

Physical and Chemical Changes



Chapter 2

Chapter Objectives

In this chapter, you will learn about:

- ◆ Physical and chemical changes
- ◆ Differences between physical and chemical changes
- ◆ Classification of changes as physical and chemical changes

How is burning of paper different from tearing of paper? How are the changes in both the cases different?

CHANGES AROUND US

We see different things happening around us daily. Things change in a fraction of a second. But have you ever wondered, what is the meaning of the term 'change'? Well, *a change is defined as the modification of either the physical or chemical features of a substance.*

Some changes that we often see in our daily life include occurrence of day and night, burning of paper, germination of seed, rusting of iron, ripening of fruits, cooking of food, and so on. We can mainly classify these changes as physical or chemical changes.

Based on the characteristics, these changes can be classified into different categories such as physical and chemical changes, desirable and undesirable changes, and endothermic and exothermic changes. We will learn about some of these types of changes in this chapter.

Physical Changes

A change in which a substance changes its physical form and no new substance is formed is called a physical change. The chemical composition of the substance undergoing physical change

remains the same. It means that the physical changes are the ones in which only the physical properties are altered, but there are no changes brought about in their chemical structures.

Characteristics of a physical change

- Physical changes are temporary in nature.
- Physical changes can be reversed in most cases.
- There is no change brought about in the chemical composition or structure of the substances involved.
- Sometimes, physical properties including state, shape, or colour may not change.

Heating of the bulb when it is switched ON, changing of water into ice or steam, melting of wax, cutting of vegetables, cutting of wood, formation of clouds and cutting of diamond are some examples of physical changes.



Fig. 2.1 Melting of ice is a physical change

ACTION TIME 1

Aim: To observe and conclude what is a physical change.

Materials required: ice cubes, bowl, a Bunsen burner

Procedure: Take an empty bowl and add some ice cubes to it. Heat the bowl using the Bunsen burner. Now, keep this bowl in a freezer. Leave this undisturbed for a few hours.

Write the observation(s) in your notebook.

Conclusion: This is a physical change. You saw how ice is changed to water on heating and returns to its original form on freezing. You can see that there were no changes brought about in the characteristics of the ice.

Chemical Changes

Chemical changes are the changes that lead to change in the chemical composition and properties of a substance undergoing change. These changes result in the formation of a new product. The new products thus formed cannot be converted to their original forms and hence the reaction in such a case is irreversible. Most chemical changes are irreversible in nature.

Characteristics of a chemical change

- A chemical change is a permanent and irreversible change.
- A chemical change occurs when a new product is formed. This new product has properties different from that of the original product.

- In a chemical change, the chemical structure and composition of the new product gets altered.
- Heat is released/absorbed during a chemical change.

Curdling of milk, burning of paper, burning of a matchstick, rusting of iron, bursting of crackers, and reaction of sulphur with iron powder are some examples of chemical changes.



Fig. 2.2 Rusting of iron is a chemical change

ACTION TIME 2

Aim: To observe a chemical change.

Materials required: a bowl, milk, spoon, curd

Procedure:

- Take a bowl and add lukewarm milk in the bowl.
- Now, take a tablespoon of curd and add it into the milk.
- Stir it well such that the curd is mixed.
- Keep the bowl in a warm place overnight.

Observation: You will see that the milk has curdled and changed to curd.

Conclusion: The change in milk resulted in the formation of a new product. Hence, it is a chemical change.

ACTION TIME 3

Aim: To show that gas is evolved during a chemical change.

Materials required: a bottle, vinegar, baking soda, a balloon, a funnel

Procedure: Place a small amount (3–4 tablespoons) of baking soda in the balloon using the funnel. Then, pour vinegar into the bottle such that it is about half full. Very carefully, stretch the opening end of the balloon around the top of the bottle, making sure you keep the balloon down so that the baking soda does not fall into the bottle.

Lift the balloon up to allow the baking soda to drop into the bottle.

Observation and conclusion: You will see effervescence forming when baking soda reacts with vinegar. This shows that a chemical reaction has taken place. The gas that is evolved, inflates the balloon.

