HOW THINGS CHANGE & REACT WITH ONE ANOTHER

CONTENTS

PHYSICAL AND CHEMICAL CHANGES

There are two possible definitions for physical and chemical change :

- A physical change is reversible, a chemical change is not always. For example, the freezing of water would be a physical change because it can be reversed, whereas the burning of wood is a chemical change and the burning cannot be withdrawn once having burnt.
- A physical change is a change in which no new substance is formed, a chemical change results in the formation of one or more new substances. Again, consider the previous examples: freezing water into ice just results in water molecules, which are stuck together it is still H_2O. Whereas burning wood results ash, carbon dioxide etc, all new substances, which were not, there when you started burning.

  A physical change in a substance does not change what the substance is. In a chemical change where there is a chemical reaction, a new substance is formed and energy is either given off or absorbed. For example, if a piece of paper is cut up into small pieces, it still is paper. This would be a physical change in the shape and size of the paper. If the same piece of paper is burned, it is broken up into different substances that are not paper. Physical changes can be reversed; chemical changes cannot be reversed with the substance changed back without extraordinary means, if at all. For example, a cup of water can be frozen when cooled and then can be returned to a liquid form when heated. If one decided to mix sugar into water to make sugar water, this would be a physical change as the water could be left out to evaporate and the sugar crystals would remain. However, if one made a recipe for a cake with flour, after, sugar and other ingredients and baked them together, it would take extraordinary means to separate the various ingredients out to their original form. When heat is given off in a chemical change or reaction, it is called an **exothermic reaction.** When heat is absorbed in a chemical change or reaction, it is called an **endothermic reaction.** The speed at which chemical reactions take place depend on the temperature pressure and how concentrated the substances involved in the chemical reaction are. Sometimes substances called **catalysts** are used to speed up or help along a chemical reaction.

CHANGE

There are two types of changes:

- **Physical Change**

  In a physical change, there is only a change of state. The new substance has the same properties as the old one. No new substance(s) are produced. Ice-water-steam (They are all still water !) For example: ice melting to water or water boiling. In all of these changes, you can get the original materials back! A physical change may also involve changing the shape of the substance. Paper cut into pieces is still paper, ploughing a field but the field still remains as soil, cutting

wood into pieces is still wood, and moulding a sculpture is still cement or marble Physical changes are reversible changes.

The following are the examples of physical change, which is also a temporary change:-

(a) Stretching rubber band

(b) Chewing of food

(c) Putting an electric switch on and off

(d) Breaking a stick

(e) Tearing clothes

(f) Ploughing a farm

(g) Sawing wood etc.

(h) Melting of ice-cream etc.

(i) Dissolution of resin in alcohol

(j) Formation of dew, hail, snow, frost, mist and fog

(k) Evaporation of water from sea, river lake etc

◈ **Chemical symbols of some familiar chemical elements**

Element		Symbol
1.	Potassium	K
2.	Barium	Ba
3.	Calcium	Ca
4.	Sodium	Na
5.	Magnesium	Mg
6.	Aluminium	Al
7.	Zinc	Zn
8.	Iron	Fe
9.	Nickel	Ni
10.	Tin	Sn
11.	Lead	Pb
12.	Hydrogen	H
13.	Copper	Cu
14.	Mercury	Hg
15.	Silver	Ag
16.	Platinum	Pt
17.	Gold	Au
18.	Fluorine	F
19.	Chlorine	Cl
20.	Iodine	I
21.	Oxygen	O
22.	Hydrogen	H
23.	Sulphur	S
24.	Carbon	C
25.	Helium	He

◈ **Chemical formulae of some familiar chemical compounds:**

Compound		Chemical Formulae
1.	Water	H_2O
2.	Carbon dioxide	CO_2
3.	Hydrochloric acid	HCl
4.	Sulphuric acid	H_2SO_4
5.	Nitric acid	HNO_3
6.	Carbonic acid	H_2CO_3
7.	Phosphoric acid	H_3PO_4
8.	Sodium Oxide	Na_2O
9.	Sodium Chloride	NaCl
10.	Sodium sulphate	Na_2SO_4
11.	Sodium carbonate	Na_2CO_3
12.	Sodium hydroxide	NaOH
13.	Sodium nitrate	$NaNO_3$
14.	Magnesium Oxide	MgO
15.	Magnesium Chloride	$MgCl_2$
16.	Magnesium sulphate	$MgSO_4$
17.	Magnesium Carbonate	$MgCO_3$
18.	Magnesium hydroxide	$Mg(OH)_2$
19.	Magnesium nitrate	$Mg(NO_3)_2$
20.	Calcium oxide	CaO
21.	Calcium chloride	$CaCl_2$
22.	Calcium sulphate	$CaSO_4$

