INTRODUCTION :

Every day we come across many changes that are taking place all around us. These changes may involve one or more substances. Sometimes, milk becomes sour. Souring of milk is a change. Making a sugar solution is a change. Similarly, setting of curd from milk is a change.

Some changes that we have noticed around us are melting of ice, making of ice cream, melting of wax, stretching a rubber band, evaporation of water, cutting of paper, breaking of glass pane, bending of glass tube by heating, boiling of water, sublimation of camphor, etc.
Broadly, these changes are of two kinds:

- Physical changes
- Chemical changes

Physical Changes

In a physical change, a substance undergoes changes only in its physical properties such as shape, size, colour and state, and no new substance is formed. First, we shall perform some activities to show the physical changes that are taking place all around us are:

Characteristics of Physical Changes

The physical changes are temporary changes which can be easily reversed to form the original substance. In such a change, no new substance is formed.
Thus, we noticed that the important characteristics of physical changes are as follows:

- No new substance is formed in this change.
- It is a temporary change and is generally reversible.
- A temporary change in colour may take place.
- Very little energy (heat, etc) is either absorbed or evolved.

Chemical Changes

Chemical changes are also called chemical reactions. A chemical change occurs when two substances react chemically to form a new substance with different chemical properties. All the new substances which we use in various fields of our life are produced as a result of chemical changes (or chemical reactions).

A change with which we are quite familiar is the rusting of iron. Almost every iron (or steel) object kept in the open gets rusted slowly. It acquires a coating of a brownish substance called rust and the process is called rusting. We can usually see iron gates of parks or farmlands, iron benches kept in lawns and gardens, almost every article of iron, kept in the open gets rusted. The agricultural tools such as spades and shovels, also get rusted when exposed to the atmosphere for some time. In the kitchen, a wet iron pan (tawa) often gets rusted if left in that state for some time. Rust is not iron. It is different from iron on which it gets deposited.

Now, we shall perform some activities to show the chemical changes where new substances are formed.

When baking soda ($NaHCO_3$) reacts with vinegar which contains acetic acid carbon dioxide comes out, which turns lime water milky, therefore it is a chemical change. In all these activities, we saw that in each change, one or more new substances are formed. When the magnesium ribbon was burnt, the ash was the new substance formed.

The reaction of copper sulphate with iron produced two new substances, i.e. iron sulphate and copper. Vinegar and baking soda together produced carbon dioxide which turned lime water milky. So, all those changes in which one or more new substances formed, are called chemical changes. These are permanent changes which can usually not be reversed to form the original substance.

In addition to new products, the following may accompany a chemical change:

- Heat, light or any other radiation (e.g. ultraviolet) may be given off or absorbed.
- The sound may be produced.
- A change in smell may take place or a new smell may be given off.
- A colour change may take place.
- A gas may be formed.

Chemical Changes in Our Daily Life

Chemical changes are very important in our lives. Indeed, every new material is discovered by studying chemical changes, e.g. If metal is to be extracted from an ore such as iron from iron ore, we need to carry out a series of chemical changes. Medicine is the end product of a chain of chemical reactions. Important and useful new materials such as plastics and detergents are produced by chemical reactions.

Let us consider some more examples of chemical changes. We saw from the activity that burning of magnesium ribbon is a chemical change. Burning of coal, wood or leaves is also a chemical change. In fact, burning of any substance is a chemical change. Burning is always accompanied in the production of heat and light.

- An explosion of a firework (or crackers) is also a chemical change which produces heat, light, sound and unpleasant gases that pollute the atmosphere.
- When food gets spoiled, it produces a foul smell. This shows that new substances have been formed in the spoiled food which has a foul smell. So, the spoilage of food is a chemical change.
- If we cut an apple into slices and kept in the open for some time, we will find that the cut surface of apple acquires a brown colour. This change in colour is due to the formation of the new substance by the action of oxygen (or air). So, this change in colour is a chemical change.
- Similarly, the cut surface of potato or brinjal turns black on keeping in air for some time due to the chemical change.
- When an acid reacts with a base, then a neutralisation reaction takes place in which two new substances, salt and water, are formed. So, neutralisation is a chemical change.

- During photosynthesis, the plants intake carbon dioxide and water in the presence of chlorophyll and sunlight to form two new substances, glucose (food) and oxygen. So, photosynthesis is a chemical change.
- In the process of digestion, the various food materials break down to form new substances which can be absorbed by the body, so the process of digestion is a chemical change.

Rusting of Iron

When an iron object is left exposed to moist air, it chemically reacts with oxygen and water in the air to form a red-brown flaky substance called rust. The process of rusting can be represented by the following equation:

Iron (Fe) + Oxygen (O_2) (From air) + Water (H_2O) $\rightarrow$ Rust (Iron oxide, Fe_2O_3)

Rusting occurs in the presence of both oxygen and water. The more humid the air, the faster the rusting occurs. The rust slowly eats away or corrodes the iron, leading to considerable loss. Since iron is used in making bridges, ships, * cars, truck bodies and many other articles, the monetary loss due to the rusting is huge.

