CHANGES AROUND US

Concepts Covered

- Introduction to Change, Periodic and Non-Periodic changes
- Physical Changes and Chemical Changes
- Rusting of Iron, Crystallisation

Introduction

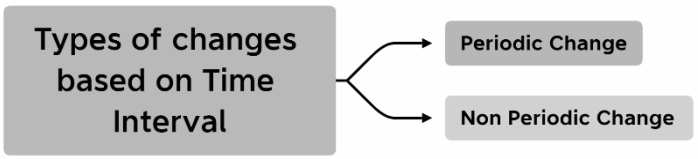
Change is a permanent part of our lives. Many changes are taking place around us on their own. In the fields, the crops grow and hence change from time to time. Sometimes, leaves fall from trees, change colour and dry out. The flowers bloom and then wither away. Some changes happen in our body too, like our nails grow, our hair grows, we grow taller and our weight increases as we grow.

A change could alter physical properties or chemical properties or both of the concerned matter. These changes may be observed by us at school, home, in the playground, garden or at any other place. A change can bring about different kinds of effects on the things around us. Some of the effects brought about are permanent in nature, and hence, cannot be reversed. However, some effects are about in position, shape, size or state of the things. These effects are temporary in nature, and hence can be reversed. Hence, a change can be defined as **"an alteration in properties of matter, brought about by some cause**.

We know there are certain changes that repeat after roughly a fixed period of time.
For example, we observe the repetition of sunrise and sunset every day. Similarly, we notice changes in seasons after every few months every year.

Types of Changes based on Time Interval

Changes are classified as Periodic and Non-Periodic changes:



Periodic Change:

A change which is repeated after regular intervals of time is called a periodic change. Swinging of a pendulum, rising and setting of the sun at a given place, and change of seasons are some examples of periodic changes.

Swinging of a Pendulum

Rising and Setting of the Sun

Change of Seasons

Non-Periodic Change:

A change which does not occur after regular intervals of time is called a non-periodic change. Most of the changes happening around us are non-periodic changes like occurrence of floods and cyclones.

Flood Cyclone

Types of Changes- Physical and Chemical

A matter is said to undergo a change only if its physical state changes to solid, liquid or gas or its chemical composition changes. A change in position is not a change in matter. A study of all types of changes is made easier if the changes are grouped into broad categories and sub-divided into smaller groups. For this purpose, we will divide the changes that take place around us into two groups.

Changes are of two types:

1. Physical change
2. Chemical change

Physical Change

A physical change is a change that involves only a change in the physical state of matter.

Melting of Ice

Chemical Change

A chemical change is a change that involves a change in the chemical composition of matter.

Burning of wood

Characteristics of Physical Change

(1) In a physical change, chemical properties remain the same.
(2) Usually increasing the temperature or applying pressure or both bring about a physical change.
(3) On reversing the condition, i.e., decreasing the temperature or decreasing the pressure or both, the original state of matter is restored. In other words, physical changes are reversible.
(4) For example, heating water to its boiling point changes its physical state, as it becomes steam. Steam is also water only its physical state is different. The chemical properties of water and steam are the same. On cooling, the steam changes back to water.

Characteristics of Chemical Change

(1) In a chemical change, a new substance is formed.
(2) In a chemical change, the chemical and physical properties of the substance formed will be different from the original substance.
(3) On reversing the condition, the original substance may or may not be formed. In other words, chemical changes may or may not be reversible.
(4) For example, burning of coal is chemical change. When coal is burnt, the chief component, carbon is changed to carbon dioxide. This process cannot be reversed.

