

Changes of Matter

PHYSICAL CHANGE	CHEMICAL CHANGE
A change in which the physical properties of a substance like its shape, size, appearance, state change.	A change in which two or more substances react chemically to form a new substance.
The composition of the substance remains the same.	The new substance that is formed has an entirely different composition from the original substances.
These changes are usually temporary.	These changes are mostly permanent.
Temporary changes are generally reversible.	These changes cannot be reversed easily.
There is no change in the mass of the substance.	Mass of the individual substances may either increase or decrease. However total mass of the reactants is equal to the total mass of the products.

EXAMPLES OF PHYSICAL CHANGES:

- Change in the state of a substance.
E.g. Water freezes to form Ice (Solid to Liquid), Ice melts to form Water (Solid to liquid)
- Molding of wet clay only leads to a change in shape but not its state.
- Rings, Earrings, necklaces made from gold only differ in shapes & styles. No change happens to the composition of gold.
- Pulling copper into a wire only leads to a change in its shape and not its composition.
- Electric bulb lights up on flow of electricity and emits light but no change happens to it chemically.
- Heating water to convert it into water vapour is a change in its state (from liquid to gas), but there is no chemical change. Also if we place a plate above the vessel where water is being heated, the water vapour cools down and water droplets come on top of the plate showing the physical change could be reversed.
- A lake freezes in winters and melts in summer, thus reversing this physical change.
- Sharpening of a pencil
- Tearing of paper is a physical change because though it is torn into pieces, the composition of paper has not changed.
- Stirring sugar in tea – just mixes it with milk. It does not change the property of sweetness of sugar.
- The height of Mount Everest rises by an inch every year. This is a physical change.

EXAMPLES OF CHEMICAL CHANGES

- Paper burnt results in a chemical reaction since the burnt piece of paper turns into ash and release of gas. Hence new substances get formed due to this change and we cannot reverse this change.
- Sugar dissolved in H₂O → Physical & sugar burnt → Chemical change.
- Baking of a cake is a chemical change since the process is irreversible and a totally new substance is formed after the original ingredients were mixed and heated.
- Burning of Candle (Melting of Wax) → Physical change, where solid wax gets converted to molten wax.

(Burning of Wick) → Chemical change, this is because the wick covered with wax burns to give out gas and also the carbon gets deposited on the wick and the wick keeps reducing in size. Also this process cannot be reverted.

5. Cutting of wood → Physical Change
6. Burning of wood → Leads to production of ash, Carbon dioxide and water. Chemical Change.
7. Rotting of Vegetables / Eggs → Chemical change, as the properties of the substance changes and also because the process is irreversible.
8. Cooking of Food → Chemical change as the original ingredients when mixed and heated produce a new product.
9. Cement when mixed with water to make concrete → Chemical change as cement cannot be obtained back from concrete.
10. Plaster of Paris when hardens on adding water → Chemical change.
11. Bursting of crackers → Chemical change that produces heat, light, sound & some unwanted gases.

Symptoms of a Chemical change

When a chemical change occurs the following sign could be observed:

1. A gas (fizz) is produced.
2. A solid (precipitate) is formed.
3. Sound or light is produced
4. Temperature changes
5. A colour change occurs
6. A substance disappears
7. A new odor is produced

RUSTING

i.e. Iron + Oxygen + Water → Rust.

Rusting eats away the surface of objects made from iron and destroys them.

The rust is in the form of flakes. The flakes gradually break off and the lower iron layer that gets exposed also starts rusting.

E.g. If we dip iron nail in CuSO_4 solution, we observe that after some time, the solution changes from blue to green and there is a Reddish-brown deposit on Fe nail.

This is because Iron is more reactive than Copper.

So, $\text{CuSO}_4 + \text{Fe} \rightarrow \text{FeSO}_4 + \text{Cu}$

Q. What are the things that hasten (Fasten) rusting?

Ans. The presence of impurities like salt, water vapour & Carbon dioxide hasten rusting.

Q. Why is rusting seen mostly during the rainy season or often near coastal areas?

Ans. Since rainy season exposes a surface to excessive moisture and since coastal areas have a lot of salt in the water content along with being humid (ie. having excessive water vapour), hence such places have greater things getting rusted than other places.

Q. Why do ships suffer lot of damage due to rusting?

Ans. Since the movement of ships in saline water hastens up the process of rusting.

NOTE: Like Iron getting rusted, many other metals like copper, brass, aluminium and other semi-reactive metals get tarnished as their outermost layer undergoes a chemical reaction.

Ex. Tarnish (called patina or green coloured) thin layer that forms over copper.

However Rust destroys the iron quite fast whereas patina takes much longer to destroy copper.

