Chapter 6

Physical and Chemical Changes

Physical Change

The changes around us are classified into two types:

(1) Physical Change

(2) Chemical Change

♦ Physical Change:

A change in which only the physical properties of a substance change (for example change in shape, size, position, or physical state) but the chemical composition remains the same is called a physical change.

⇒ These changes are mostly reversible and temporary.

⇒ No new substance is formed in physical changes.

⇒ Some examples are stretching of a rubber band, melting of wax, melting of ice, hammering metals into sheets, etc.

Chemical Change

The changes that involve changes in composition and chemical properties are called chemical changes.

⇒ These changes are irreversible and permanent.

⇒ A new substance is formed in chemical changes.

⇒ Some examples are the formation of curd from milk, digestion of food, burning of crackers, and change in color of sliced pieces of fruits, etc.

Chemical reactions as Chemical changes:

⇒ When we burn magnesium ribbon, it reacts with air to form ash of magnesium oxide. It represents the chemical change in the magnesium ribbon.

Burning of magnesium ribbon

Magnesium (Mg) + Oxygen (O_2) → Magnesium oxide (MgO)

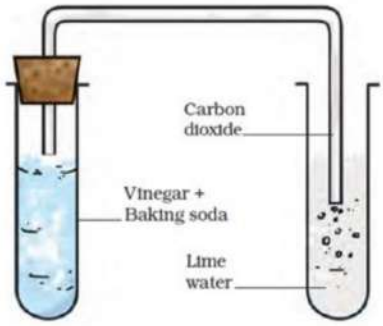
When we mix magnesium oxide in water, it forms a new solution (magnesium hydroxide) that is a base.

Magnesium oxide (MgO) + Water (H_2O) → Magnesium hydroxide [$Mg(OH)_2$]

⇒ A chemical reaction takes place when vinegar is mixed with baking soda to give carbon dioxide gas.

Vinegar (Acetic acid) + Baking soda (Sodium hydrogencarbonate) → Carbon dioxide + other substances

When this gas is passed through the solution of limewater, it turns milky due to the formation of calcium carbonate.

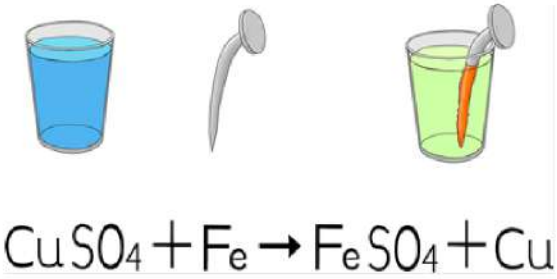


Setup to pass carbon dioxide through lime water (PC: NCERT)

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

⇒ When we place an iron nail in a copper sulphate solution, the color of the solution changes to green due to the formation of a new substance (ferrous sulphate).

Copper sulphate solution (blue) + Iron → Iron sulphate solution (green) + Copper (brown deposit)



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

Formation of iron sulphate

Hence, chemical reactions are also called chemical changes where one or more substances are formed. In addition to new products the following may accompany a chemical change: Heat, light, or sound. For example, the burning of crackers produces light and sound.

Some other example of chemical change:

Neutralisation: It is the reaction of an acid and a base to give salt and water with the evolution of heat. Thus, a new substance is formed called salt.

Acid + Base →Salt + Water

For example, hydrochloric acid reacts with sodium hydroxide to form sodium chloride and water.

$HCl + NaOH \rightarrow NaCl + H_2O$

Photosynthesis: Photosynthesis is the process through which plants convert light energy into chemical energy. It involves a chemical reaction in which water combines with carbon dioxide to produce glucose and oxygen. Since in this process, new chemical species are produced so it is classified as a chemical change.

* Question: Boiling of an egg is a (a) _____ change while the melting of chocolate is a (b) _____. Fill in the blanks.

Answer: The egg is boiled to form a new substance whose chemical composition is also different. So, the boiling of the egg is a chemical change that cannot be reversed. Thus, boiling the egg is (A) an irreversible chemical change.

The chocolate is melted to form liquid chocolate. So, the physical state changes from solid to liquid. It can be frozen to form solid chocolate. Thus, the melting of chocolate is a (B) reversible physical change.

Rusting of Iron

• It is the process of formation of a brown layer on iron substances when exposed to moist air (which contains oxygen and water) a brown flaky layer is formed on their surface. This brown layer of iron is hydrated iron oxide or rust.

• It is a chemical and irreversible change. The process of rusting can be represented by the following chemical equation:

$Fe + O_2 + H_2O \rightarrow Fe_2O_3.x\ H_2O$ (Rust)

• The two essential conditions for rusting of iron objects are water (moisture) and oxygen.

• It is a corrosive process that occurs easily under natural conditions.

• Iron kept in dry and non-humid air cannot undergo rusting. Rusting is an undesirable change because it damages iron and steel objects and slowly destroys them.

♦ Prevention of Rusting:

⇒ By coating the iron surface with grease or oil.

⇒ By painting the surface of iron articles.

⇒ Both the above methods cut off the contact of metal surface with air and moisture, thus preventing rusting.

⇒ By coating iron with a layer of other metals.

⇒ The process of coating a thin layer of other metals which are more resistant to air and moisture like zinc or chromium on the surface of iron articles by passing electric current is called galvanization. In this process, iron or steel objects are dipped into heated containers of zinc. The zinc is in the molten form usually kept at a very high temperature. Because of high temperatures, zinc gets deposited over the iron body. The protective coating of zinc prevents the reaction of iron with oxygen and water.

Crystallisation

• The process of obtaining crystals of pure substances from their saturated solution is called crystallisation.

• Substances like sugar, salt, urea and copper sulphate can be obtained by crystallisation.

• Crystallisation is an example of physical change because it is reversible and involves only changes in shape and size. For example, the copper sulphate is a blue colored crystal that is obtained by heating the aqueous solution of copper sulphate.