Check Your Concept - 1

(i) Change of milk to curd is a:
(A) Physical Change (B) Chemical Change
(C) Both (A) and (B) (D) None of these

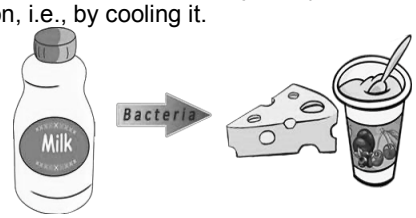
(ii) Characteristic of matter exhibited without a change in its identity is:
(A) Physical Property (B) Chemical Property
(C) Thermal Property (D) None of these

(iii) Rotation of fan blade is a:
(A) Permanent Change (B) Periodic Change
(C) Undesirable Change (D) Non- periodic Change

Irreversible and Reversible Chemical Change

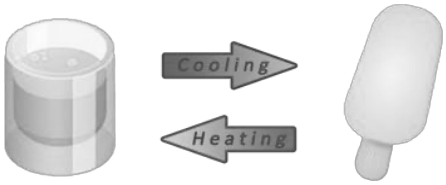
Irreversible Chemical Change

Heating carbon in the air changes it to carbon dioxide. The physical and chemical properties of carbon and carbon dioxide are different from each other. Carbon dioxide cannot form carbon just by reversing the condition, i.e., by cooling it.



Reversible Chemical Change

Nitrogen and hydrogen when compressed and heated change to ammonia gas. Under the same conditions, ammonia decomposes to give nitrogen and hydrogen gases.

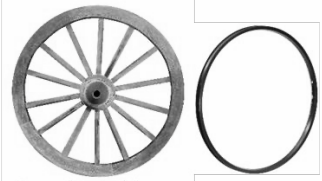


Chemical Changes caused by Heating

1. Some objects simply get hot, but no other changes take place. When you drink hot milk or coffee from a cup you may feel that the cup gets hot however, no change in the state of the cup takes place.
2. Some objects get hot and expand. Eg. Metal key upon heating gets hot and expands in size.
3. Some objects get hot and their shape and size changes. Eg. When the candle is lighted it starts burning and it's shape and size also changes.
4. Some of the objects show change in their state. Eg. When ice is heated it changes into water and on further heating it changes the water into steam. All these changes can be reversed.

Extended Learning

The metal rim is made slightly smaller than the wooden wheel. On heating, the rim expands and fits onto the wheel. The cold water is then poured over the rim, which contracts and fits tightly onto the wheel.



Cart wheel with metal rim fixed to it

Factors Determining Chemical Changes

Not all situations result in chemical changes. Specific conditions must be met for a chemical change to occur. The following situations can lead to chemical changes:

a. Contact in physical states b. Solution of reactants c. Electricity
d. Heat e. Light f. Catalyst

Burning A Matchstick

(a) Contact in Physical States: The burning of a matchstick on rubbing on the sides of a matchbox and the reddish browning of iron objects are just two examples of the numerous events that occur every day. These changes: Why and how do they occur? **These changes are the result of chemical reactions brought about by physical touch.** Contact in physical states is the combination of reactants in their naturally occurring states (solids, liquids, or gases).

- When dry wood is exposed to flames, it burns with the help of oxygen to produce carbon dioxide, which is released as smoke.
- Calcium oxide, or fast lime, reacts with water to produce slaked lime (calcium hydroxide).
- When a matchstick is rubbed on the sides of a matchbox, a chemical reaction takes place to form heat, light and smoke.

Reactants in Aqueous Solution

The head of a matchstick contains potassium chlorate and antimony trisulphide. The sides of the matchbox contain red phosphorous.

(b) Solution of reactants: Due to chemical interaction, the colour of the milk and the coffee decoction changes when combined. Similar to this, a chemical reaction occurs when two compounds (reactants) are combined in the solution form, resulting in the formation of new substances (products).

(c) Electricity: Electricity is necessary for us to live. For cooking, lighting, grinding, watching television, and other activities, we use electricity. Do you know it can also be used to carry out chemical reactions? Electricity facilitates a large number of chemical processes that are crucial for the industries. As you know, oxygen and hydrogen molecules

make up water. Hydrogen and oxygen gases are released when electricity is applied to water that has tiny amounts of sulfuric acid in it.

Thus, we can conclude that some chemical processes can only occur when electricity is present. These processes are referred to as **electrochemical processes or electrolysis**.

