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PHYSICAL AND CHEMICAL CHANGES

- Changes in energy are always accompanied by a particular **chemical change or physical change**.
- Many changes happen in a natural environment such as evaporation of water, condensation, rainfall, etc. The change in state is involved in all these changes. During some reaction, the old bonds in the reactants break and new bonds are created in the products.

What is Physical Change?

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



Figure 1: Physical Properties

Examples of Physical Change

1. Dissolution of sugar in water
2. Melting of ice
3. Freezing of water
4. Boiling of water
5. Melting of wax



What is Chemical Change?

- The change in which the molecular composition is completely altered and a **new product is formed** is called a chemical change.
- Chemical changes create a new product.
- The changes in Chemical **change are irreversible and permanent**.
- It reveals that chemical change cannot be reversed by changing or altering the experimental changes.
- The mass of the substance is altered during a chemical change. Either the mass is added or removed.
- During a chemical change, the energy changes occur. There is an energy difference in the **breaking of old bonds in reactants and the formation of new bonds** in products.
- The reaction is called an exothermic reaction if the energy is released and as an endothermic reaction when the energy is absorbed.
- 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.
- 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 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.

Change in Property	Example
Radiation or absorption of heat	Burning of a substance such as coal, wood or candle results in production of heat and hence is a chemical change. Similarly, melting of ice results in absorption of heat and therefore it is a chemical change.
Production of sound	Bursting of fireworks is a chemical change. It results in production of sound, heat, radiation as well as gas.
Change in the colour of the substance	Raw fruits and vegetables when cut and left in open air start acquiring brown color due to a chemical change. Similarly, rusting of iron results in change of color of iron to reddish brown is also a chemical change.
Formation of a gas	When antacids are mixed in water bubbles are formed indicating the production of a gas and therefore it is a chemical change.
Change in the smell of the substance	When food gets spoiled, it produces foul smell. This is because of a chemical change in food. Rotten eggs often produce a bad odour due to production of sulphur.
Formation of Solids	Two liquids combine with each other and form a solid called precipitate. For Example, shells of animals are precipitates formed by chemical changes.



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.

- 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

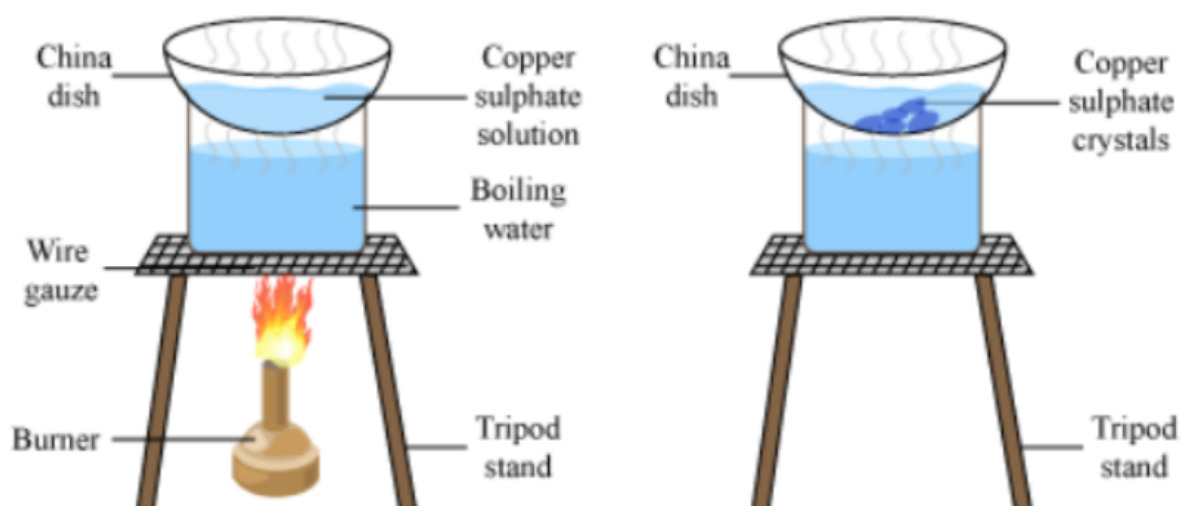
- When an iron object is left exposed to moist air, it chemically reacts with oxygen and water in the air to form a red-brown flaky substance called rust. The process of rusting can be represented by the following equation:
Iron (Fe) + Oxygen (O₂) (From air) + Water (H₂O) → Rust (Iron oxide, Fe₂O₃)
- 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.

Crystallisation

- Seawater contains salts dissolved in it which makes it salty.
- The salt obtained from seawater by the process of evaporation is not pure and its crystals are small. The shape of the crystals cannot be seen clearly.
- Large crystals of pure substances can, however, be obtained from their solutions by the process of crystallisation. It is an example of a physical change.
- The process of cooling a hot concentrated solution of a substance to obtain crystals is called crystallisation. The process of crystallisation is used to obtain crystals of a pure solid substance from the impure solid substance.
- Impure copper sulphate powder can be purified by the process of crystallisation to obtain large crystals of pure copper sulphate.





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