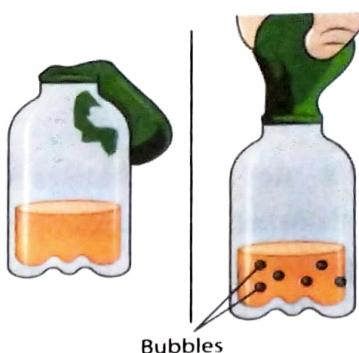


Table 2.1 Differences between physical and chemical changes

	Physical Change	Chemical Change
1.	No new products are formed.	New products are formed at the end of a chemical change.
2.	Physical change is reversible in nature, that is, the original product can be recovered.	Chemical change is irreversible in nature, that is, the original product cannot be recovered.
3.	A physical change is temporary in nature.	A chemical change is permanent in nature.
4.	It involves the change in physical state of the substance, such as shape, colour or size.	It involves the change in chemical properties and composition of the substance.
5.	Absorption or evolution of energy does not take place.	Absorption or evolution of energy takes place.

Desirable and Undesirable Changes

Some changes that take place are useful for us and hence are also called *desirable changes*. Ripening of fruit, cooking food and curdling of milk, are some examples of desirable changes. Some changes such as rusting of iron, eruption of volcano and burning of forests are not useful for us and are called *undesirable changes*.



a. Ripening of fruits is a desirable change



b. Forest fire is an undesirable change

Fig. 2.3 Desirable and undesirable changes

Exothermic and Endothermic Changes

Exothermic changes

When a change takes place, there also occurs a change in energy of that substance during the change. During the burning of paper, energy is released in the form of heat. The changes, such as burning of paper, photosynthesis and evaporation of water, in which heat is released are called *exothermic changes*.

Effervescence: The process of bubbling as gas escapes

Let us take an example of quicklime. It reacts vigorously with water to produce slaked lime, and releasing a large amount of heat. So the reaction is highly exothermic.

Endothermic changes

There are some changes during which heat is absorbed, for example melting of ice, evaporation of liquid water and cooking of food. *The changes in which heat is absorbed are called endothermic changes.*

Reversible and Irreversible Changes

The changes that can be reversed are called reversible changes. For example, if we blow air into a balloon, its shape and size changes, but if we release the air filled in it, the balloon will get back to its original shape and size.

The changes that cannot be reversed are called irreversible changes. For example, we can make cheese from milk, but we cannot convert cheese back into milk.

ACTION TIME 4

Aim: To observe the heat energy absorbed or evolved during a chemical change.

Materials required: a porcelain dish, iron powder, sulphur powder, Bunsen burner, a tripod stand

Procedure:

- Place the dish on a tripod stand and put iron powder in it.
- Then add sulphur powder in the dish.
- Heat the dish using a Bunsen burner.
- After sometime, the mixture of iron and sulphur will turn red hot in the porcelain dish and a compound iron sulphide is formed.

Conclusion: Energy is either absorbed or given out during a chemical reaction. In this reaction, initially energy was supplied to the reaction to take place using a Bunsen burner. But once the reaction started, it released energy as the mixture turned red, showing that a large amount of energy was released in the later stages of the reaction.

ACTION TIME 5

Aim: To observe how energy changes when a change takes place in a substance.

Materials required: water, salt, quicklime, two test tubes, test tube holders

Procedure:

- Hold each test tube with a test tube holder and take some water in the test tubes. Label them as test tube A and B.
- Add a pinch of salt in test tube A and observe. Touch the test tube and feel/(observe) if there is any change in the temperature.
- Add some quicklime in test tube B and observe. Touch the test tube slightly and observe (feel) if there is any change in the temperature.

Observation: The test tube A feels cold to touch while test tube B feels hot or warm to touch.

Conclusion: Dissolution of salt in water is an endothermic change as it absorbs heat. This is because the test tube was cold to touch. The dissolution of quicklime in water is an exothermic change as it releases heat. This is why the test tube appeared hot/warm to touch.

Quick Check 1

State whether the following statements are True (T) or False (F).

1. No new product is formed in a chemical change.
2. Physical changes are temporary in nature.
3. Curdling of milk is a physical change.
4. A chemical change is irreversible in nature.
5. Melting of wax is a chemical change.
6. A new product is formed at the end of a physical change.
7. Rusting of iron is a physical change and can be reversed.
8. Burning of paper is a chemical change.