(d) Heat: Both our survival and the survival of many other living things depend on food. Have you ever paid attention when your mother prepared food? She uses the stove to boil the rice, cook the vegetables, and make the gravy. When enough heat is applied, certain chemical reactions turn raw (uncooked) food into cooked food.

Chemical reactions accompanying evolution of heat are called exothermic reactions. Whereas chemical reactions which involve absorbtion of heat are called endothermic reactions.

(e) Light: What would occur in the absence of sunlight? It is true that all living things will be affected, and we won't have enough food to survive. Not just for humans, but also for plants, sunlight is essential. As you are aware, photosynthesis is a process in which plants use light energy from the sun to create starch from carbon dioxide and water. "Photo" means light, and "synthesis" is production. The chemical reaction between carbon dioxide and water is started by sunlight, and the result is the creation of starch. Photochemical reactions are thus defined as chemical processes brought on by light.

Photochemistry is the branch of chemistry which deals with chemical reactions involving light.

(f) Catalyst: After a large meal, you may occasionally receive advice from the elders to sip a tiny amount of "oma water." Do you know why? This is due to oma water's ability to speed up digestion. Similar to this, several chemical compounds are utilized in industry to accelerate chemical reactions. These elements are referred to as catalysts. For instance, Haber's process for producing ammonia uses metallic iron as a catalyst. This ammonia serves as the raw material for creating urea, an essential fertilizer for farming. The catalyst used in the manufacture of vanaspati ghee (dalda) is finely split nickel. As a result, some reactions are speed up by catalysts, and these are known as catalytic reactions.

Enzymes and Yeasts are called Biocatalysts.

Effects of Chemical Changes

We know that every chemical reaction requires a specific condition to occur. When chemical reactions take place there will be a production of heat, light, sound, pressure etc. and also many other effects.

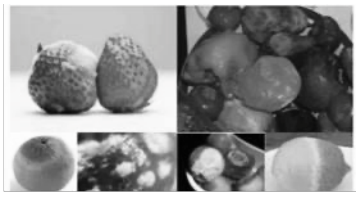
Biological Effects

Spoilage of Food and Vegetables

Any change that renders food unfit for ingestion by humans is considered **food deterioration**. The food quality deteriorates as a result of the chemical processes that the enzymes catalyse, including the creation of unpleasant flavours and odours, deterioration, and nutrient loss.

Examples:

The production of hydrogen sulphide gas gives rotten eggs their foul odour. The microbial decay of fruits and vegetables.



Spoilage of Food & Vegetables

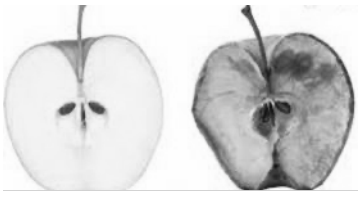
Fish and Meat Rancidity

Fish and meat containing a lot of polyunsaturated fatty acids oxidize when exposed to air or light and release a bad odour. **Rancidity** is the term used to describe this.

Fish rancidity

Sliced fruits on exposure to air

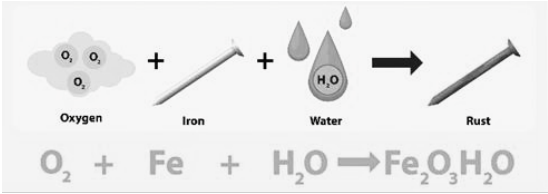
Fruits such as apples and other fruits turn brown when they are chopped because of a chemical interaction with the oxygen in the air. The name of this chemical reaction is **browning**.

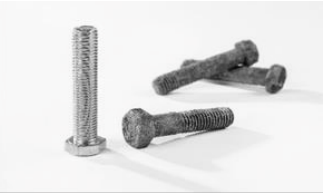


Oxidation = Rusting

Rusting of Iron

In the presence of moisture, an iron combines with atmospheric oxygen to form a brown-colored chemical called **rust** (iron oxide). Remaining iron from rust (iron oxide) has no physical process. It is a costly nuisance. The process of slowing down can save a lot of money.





