substance is formed in a _____ change.
3. A physical change is a _____ change.
4. Melting of ice is a physical change because it is a _____ change.

CHEMICAL CHANGE

A change in which a new substance is formed is called a chemical change. A chemical change is generally called a chemical reaction. It usually cannot be reversed.

Have you ever seen brown – coloured substance deposited on iron articles? This brown – coloured substance is called rust. Rusting of iron nails is a chemical change. Cooking of food, burning of fuel and souring of milk are some other examples of a chemical change.

Characteristics of a Chemical Change (reaction)

A chemical reaction is usually accompanied by:

- Change in colour of reactants
- Formation of a precipitate
- Evolution of a gas
- Absorption or evolution of heat energy

Let us now study about the characteristics of a chemical change (reaction) in detail.

ACTIVITY 12

Aim: To observe the change in colour in a chemical change

Materials Required: A beaker, water, copper sulphate, a stirrer, a spatula, a test tube, a test – tube stand and a clean iron nail

Procedure: Fill a beaker half with water. Add a spatulaful of copper sulphate to it. Stir it well. A blue – coloured solution is formed. Pour some of this solution into a test tube and keep it aside in a test – tube stand. Take a clean iron nail. Observe its colour. Place it gently in a beaker containing copper sulphate solution. Leave this set – up undisturbed for about half an hour. Note if the blue colour of the solution has faded away. Compare this with the sample you saved in the test tube. Remove the iron nail from the copper sulphate solution. Note if the colour of iron nail has also changed.

Observation: The blue – coloured solution becomes green and the iron nail becomes reddish – brown.

Conclusion: When an iron nail is placed in copper sulphate solution, a new substance called ferrous sulphate is formed and copper gets deposited on the iron nail. This change can be represented as:



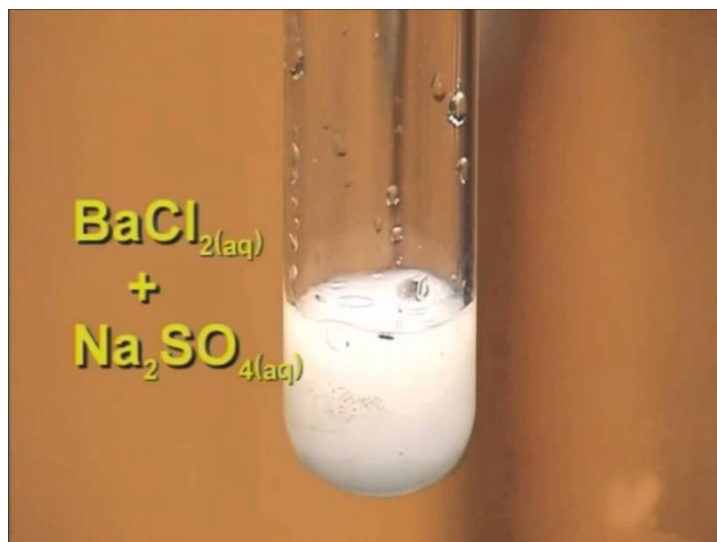
ACTIVITY 13

Aim: To show that a chemical reaction may result in the formation of a precipitate

Materials Required: Two test tubes, barium chloride, water and sodium sulphate

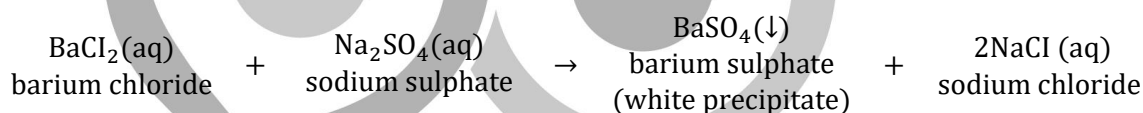
Procedure: Take a test tube and add a little barium chloride and about 5 mL of water to it. Shake the test tube. Observe the colour of barium chloride solution. It is colourless. In another test tube, add a little sodium sulphate and about 5 mL of water to it. Shake the test tube. Observe the colour of sodium sulphate solution. It is also colourless.

Now, mix the two solutions and shake gently. What do you observe?



Observation: you will observe that a white and insoluble solid (precipitate) settles down at the bottom of the test tube.