Preventions of Rusting

Rusting can be prevented by not allowing the iron to come in contact with moisture and air. The simplest method is to coat the iron with oil, grease or paint. These coats should be applied regularly to prevent rusting.

A more efficient method is to coat the iron with another metal such as zinc or chromium. The process of depositing a layer of zinc on iron is called galvanisation. The iron pipes we use in our homes to carry water are galvanised to prevent rusting.

Rusting of ships is a major problem in the shipping industry as the body of a ship is always in contact with water and the air around it is also very humid. The salt in water speeds up the process of rusting. This leads to huge monetary loss to the shipping industry. Rusting of iron can be prevented by allowing it to make stainless steel. Stainless steel is made by mixing iron with carbon and metals like chromium, nickel and manganese. It does not rust.

Physical change	Chemical change
Physical changes are mostly reversible.	Chemical changes are not reversible.
No new substances are formed.	One or more new substances are formed.
The substance retain its chemical properties.	the new substances formed have different properties from the original substance.

Chemical reaction:

A chemical change occurs when chemicals react with each other. Thus, a chemical change is also called a chemical reaction.

Some of the properties of a chemical change or chemical reaction are:

- Change in energy
- Change in colour
- Evolution of gas
- Formation of precipitate

Change in energy: Almost all chemical reactions involved energy change. Some chemical reactions produce heat while some take away heat.
A change or reaction in which heat is released is called an **exothermic reaction.**
For example; In a reaction between carbon and oxygen, carbon dioxide is formed with the generation of heat.
Carbon + Oxygen -> Carbon dioxide + Heat

A change or reaction in which heat is absorbed from the surrounding is called an **endothermic reaction.**
For example in a reaction between carbon and sulphur, carbon disulphide is formed with the absorption of heat.
Carbon + Sulphur + Heat …….. Carbon disulphide

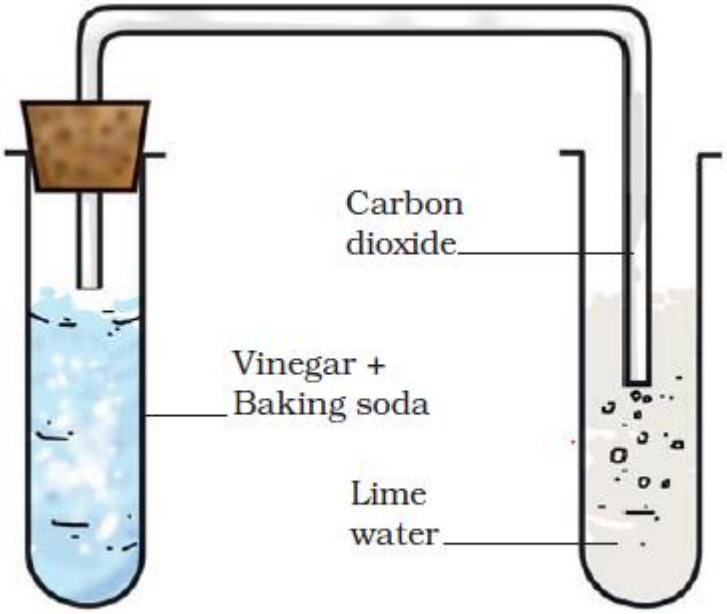
Change in colour: The colour of the product may differ from that of the reactants.
For example; copper sulphate is blue in colour, but after reacting with iron, the product formed (iron sulphate) is of green colour.

Evolution of gas: Some chemical changes also produce gases. Generally the gases produced can be carbon dioxide, hydrogen, ammonia etc. The presence of carbon dioxide can be confirmed as it turns lime water milky.

Activity:

Reaction between vinegar and baking soda:

Take vinegar (acetic acid) in a glass beaker and add a pinch of baking soda (sodium hydrogen carbonate) to it. We will observe gas bubbles coming out of the beaker. This is due to the release of carbon dioxide. This can be confirmed by making the gas produced pass through freshly prepared lime water. The lime water turns milky when carbon dioxide is passed through it due to the formation of calcium carbonate.



Set up to pass gas through lime water

Carbon dioxide (CO_2) + Lime water [$Ca(OH)_2$] -> Calcium Carbonate ($CaCO_3$) + Water (H_2O)

Formation of precipitate: In some chemical changes, the product formed separates from the solution and form a different mass of layer. This insoluble solid is called a precipitate.

For example; in a reaction between copper sulphate and hydrogen sulphide, copper sulphide and sulfuric acid are formed. The copper sulphide formed is given out as a precipitate.

- Next portion followed for Achievers group.

To understand chemical reactions, let us learn about elements, molecules and compounds.

Elements: Substances that consists of only one type of atoms and cannot be broken down into simple substances either physically or chemically are known as elements.
Elements can be classified into two broad groups- metals and nonmetals.
For example: Iron, copper, oxygen and carbon.

Compounds: Substances in which two or more elements are combined together chemically in

definite proportions are known as compounds.
For example; two atoms of hydrogen and one atom of oxygen combine in a definite proportion to form a molecule of water.