CLASSIFICATION OF PHYSICAL AND CHEMICAL CHANGES

We have studied about the properties of physical and chemical changes. Now, let us study about the classification of physical and chemical changes.

Physical Changes

Melting

Melting is a physical process in which a solid changes to liquid on heating. The temperature at which a

solid substance starts melting is called **melting point**. The melting point of ice is 0 °C. Melting is a physical, reversible, desirable and also an endothermic change.

Freezing

The physical process in which liquid changes to solid when cooled is called **freezing**. For example, when water is cooled, it changes to ice. The temperature at which a liquid starts freezing is called its **freezing point**. Freezing is a reversible physical change, as the solid thus obtained can be changed to its liquid form on melting. It is also an exothermic and desirable change.

Boiling

The physical process in which a liquid is heated so that it changes into its vapour state is called **boiling**. The boiling point of pure water is 100 °C, that is, water starts boiling at 100 °C. Boiling is an example of a desirable and reversible physical change.

Sublimation

Sublimation is a process in which a solid changes directly into its vapour. Ammonium chloride and iodine change to their vapour state when heated. When these vapours are cooled, solid ammonium chloride or iodine, respectively, can be obtained. It is a physical change.

ACTION TIME 6

Aim: To observe the process of sublimation.

Materials required: pieces of camphor, china dish, burner

Procedure:

- Take a few pieces of camphor.
- Place the pieces of camphor in a china dish.
- Heat the china dish on the Bunsen burner.
- Write down your observations in your notebook.

Conclusion: Camphor is a solid that converts directly into gas or vapours.



Evaporation

Evaporation is a process in which a liquid is changed to its vapour form on heating. It is a reversible, physical, desirable and an endothermic reaction.

Dissolving

Dissolving involves mixing of a solid or liquid into a liquid. When the particles of a solid or liquid mixes with the particles of a liquid in the right amount, they get mixed together and form a solution. For example, dissolving of sugar cubes in milk and water while making tea.



Fig. 2.4 Some physical changes

Chemical Changes

Digestion

Digestion is the process of breaking down of food by chemical and enzymatic, and mechanical actions into simpler substances to be used by the body. New products in the form of simpler substances are formed in this process. It is an example of an irreversible and endothermic chemical change.

Respiration

The process by which the living organisms take in oxygen and break down the food to produce energy and carbon dioxide is called **respiration**. It is a chemical, an irreversible, a desirable, and an exothermic reaction, where heat is released during the process.

Burning

A chemical reaction that involves the rapid combination of a fuel with oxygen is called **burning**.

Heat is released during burning. It is a desirable and irreversible chemical change.

Rusting

When iron comes in contact with moisture, it forms a reddish-brown layer on its surface. The layer thus formed is called **rust**, whereas the process is called **rusting**. Rusting is an undesirable and irreversible chemical change.

Curdling

Curdling is a change in which milk changes to its semisolid form when acted upon by microorganisms. It is a desirable, a chemical, an irreversible, and an endothermic change.

Photosynthesis

The process by which most green plants make their food in the presence of chlorophyll, sunlight and carbon dioxide is called **photosynthesis**. It is an irreversible, a chemical, a desirable and an endothermic change.



a. Burning of paper



b. Curdling of milk

Fig. 2.5 Some chemical changes

ACTION TIME 7

Aim: To observe that the burning of a candle is a chemical change.

Materials required: candle and matchstick

Procedure:

1. Take a candle and light it with a matchstick.
2. As the candle wax (paraffin) burns, you can see molten wax dropping down.
You will also see light, smoke, and water, and feel the heat.

What do you observe? Discuss in class.

Conclusion: Unlike the physical change, there is a change in the state of wax in the form of flame, smoke and water vapour. Thus, burning of a candle is a chemical change.



Quick Check 2

State whether the following statements are True or False.

1. Melting of ice cubes is a chemical change.
2. During the process of respiration heat is absorbed.
3. During the process of burning, food in our body is broken down to release energy.
4. Freezing is a physical change so it cannot be reversed.
5. We can turn curd back into milk as it is a physical change.