Process of Rusting

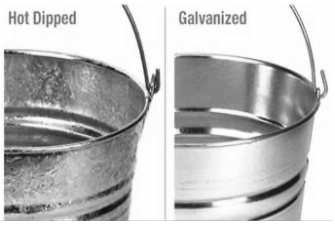
Many metals corrode when exposed to air. **Corrosion of steel and iron is called rusting**. The most common example of corrosion is that the rust peels off the metal surface, the rusting of the iron causes the iron to turn into rust-an orange-red powder, the fresh metal surface is exposed, and the corrosion process continues**.**

How do we Prevent Rusting of Iron?

Corrosion occurs when an iron object comes into contact with air and water. Therefore, if air and water are prevented from coming into contact with iron objects, rusting will not occur. So most methods of preventing iron from rusting involve coating iron objects with "something" to keep air and water out.

Some of the ways to prevent iron from rusting are listed below:

Galvanization	Painting	Oil or Grease
Galvanizing is a preventive tool against corrosion. A thin layer of zinc coveres the iron or steel object. This prevents oxygen and water from accessing the base metal, but the zinc also serves as a sacrificial metal. Zinc is more reactive than iron, but it oxidizes preferentially over an iron object. Galvanized metal, such as storage sheds, mesh and metal on boats, is most often used on outdoor items or anything likely to be in contact with moisture or water.	Rust can be prevented by something as simple as painting the surface of the iron. Varnishing creates a barrier on the surface of the iron, similar to galvanizing. The presence of a dye forms the boundary between the iron and the surrounding atmosphere. However, the disadvantage of painting iron is that it does not last as long as other surface treatments.	The oil not only lubricates and facilitates the movement of metal parts with less friction but also provides a protective shield against corrosion. The idea here is quite simple as the moisture will not interfere with the iron in the oil-coated metal and cause corrosion. The use of oil or grease significantly decreases the risk of iron corrosion. Basically, like ink, grease or oil forms a protective coating on the iron and thus prevents rust from forming.



Galvanized Metal


Painting of Iron Gate


Application of Lubricants

Check Your Concept - 2

(i) What is the chemical name of rust?

(ii) What are the three main components required for rust to occur?

(iii) What are the three methods to prevent rusting?

Crystallization

The process of separating a soluble solid from the solution by heating or evaporating the solvent is called crystallization.

Application or Uses of Crystallization:

- Separation of salt from sea water.
- Separation of crystals of alum from pure samples.
- Separation of pure copper sulphate from impure sample.

Crystallization Process:

- The solution is heated in an open container.
- The solvent molecules start evaporating, leaving behind the solutes.
- When the solution cools, crystals of solute start accumulating on the surface of the solution.
- Crystals are collected and dried as per the product requirement.
- The undissolved solids in the liquid are separated by the process of filtration.
- The size of crystals formed during this process depends on the cooling rate.
- Many tiny crystals are formed if the solution is cooled at a fast rate.
- Large crystals are formed at slow cooling rates.

Solved Examples

(1) **What kind of change does a glowing electric bulb undergo?**
Answer: As no new substance is formed when an electric bulb glows, it is a physical change.

(2) **Which change results in the formation of a new substance?**
Answer: A chemical change results in the formation of a new substance.

(3) **On sprinkling salt on an ice cube, it starts melting. What change does the cube of ice undergo?**
Answer: On sprinkling salt on a piece of ice, it melts. It is a physical change (a temporary change).

(4) **What kind of change is neutralization?**
Answer: Neutralization is a chemical change in which an acid reacts with a base to form salt and water.

(5) **What kind of change is undergone by the expansion of railway tracks during summer?**
Answer: The railway tracks undergo expansion in summer and contraction in winter. So, it is a reversible and a physical change.

(6) **Rina wrapped some green gram pulses in a wet cotton cloth and when she observed them after a couple of days, she found small white growths on them. What type of change is this?**
Answer: Pulses germinate undergoing several changes. During the chemical change, physical changes also takes place. The change is irreversible. Hence, it is a chemical change.

(7) **Why is the rusting of iron grouped under a chemical change?**
Answer: Rust (Iron oxide) is a substance that has properties which are different from both iron and oxygen. So, a new substance is formed.