Conclusion: The white precipitate formed is of barium sulphate. Another product, sodium chloride, is also formed which remains dissolved in the solution. The chemical reaction between barium chloride and sodium and sodium sulphate can be represented as:



ACTIVITY 14

Aim: To study the reaction of zinc granules with dilute hydrochloric acid (To be demonstrated by the teacher)

Materials Required: A test tube, a dropper, dilute hydrochloric acid, zinc granules and a matchbox

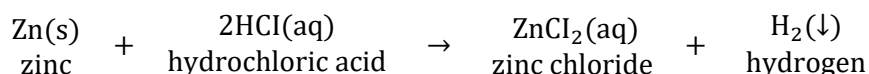
Procedure: Place a clean piece of zinc granule in a test tube. Touch the bottom of the test tube. Does it feel warm? With the help of a dropper, add some dilute hydrochloric acid to the tube. Observe changes taking place.

Observation: Some bubbles are formed. When a burning matchstick is brought near the mouth of the test tube, a pop sound is heard.

Heat energy is given out when zinc granules combine with dilute hydrochloric acid.

Conclusion: Zinc granules react with dilute hydrochloric acid to form zinc chloride and hydrogen gas.

This reaction can be represented as:



A chemical reaction may result in the evolution of heat

A chemical reaction in which heat is evolved is called an exothermic reaction. Some examples of exothermic reactions are discussed below.

What does the upward arrow (\uparrow) indicate in the chemical equation given in activity 24?
The upward arrow (\uparrow) indicates that a gas is being evolved in the reaction.

ACTIVITY 15

Aim: To show that a chemical reaction may result in the evolution of heat (To be demonstrated by the teacher)

Materials Required: A magnesium ribbon, a sand paper, a burner or a candle and a pair of tongs

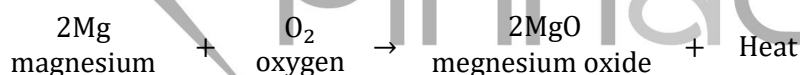


Procedure: Take a magnesium ribbon and clean it with a sandpaper. Observe its colour. Heat it on a burner or a candle by holding it with a pair of tongs. What do you observe?

Observation: Magnesium ribbon burns with a dazzling white flame. A powdery ash is left behind. The powdery ash formed is magnesium oxide. A lot of heat is evolved in the reaction.

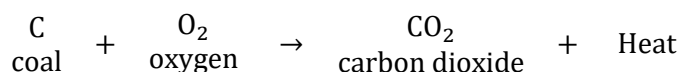
Conclusion: A chemical reaction may result in the evolution of heat.

A change has occurred on burning magnesium ribbon which can be represented as follows:



Coal contains carbon which burns in the presence of oxygen gas (in the air) to give out carbon dioxide gas as the main product and a lot of heat.

This can be represented as:



A chemical reaction may result in the absorption of heat

A reaction in which heat is absorbed is called an endothermic reaction.

Let us perform this reaction with the help of Activity 16.

ACTIVITY 16

Aim: To show that a chemical reaction may result in the absorption of heat

Materials Required: A test tube, solid calcium carbonate and a burner

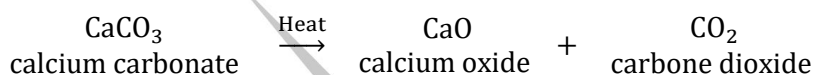
Procedure: Take calcium carbonate in a test tube and heat with a burner.

Observation: You will observe that a colourless and odourless gas is evolved.

Conclusion: The reaction has resulted in the absorption of heat from the surroundings.

This reaction can be represented as follows:

Limestone (calcium carbonate) on heating breaks down to give calcium oxide and carbon dioxide gas.



Uses of chemical changes

Chemical changes are very useful to us. Some uses of chemical changes are listed below.

- Burning of coal, petrol and gas are all chemical changes. A lot of heat is given out in such change. This heat is used to produce electricity, run engines and also to cook food.
- Many chemical changes take place when a metal is extracted from its ore. For example aluminium and iron are extracted from their ores by a series of chemical changes.
- Chemical changes are also used in the purification of metals.
- Many useful things that you use in your daily life like soaps, detergents, polythene bags, colours, ink, etc. are produced due to chemical reactions.
- Medicines are also a result of many chemical reactions.