Mixtures: Substances in which two or more substances are mixed together physically in no definite proportion are known as mixtures.
For example; sugar solution.

Chemical symbols:
The representation of an element using the short form or abbreviation of its name is known as its chemical symbol. The name is based on English name or Latin name. For example; the name Copper and its symbol 'Cu' came from the Latin word cuprum.
All the names and symbols of the elements are approved by the International Union of Pure and Applied Chemistry (IUPAC).

Element (Latin Name)	Symbol	Element (Latin Name)	Symbol	Element (Latin Name)	Symbol
Hydrogen	H	**Aluminum**	Al	**Zinc**	Zn
Carbon	C	**Nitrogen**	N	**Phosphorus**	P
Boron	B	**Argon**	Ar	**Sulphur**	S
Iodine	I	**Fluoride**	F	**Lead (Plumbum)**	Pb
Lithium	Li	**Oxygen**	O	**Silver (Argentum)**	Ag
Beryllium	Be	**Barium**	Ba	**Copper (Cuprum)**	Cu
Silicon	Si	**Bromine**	Br	**Gold (Aurum)**	Au
Magnesium	Mg	**Calcium**	Ca	**Helium**	He
Manganese	Mn	**Iron (Ferrum)**	Fe	**Neon**	Ne
Chlorine	Cl	**Sulphur**	S	**Potassium (Kalium)**	K
Mercury (Hydragyrum)	Hg	**Sodium (Natrium)**	Na	**Cobalt**	Co

Chemical formula:
The symbolic representation of the composition of a chemical compound is known as its chemical formula.

For example; the chemical formula of sodium chloride is NaCl.

Compounds	Formula
Carbon dioxide	CO_2
Magnesium Oxide	MgO
Sodium Chloride	$NaCl$
Copper Sulphate	$CuSO_4$
Sulphuric Acid	H_2SO_4
Nitric Acid	HNO_3
Sodium Hydroxide	$NaOH$
Sulphur dioxide	SO_2
Water	H_2O
Ammonia Gas	NH_3
Sodium Chloride	$NaCl$
Potassium Chloride	KCl
Carbon dioxide	CO_2
Magnesium Chloride	$MgCl_2$
Hydrogen Sulphide	H_2S
Methane	CH_4
Hydrochloric acid	HCl

Valency:

The combining capacity of the atom of an element with the atom of other elements is known as its valency. Valencies of Some common elements are given below

Elements	Valency	Element	Valency	Element	Valency
Sodium	1	Magnesium	2	Chlorine	1
Potassium	2	Calcium	2	Carbon	4
Silver	1	Aluminium	3	Oxygen	2
Zinc	2	Hydrogen	1	Iodine	1

Chemical equations:

A Chemical change resulting in the formation of one or more new substances is called a chemical reaction. The representation of a chemical reaction using symbols and formulae of the elements or compounds involved in the reaction is known as chemical equation.

The chemical substances that participate in a chemical reaction are known as **reactants**.
The new substances formed due to a chemical reaction are known as **products**.
For example; Consider the reaction of magnesium with oxygen. Magnesium reacts with oxygen to form magnesium oxide.

Magnesium +oxygen → Magnesium Oxide

$$2Mg+O_2 \rightarrow 2MgO$$

Types of chemical reactions:

Chemical reactions are classified in the following types:

- Combination reaction
- Decomposition reaction
- Single displacement reaction
- Double displacement reaction

Synthesis or Combination reaction:

In this type of reaction, two or more substances combine to form one new substance. For example; hydrogen and oxygen react to form water.

$$2H_2+O_2 \rightarrow 2H_2O$$

Decomposition reaction:
In this type of chemical reaction, a compound breaks down into two or more substances. For example; silver chloride when exposed in sunlight breaks into silver and chlorine gas.

$$2Ag+CL_2 \rightarrow 2AgCl$$

Single displacement reaction:
In this, atoms of one element displays the atoms of another element from a compound.
For example; when iron is dipped in copper sulphate solution then iron displaced copper from copper sulphate solution and copper and iron sulphate solution is formed.

$$Fe+CuSO_4 \rightarrow FeSO_4+Cu$$

Double displacement reaction:
In this, Atom of two compounds switch places to form two new compounds.
For example; when hydrochloric acid and sodium hydroxide react then two new compounds sodium chloride and water are formed.

$$HCl+NaOH \rightarrow NaCl+H_20$$

Crystallization:

Some pure substances which are solid at room temperature from crystals. The process of formation of crystals is known as crystallization.

The process of crystallization is an example of a physical change. By obtaining crystals, we are able to purify certain substances. Pure sugar, urea, copper sulphate, alum and table salt form crystals.

The salt obtained by evaporation consists of many impurities such as sand, magnesium chloride etc. The impure salt can be purified by the crystallization process.

- For crystallization a large amount of salt is dissolved in water and allowed to boil to obtain a saturated solution.
  - Filter the saturated solution to remove impurities.
  - Now, let the solution cool slowly to form Salt crystals