(8) **Pooja put a candle in a vessel and heated the vessel. Even though the candle did not burn, it changed its shape and state. What kind of change is this?**
Answer: The candle melted on heating but no new substance is formed. So, it is a physical change.

(9) **Which type of change does sugar undergo when it is dissolved in water to form a sugar solution?**
Answer: Sugar dissolves in water and forms a sugar solution. It is a physical change, because we can get back the sugar by the evaporation of sugar solution.

(10) **Name the irreversible changes caused by heating a substance.**
Answer: Change in a substance due to heating may not be reversible. For example, when paper is burnt, ash is formed. Ash is a new substance and this change is irreversible.

Exercise

FILL IN THE BLANKS

(1) In_____change no new substance is formed.
(2) A chemical change is also called a_____ .
(3) Burning of any substance is a _____ change.
(4) Conditions for rusting of iron is _____ and_____.
(5) Two methods by which rusting of iron can be prevented are _____ and _____.
(6) Changes in which only _____properties of a substance change are called physical changes.
(7) Changes in which new substances are formed are called _____ changes.
(8) Setting curd from milk is a _____ change.
(9) Physical properties of a substance consists of _____ , _____ , and _____ state.
(10) No new substance is formed in a _____ change.

TRUE OR FALSE

(1) Cutting a log of wood into pieces is a chemical change.
(2) Iron pipes coated with zinc do not get rusted easily.
(3) Iron and rust are the same substances.
(4) Burning of any substance is a chemical change.
(5) Stretching of rubber band is a physical change.
(6) Galvanizing is a physical change.
(7) The mass of a substance changes during a chemical change.
(8) Oxygen layer protects us from harmful radiations of the sun.
(9) Burning of paper is physical change.
(10) Chemical change is permanent.

OBJECTIVE TYPE QUESTIONS

(1) Galvanisation is a process used to prevent the rusting of which of the following?
(A) Iron (B) Zinc
(C) Aluminium (D) Copper

(2) Which of the following statements is incorrect for a chemical reaction?
(A) Heat may be given out but never absorbed (B) Sound may be produced
(C) A colour change may take place (D) A gas may be evolved

(3) Which of the following is a physical change?
(A) Rusting of iron (B) Combustion of magnesium ribbon
(C) Burning of candle (D) Melting of wax

(4) Which of the following is a chemical change?
(A) Twinkling of stars (B) Cooking of vegetables
(C) Cutting of fruits (D) Boiling of water

(5) A physical change is generally
(A) Reversible (B) Irreversible
(C) Considerable (D) All of these

(6) Rusting of iron is a
(A) Physical change (B) Chemical change
(C) Both (A) and (B) (D) None of these

(7) Rusting occurs when the iron is exposed to
(A) Oxygen and water (B) Soil and rain
(C) Breeze and sunlight (D) Salt water and clouds

(8) When carbon dioxide is passed through lime water, the substance formed is
(A) Calcium oxide (B) Calcium carbonate
(C) Both (A) and (B) (D) None of these

(9) Which among the following is a physical change?
(A) Burning of wood (B) Ripening of fruits
(C) Cutting wood in small pieces (D) Cooking of food

(10) A chemical change may bring
(A) Evolution of gas (B) Change in colour
(C) Change in taste (D) All of these

Answer Key

CHECK YOUR CONCEPT

(1) **(i)** B **(ii)** A **(iii)** B

FILL IN THE BLANKS

(1) Physical
(2) Chemical Reaction
(3) Chemical
(4) Air and Water
(5) Painting or Greasing, Galvanisation
(6) Physical
(7) Chemical
(8) Chemical
(9) Shape, Size, Colour
(10) Physical

TRUE OR FALSE

(1) False
(2) True
(3) False
(4) True
(5) True
(6) True
(7) True
(8) False
(9) False
(10) True

OBJECTIVE TYPE QUESTIONS

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
(A)	(A)	(D)	(B)	(A)	(B)	(A)	(B)	(C)	(D)