23.	Calcium carbonate	$CaCO_3$
24.	Calcium hydroxide	$Ca(OH)_2$
25.	Zinc oxide	ZnO
26.	Zinc Chloride	$ZnCl_2$
27.	Zinc sulphate	$ZnSO_4$
28.	Zinc carbonate	$ZnCO_3$
29.	Zinc nitrate	$Zn\ (NO_3)_2$
30.	Ferrous oxide	FeO
31.	Ferric Oxide	Fe_2O_3
32.	Ferrous Chloride	$FeCl_2$
33.	Ferric Chloride	$FeCl_3$
34.	Ferrous sulphate	$FeSO_4$
35.	Ferric Sulphate	$Fe_2(SO_4)_3$
36.	Lead trioxide	Pb_3O_4
37.	Lead monoxide	PbO
38.	Mercury oxide	HgO
39.	Copper sulphate	$CuSO_4$

◈ **Chemical change**

In a chemical change, one or more new substances are created. The new substance is different from the original. It has properties that are different from those of the starting materials. In addition, you can get the original matter back conveniently.

Consider an ordinary box of matches. A single match in a box can remain unchanged forever. However, if someone were to take the match and then light it a flame light up and the burns out. What remains will have changed forever. The match can never be lighted again. The match has undergone a chemical reaction. Chemical changes are irreversible changes.

The following are the examples of chemical changes:

a. Rusting of iron

b. Burning of fuel such as, gas, petrol etc.

c. Oxidising food for energy

d. Lighting a match

e. Decay of food, dead plant and animal bodies

f. Cooking of food

g. Butter turning sour

h. Photosynthesis in plants

i. Fermentation of fruit juice etc.

j. Respiration in living being

k. Digestion

In the chemical change, gas is evolved; change of state, precipitate formation and the energy transfer takes place. Consider the following examples of chemical changes:

a. Zinc reacts with hydrochloric acid to form Zinc chloride and hydrogen gas is evolved.

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

b. In the process of photosynthesis, solar energy is transferred or change to chemical energy

$CO_2 + 12\ H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$

c. Two gaseous substance H_2 and O_2 react together to form wter, which is a liquid. This satisfies that the change of state takes place during a chemical change.

$2H_2(gas) + O_2(gas) \rightarrow 2H_2O\ (liquid)$

d. Sindoor (vermillion) is chemically lead nitrate. When it is heated, the compound liberates oxygen and forms a yellowish substance called lead oxide.

$2Pb_3O_4 \rightarrow 6PbO + O_2$

➢ RUSTING AND ITS PREVENTION

Rusting is a significant difficulty because it wears off the structure of bridges, iron railings, machine parts, agricultural equipments such as khurpi, spade, sickle etc. Rusting is a type of corrosion. Eating away of metals due to oxygen, carbon dioxide, water vapour, hydrogen sulphide (a gas with pungent smell) etc. present in the atmosphere is called **corrosion.** Eating away of metals due to oxygen alone is called **rusting.** The powdery substance that is deposited on iron (metals) is called **rust.** Prevention of rusting has always been a challenge and involves a huge expenditure.

Fe (iron) + O_2 (Oxygen from atmosphere + H_2O (from moisture water) = Fe_2O_3 (Ferric Oxide or rust)

Rusting is a process of slow oxidation. It is a chemical change which is responsible for destroying the iron articles such a khurpi, kodal etc. slowly.

By **greasing and oiling** of metal accessories, tools and machines.

- The process of coating a metal with other suitable material to stop its contact with air, water or moisture is called **galvanization.** Iron sheets are dipped in molten zinc to coat the surface of iron objects or sheets with a thin layer of zinc. A thin layer of zinc on iron protects the surface or iron from rusting or corrosion. Bicycle wheels and wheels of automobiles are coated with nickel and chromium, which makes them lustrous, protects from rusting and becomes durable.
- **Painting** on a metal forms a layer on the metal surface to detach it from the contact of air, water or moisture. This prevents a metal from getting corroded or rusted.

➢ CRYSTALS AND CRYSTALLISATION

Solids with regular geometric shapes such as square, a triangle, a quadrilateral or a pentagon etc. formed from regular arrangements of particles are called **crystals.** The edges of crystals are straight and the surfaces flat. Substances that form a crystal are called **crystalline.** Solids without a regular shape are called **amorphous** substances. The process of obtaining crystals from its saturated solution at a higher temperature is called **crystallisation.** It is a physical change as no new substance is formed. A crystal has a similar set of chemical property as that of mother liquid. The main aim to crystallize a substance is to obtain a pure substance from their naturally occurring impure substance.

- **Common Salt and the sea water**

  Common salt is obtained from seawater by the process of crystallization. Seawater is richest source of salt. Seawater is rich of aquatic lives. Their excreta and dead of aquatic plants and animals keep on decaying and salts from their remains keep on adding salt to the seawater. Various rivers and rain also add salt to seawater. Water is the best solvent known to us. Deposition of salt in seawater is much larger than the capacity it can dissolve. Seawater is saturated solution of salt. Excess of salt sediments to the bottom of sea. A saturated solution of seawater contains around 35 gm of dissolved salt per litre of water. This why seawater is saline.