CORROSION:

When a material reacts with the external environment, over a time, its structure will be deteriorated, and breaks down into small pieces. This is known as corrosion. Most commonly this happens to metals.

The external factors that cause metals to corrode are water, acids, bases, salts, oils, and other solid and liquid chemicals. and even gases like acid vapors, formaldehyde gas, ammonia gas etc.

Some materials are resistance to corrosion, while some are prone to corrosion. However, corrosion can be prevented by certain methods.

DIFFERENCE BETWEEN RUSTING AND CORROSION

Corrosion is the degradation of any metallic surface due to chemical reaction through the agents of oxygen, water vapours, hydrogen.

Rusting is a special case of corrosion. Rusting occurs only on iron surfaces when it is exposed to humidity for a long period. . In other words, the corrosion process taking place when there is iron, it is known as rusting.

HOW ARE RUST AND TARNISH DIFFERENT?

- Rust destroys iron which is undesirable as it eats away the iron. However in case of silver and copper tarnish (or a thin layer above silver and copper) actually preserves the underlying metal and may be considered desirable.

Ex. The Statue of liberty is made of shiny brown copper. **Due to its interaction with carbon dioxide and water, a natural patina is formed on the metal surface which made it turn green in color.**

PREVENTION OF RUSTING

Rusting can be avoided by preventing iron surface from getting exposed to air and moisture.

Various methods are done to do this:-

Painting:

Painting the metal surface prevents it from coming in contact with oxygen and moisture present in atmosphere, thus preventing it from rusting.

Applying Oil:

Water and oil don't mix with one another and oil floats on water.

Hence applying oil on the metal surface prevents water from reaching the metal surface. This prevents rusting.

Galvanizing:

Galvanizing is the deposition of a layer of zinc on an object so as to prevent it from getting rusted.

Zinc forms a layer of zinc oxide on its reaction with oxygen. This layer acts as a barrier between iron and atmosphere.

Eg. The iron pipes used in homes to carry water are galvanized to prevent rusting.

Alloying:

Alloy: A solid solution of two or more metals or a metal and a non metal is called an alloy.

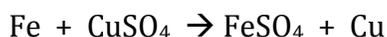
Steel is an alloy of iron and carbon, when mixed with other metals like chromium, nickel, molybdenum, and titanium, it becomes stainless steel. The presence of these metals prevents rusting. Most of the utensils and kitchen sinks are made up of stainless steel.

NOTE: Adding chromium to low carbon steel makes it stain resistant, & rust resistant. Hence it is called stain 'less' or stainless steel.

Displacement Reactions

A reaction in which a more reactive element displaces a less reactive element from its compound is called Displacement Reaction.

Iron + Copper Sulphate (Blue) → Iron Sulphate (Green) + Copper (Reddish Brown)



In the reaction above we see that since Iron is more reactive than Copper, it displaces copper from its compound. It then forms a solution of Iron sulphate. Also copper Sulphate was a blue coloured solution whereas iron sulphate now formed in green colored.

e.g. Replacement of hydrogen from acid by metal. $Zn + HCl \rightarrow ZnCl_2 + H_2$

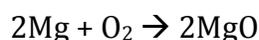
Observation : $Zn + HCl \rightarrow ZnCl_2 + H_2$ (H_2 gas – highly combustible)

A burning matchstick brought near H_2 gas. It burns with a pop sound, and a blue flame.

Combustion

Combustion is a type of chemical reaction that takes place in the presence of oxygen to produce heat and light.

e.g. A Magnesium ribbon when burnt will burn with a bright white light like that of a cracker. It is a chemical change since a new substance is formed due to Combustion Reaction. Hence the metal combines with oxygen to form its oxide.



- The burning of Magnesium also produces ash which can be seen at the bottom of the jar.
- The walls of the glass jar appear milky due to the smoke given out.

DEFINITIONS:

Alloy: A homogenous mixture of two or more metals.

Reactants: The starting substances present before the beginning of a chemical change.

Product: The substance formed after occurrence of a chemical change.

Corrosion: The process by which metals are destroyed progressively by chemical action.

Rusting: The process of formation of an iron compound on the surface of iron objects.

Combustion: Burning of any substance in the presence of air.

MENTION WHETHER THE FOLLOWING ARE PHYSICAL (P)OR CHEMICAL(C) CHANGES

- Cutting your hair (P)
- Making a mixture of fruit and cornflakes (P)
- Baking soda reacts with vinegar (C)
- Rotten food (C)
- A piece of metal bent into half (P)
- Aspirin tablet cut into fine powder (P)
- Baking Cookies (C)
- A tree burning to form ashes (C)
- A piece of paper is crumpled up (P)
- Water freezes to form ice (P)
- A candle is burning (BOTH)
- A candle is melting (P)
- Beating of Aluminium metal to make aluminium foil (P)