KEY TERMS

Physical change: The change in which properties do not change and no new substance is formed

Chemical change: The change in which a new substance is formed when the reaction takes place

Evaporation: The process in which liquid changes into its vapour form

Rusting: The process of formation of a reddish-brown layer on the surface of iron when acted upon by moisture

Desirable change: The change that is useful for us

Undesirable change: The change that is not useful for us

Exothermic change: The change in which heat is released

Endothermic change: The change in which heat is absorbed

Reversible change: The change that can be reversed

Irreversible change: The change that cannot be reversed

QUICK NOTES

- * Physical changes are the ones in which only the physical properties are altered, but there are no changes brought about in the chemical structure of a substance.
- * A chemical change occurs when a new product is formed that has properties different from that of the substance from which it is formed.

- Melting, boiling, evaporation and freezing are some examples of physical changes.
- Digestion, respiration, burning, rusting and curdling of milk are some examples of chemical changes.
- Some examples of physical changes are melting, freezing, boiling, sublimation, evaporation and dissolving.
- Some examples of chemical changes are digestion, respiration, burning, rusting, curdling and photosynthesis.

RUN-THROUGH

I. Very Short Answer Questions.

A. Tick (✓) the correct option.

- Which of the following is an example of a chemical change?
 - Melting of wax
 - Breaking of glass
 - Burning of wood
 - Tearing of paper
- Which of the following is a physical change?
 - Bursting of crackers
 - Rusting of iron
 - Melting of ice
 - Baking a cake
- Which of the following statements is true for a chemical change?
 - No new product is formed.
 - No change in the physical state takes place.
 - A new product is formed.
 - both a and b
- The boiling point of water is:
 - 0°C
 - 100°C
 - 500°C
 - 250°C
- It is the process of breaking down of food by mechanical actions into simpler substances to be used by the body.
 - Digestion
 - Curdling
 - Respiration
 - Rusting
- When iron comes in contact with water, it forms rust which is a coloured layer.
 - greenish-yellow
 - blue-green
 - dark-red
 - reddish-brown

B. Fill in the blanks.

- Physical changes are (**permanent/temporary**) in nature.
- A chemical change cannot be (**forwarded/reversed**).
- Melting is the process in which changes to (**liquid/solid/gas**).

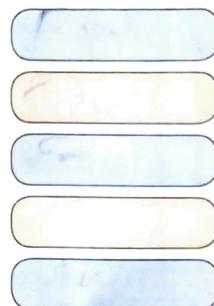
4. Heat is (**evolved/absorbed**) during evaporation.
5. (**Curdling/Rusting**) is a change in which milk changes to its semisolid form when acted upon by microorganisms.
6. The process by which living organisms break down food in the presence of oxygen and release energy is called (**digestion/photosynthesis**).

C. What type of changes are the following?

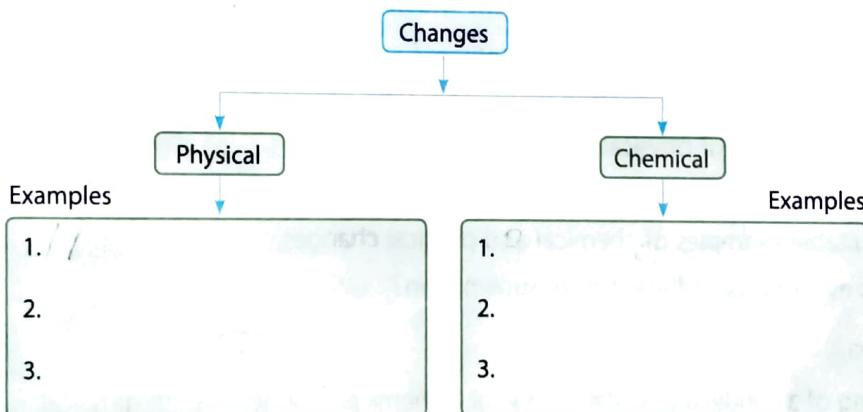
1. Curdling of milk
2. Evaporation
3. Ripening of fruit
4. Rusting of iron
5. Melting of ice

D. State whether the following statements are True or False.

1. A new substance is formed in a physical change.
2. A chemical change is irreversible in nature.
3. Respiration is an example of a physical change.
4. Heat is released during a chemical reaction.
5. The melting point of ice is 100°C.