The following Table shows the differences between physical and chemical changes.

Physical change	Chemical change
<ul style="list-style-type: none">No new substance is formed in a physical change.	<ul style="list-style-type: none">A new substance is formed in a chemical change.
<ul style="list-style-type: none">Most physical changes are reversible.	<ul style="list-style-type: none">Most chemical changes are irreversible.
<ul style="list-style-type: none">A physical changes is usually accompanied by a change is shape, size, colour or state.	<ul style="list-style-type: none">A chemical change is usually accompanied by release or absorption of heat or light, evolution of a gas, production of sound or change in smell.
<ul style="list-style-type: none">Most physical changes are temporary.	<ul style="list-style-type: none">Most chemical changes are permanent.
<ul style="list-style-type: none">Some examples physical changes are dissolving salt in water, inflating a balloon, melting of wax, etc.	<ul style="list-style-type: none">Some examples of chemical changes are rusting of iron, spoilage of food, cooking of food, burning of a substance, etc.

CHECK POINT 3

Answer these questions.

1. What do you understand by a physical change?
2. Give three examples of physical changes that you observe in your surroundings.
3. What happens when an iron nail is placed in copper sulphate solution?
4. Are most physical changes reversible or irreversible?
5. Define chemical changes.
6. Give three examples of chemical changes, other than those studied in this chapter.

Wrapping it up

- Changes are taking place all around us and also within our bodies.
- Changes can be classified as fast and slow changes; desirable and undesirable changes; periodic and nonperiodic changes; reversible and irreversible changes; physical and chemical changes.
- Changes which take few seconds of minutes to occur are fast changes whereas changes which take a long time occur are called slow changes.
- Useful changes are called desirable changes while harmful changes are called undesirable changes.
- A change which repeats itself after a fixed period of time is called a periodic change whereas a change which repeats itself at irregular intervals of time is called a nonperiodic change.
- A change which can be undone or reversed is called a reversible change whereas a change which cannot be undone or reversed is called an irreversible change/
- A change in which no new substance is formed is called a physical change whereas a change in which a new substance is formed is called a chemical change.
- Physical changes are usually reversible while chemical changes are usually irreversible.
- A change in which a substance undergoes a change in shape, size, colour or state is called a physical change.
- A change in which a new substance is formed is called a chemical change.
- A reaction in which heat is absorbed is called an endothermic change whereas a reaction in which heat is given out is called an exothermic change.

KNOW THESE TERMS

- Chemical changes** : A change in which a new substance is formed
- Irreversible change** : A change which cannot be undone or reversed
- Nonperiodic change** : A change that does not repeat itself after a fixed period of time
- Periodic change** : A change that repeats itself after a fixed period of time

Physical change : A change in which no new substance is formed

Reversible change : A change which can be undone or reversed

Rust : The brown coloured substance deposited on iron articles

TEST YOURSELF

A. Fill in the blanks with suitable words.

1. In a _____ change, new substances are formed.
2. One example of an undesirable change is _____.
3. Squeezing of a rubber ball is an example of a _____ change while burning of a candle is a _____ change.
4. Most chemical changes are _____.
5. Most physical changes are _____.
6. Boiling of milk is a _____ change.
7. Burning of coal is an example of _____ reaction.
8. No new substances are formed during a _____ change.
9. Sublimation of camphor is an example of _____ change.
10. Rusting of iron is a _____ change.

B. Define these terms.

1. Periodic change
2. Reversible change
3. Irreversible change
4. Physical change
5. Chemical change

C. Differentiate between the following.

1. Physical and chemical changes.
2. Reversible and irreversible changes.
3. Desirable and undesirable changes
4. Fast and slow changes
5. Periodic and nonperiodic changes
6. Exothermic and endothermic changes

D. Classify the following as physical or chemical change

1. Boiling of milk
2. burning of coal

3. Formation of curd from milk
4. Rotting of eggs
5. Melting of ice
6. Formation of vapours
7. Breaking of glass
8. Digestion of food