E. Complete the concept map.



II. Short Answer Questions.

A. Question and Answers.

1. Give two examples in which physical change takes place.
- ✓ 2. How is a physical change different from a chemical change?
3. Is the melting of butter a physical change?
4. Why is evaporation a physical change?

- B. Classify the following into physical, chemical, irreversible, reversible, desirable and undesirable change. (Put a ✓ mark).

Change	Physical	Chemical	Desirable	Undesirable
Rusting	X		X	✓
Respiration			✓	
Freezing	✓			
Digestion			✓	
Photosynthesis		✓	✓	
Cooking of food		✓	✓	
Burning of paper		✓		✓

- C. Define the following terms.

1. Curdling 2. Respiration 3. Digestion 4. Burning

- D. Differentiate between:

- 1. Reversible and Irreversible change
- 2. Melting and Freezing
- 3. Exothermic and Endothermic reactions
- 4. Desirable and Undesirable changes

III. Long Answer Questions.

- 1. Cutting of wood is a physical change, while burning it is a chemical change. State reasons for the same.
- 2. What type of change is taking place during the rusting of iron?
- 3. List different processes and classify them into physical and chemical changes.
- 4. Why does food get spoiled faster in summer?
- 5. Describe an activity to show that physical changes are reversible in nature.
- 6. List the properties of physical and chemical changes.
- 7. Differentiate between physical and chemical changes with examples.
- 8. Give suitable examples of chemical and physical changes.
- 9. How is evaporation different from sublimation? ✓



IV. Challenge

- 1. Is burning of a candle a physical change or a chemical change, or both (physical change as well as a chemical change). Explain this statement with reasons.
- 2. Rusting of iron is a chemical change. Give reasons for the same. How can we prevent rusting?



V. Enrichment

A. Let's Learn More—What is activation energy?

We have studied about chemical changes in this chapter. For a chemical change to take place, a minimum amount of energy is needed to initiate a reaction. This energy is called **activation energy**. This activation energy should be supplied in the form of heat, light, or electric current. In a chemical change, the reactants combine to form new products. It is important to break the old bonds of the reactants and form fresh bonds in order to get new products in a chemical change.

For the occurrence of any reaction, the molecules or atoms of the reactants must collide with one another in order to break old bonds and form new bonds. The speed with which the chemical reaction takes place is called the rate of the chemical reaction. This should be appreciable to bring about the change.

- B. **Find and Report**—Are there any changes involved during weathering of rocks and soil formation? List and classify them in your notebook.

SCIENTIFIC QUEST

1. Look around your surroundings and list the different changes that occur in your day-to-day life. Group them as physical or chemical changes.
2. Does the size of sugar crystals affect its solubility? Design and conduct an experiment and find out which type of sugar (sugar cubes, powdered sugar, granulated sugar) is easily soluble in water.



a. Sugar cubes



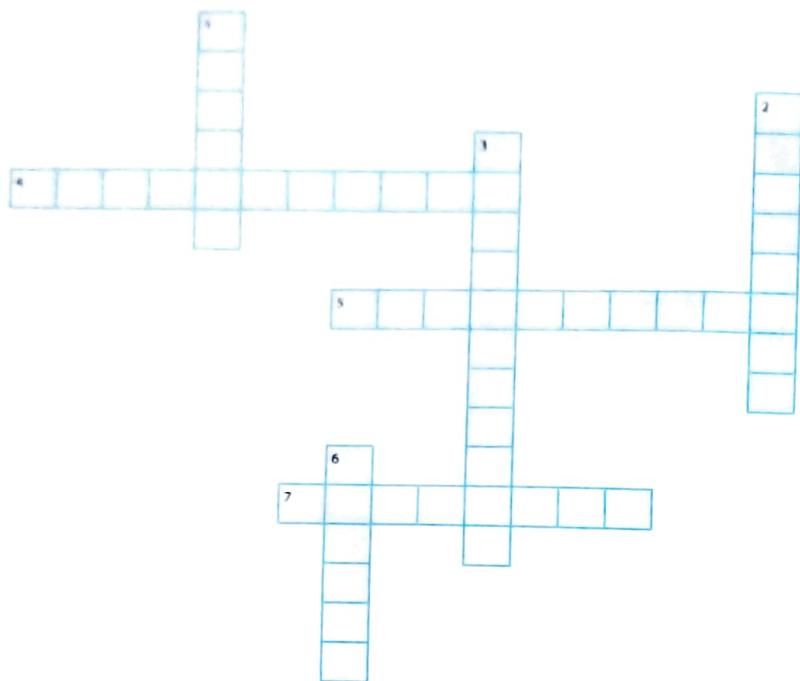
b. Powdered sugar



c. Sugar crystals (granulated sugar)

Write the experiment here:

1. Solve the given crossword.



Across

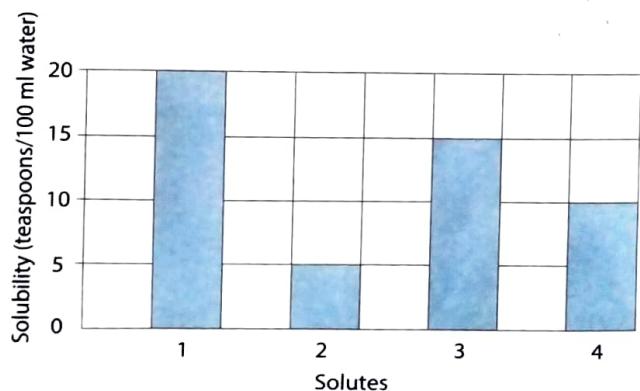
4. The process in which a solid directly changes into vapours.
5. In this process, evolution of heat takes place.
7. Type of change which takes place during cooking of food.

Down

1. In the process of melting, solid changes into
2. This type of change takes place during melting of ice.
3. The process during which heat is absorbed.
6. It is defined as the modification in either physical and chemical features of a substance.

2. The graph shows solubility of different substances. Refer the graph and answer the following questions .

- a. About how many teaspoons of solute 1 dissolve in water?
- b. About how many teaspoons of solute 4 dissolve in water?
- c. Another substance is more soluble than solute 4, but less soluble than solute 3. About how many teaspoons of this solute do you think will dissolve in the same given amount of water?
- d. List the solutes in their increasing order of solubility:



PICTURE SURVEY

1. Look at the pictures carefully. Identify the type of changes.



Chemical



Chemical

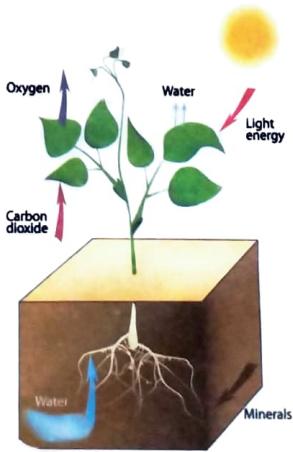
Life Connect



Chemical



Physical



Photosynthesis

RAPID FIRE 1

Tick (✓) the correct answer.

1. Change of state from liquid to solid is termed as:
a. fusion b. condensation c. sublimation d. freezing
2. A physical change:
a. is reversible b. is temporary c. both a and b d. none of these
3. Particles of a matter are held together by:
a. gravity b. intermolecular spaces
c. intermolecular forces d. glue
4. It is a physical process, in which a liquid on heating changes to its vapour.
a. Sublimation b. Melting c. Fusion d. Boiling
5. Liquids have:
a. indefinite size b. indefinite volume
c. indefinite compressibility d. indefinite pressure
6. Digestion is a form of:
a. physical change b. fusion c. chemical change d. none of these
7. Reddish-brown layer on the surface of iron is:
a. paint b. rust c. carbon d. vapour
8. The substances that cannot flow from a higher level to a lower level are/is:
a. liquids b. gases c. rice grains d. smoke
9. Gases are easy to:
a. burn b. diffuse c. store d. see
10. A chemical change:
a. absorbs/releases heat b. can be reversed
c. Both a and b d. None of these
11. The chemical composition of a substance undergoing physical change:
a. remains same b. may change
c. may or may not change d. definitely changes
12. After filling balloons with air, they expand. This shows:
a. air has weight b. air has shape c. air occupies space d. air expands
13. Which of the following is not considered as matter?
a. Ice b. Air c. Sound d. None of these
14. Which of the following is a natural desirable change?
a. Ripening of fruit b. Volcanic eruption
c. Rusting of machines d. Forest fire