E. Answer these questions.

1. What are the different ways in which you can classify changes?
2. What happens when ice is heated? Is it a reversible or an irreversible change? Justify your answer.
3. Idli batter is steamed to get idli. Is it a reversible or an irreversible change? Justify your answer.
4. What happens when dilute hydrochloric acid is added to zinc metal? Explain.
5. What are the characteristics of a chemical change?
6. Are all changes desirable? List three desirable changes.
7. Make a list of at least six changes and classify them as periodic and nonperiodic changes.
8. Give two examples of each of the following changes occurring during a chemical reaction:
 - (a) Change of state of the reactants
 - (b) Change of colour
 - (c) Evolution of a gas
 - (d) Formation of a precipitate
9. Classify the following changes as a physical or a chemical change:
10. Burning of a magnesium ribbon, dissolving sugar in water, burning sugar, melting of butter, breaking of a glass bottle, clothes being ironed, wool being knitted into a sweater, souring of milk and drying of wet hair

F. State where the following statements are true or false. If false, rewrite the correct form of statements.

1. Melting of ice is a periodic change.
2. A matchstick burns to produce smoke and some gases. It is an example of a physical change.
3. Making of an aeroplane out a paper is an example of irreversible change.
4. A chemical change can be usually reversed.
5. Blackening of surface of silver metal is a chemical change.
6. Formation of alloys is a physical change.

G. Encircle the odd one out. Give reasons for your choice.

1. Souring of milk, inflating a balloon, cooking of food and burning of coal

2. Making of ice cubes, melting of butter, frying of potatoes and heating of water

H. Give reasons for the following.

1. Changing of water into water vapour is considered a physical change.
2. Mixing of sugar with water is considered a reversible change.
3. Mixing of cement with water is considered an irreversible change.

I. Multiple Choice Questions.

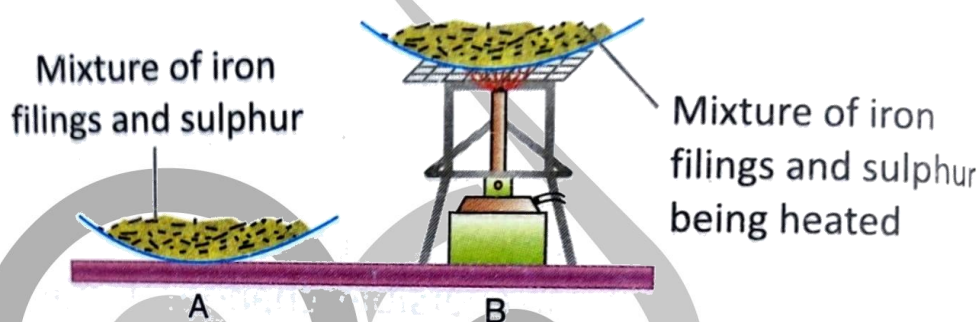
1. Which of these is not a physical change?
 - (a) Stretching a rubber band
 - (b) Melting of butter
 - (c) Burning of a piece of coal
 - (d) Changing of water into water vapour
2. Which of the following changes can be reversed?
 - (a) Physical change
 - (b) Chemical change
 - (c) Both (a) and (b)
 - (d) None of these
3. The equation that is a chemical change is
 - (a) Water changing to steam
 - (b) Burning of coal
 - (c) Dissolving sugar in water
 - (d) Mixing of iron and salt
4. Which of these is an irreversible change?
 - (a) Burning of a matchstick
 - (b) Inflating tyres
 - (c) Lighting a bulb
 - (d) Inflating a balloon
5. Most physical changes are
 - (a) Reversible
 - (b) Temporary
 - (c) Permanent
 - (d) (a) and (b)

6. Which of the following is a chemical change?

- (a) Melting of ice cream
- (b) Ironing of clothes
- (c) Burning of petrol
- (d) Drying of hair

J. Diagram – based Question

- Observe the given picture and answer the questions that follow:



- (a) Which one of the above figures shows the occurrence of a physical change?
- (b) Is the formation of iron sulphide on heating iron filings and sulphur powder a physical or a chemical change?
- (c) Is the formation of iron sulphide a reversible or an irreversible changes?

ZONE

- Have you seen things made from clay? Clay is a type of soft earth that can be moulded into different shapes. When clay is baked, it becomes very hard. Is baking of clay a reversible or an irreversible change?
- Formation of curd from milk is an irreversible change as you cannot get back milk from curd. Is this a physical or a chemical change?
- Can you think of an irreversible physical change?