

UNIT - 4

COMBUSTION

After studying this unit you :

- recall the meaning of combustion.
- state the components of combustion triangle.
- explain the types of combustion.
- recognize controlled combustion.
- give examples for different types of fuels.

You might have seen the burning of a candle, an oil lamp and the dry sticks. Have you ever tried to find out how they burn? What is burning? The invention of fire was a land mark in the history.

The production and use of fire changed the life of pre historic man. Do you know how these men could have used fire? Earlier men found that they could keep themselves warm with fire, cook food to make it more tasty and scare away wild animals at night. Later, fire was used to make useful materials like bricks and to extract metals. The use of fire has played a vital role in the development of civilization. Even today people depend upon it to meet their major energy requirements. What constitutes fire? How to continue the fire? How can it be extinguished?

Let us know the factors that are essential to make fire through some activities.

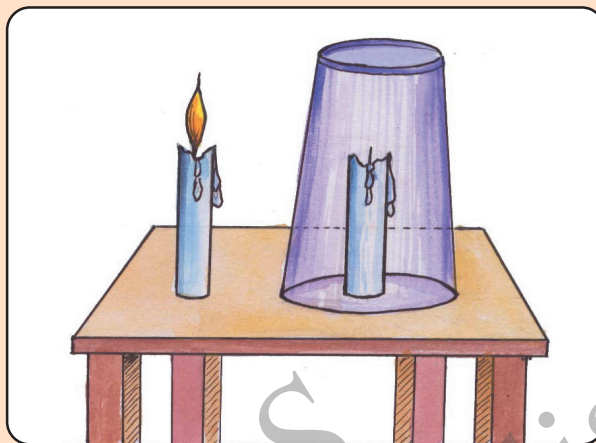


Fig. 4.1
Burning needs oxygen

Activity 4.1 : Take two lighted candles and fix them on the table. Cover one of the candles with a glass tumbler. Observe both the candles. The candle covered by the glass tumbler stops burning and gets extinguished after some time. Why?

Conclusion : Things cannot burn without **oxygen**.

Activity 4.2 : Take two agarbathi sticks. Dip one stick in water. Light both the sticks using match stick. What do you observe? Which of them did not ignite? why?

Conclusion : **Heat** is required for burning.

Activity 4.3 : Take a piece of wood and a piece of chalk. Hold them to the flame of the candle. Which one of them catches fire and burn? What do you think?

Conclusion : A combustible substance like **wood** or **kerosene** is required for burning.

Combustion Triangle :

It is observed that **oxygen**, **heat** and **fuel** are required to make fire. These three components can be represented in a **combustion triangle**. Removing any one of the components of the triangle prevents or extinguishes fire.

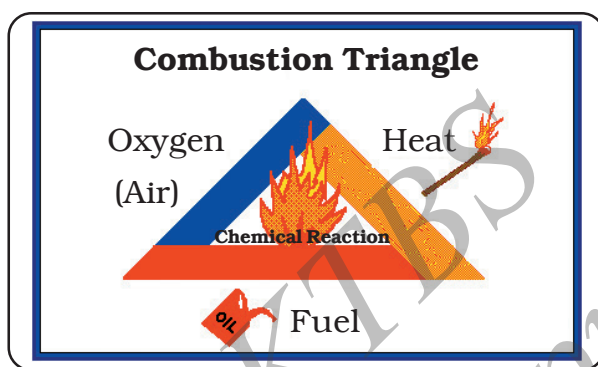


Fig. 4.2
Combustion triangle

Know this :

Under unusual circumstances carbon dioxide and chlorine can act like oxygen.

When water is poured on a burning object, the fire gets extinguished. Why? Water cuts off oxygen supply to the burning object. It also cools the burning object to a lower level transignition temperature. Throwing mud, sand, woollen blanket are other methods of cutting off oxygen supply to the burning object.

While extinguishing fire, fire fighters remove any one of the three components. In most of the cases cutting off oxygen supply is the most effective method of extinguishing fire. Observe the fire extinguisher in your school.

Combustion :

When substances burn, they use oxygen present in air and produce energy. The energy produced will be in the form of heat and light. In some type of

combustion there may not be liberation of light energy. For example, respiration. In some cases liberation of heat energy will be very little even to notice in cases such as rusting of iron.

Activity 4.4 : Take some new iron nails. Keep them outside in moist air for about 3 to 4 days and observe again. What difference do you see in the nails?



Fig. 4.3
New nails



Fig. 4.4
Rusted nails

Activity 4.5 : Ignite a piece of magnesium, it burns with a dazzling white light and magnesium oxide is formed.



Fig. 4.5
Magnesium ribbon



Fig. 4.6
Burning magnesium

Caution : If you see the burning of magnesium continuously, it affects your eye sight.

Try this :

(With adult supervision only)

Ignite a sparkler (light producing cracker) and observe the rate of burning, change of state of the sparkler and speed of combustion. Record your observation.

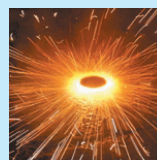


Fig. 4.7



Fig. 4.8

Light producing cracker

Have you tried to burn paper, candle, a piece of wood, plastic etc., If you have tried, have you noticed whether all the substances burn at the same temperature? Why do you think it happens?

All substances do not burn at the same temperature. The lowest temperature at which a substance starts burning is called its **ignition temperature**.

Know this :

Ignition temperature

firewood	= 280°C to 340°C
plastic	= 200°C to 300°C
charcoal	= 300°C to 350°C
match head	= around 80°C

Combustion can be stated as a process in which a combustible substance reacts with oxygen liberating different forms of energy especially heat and light.

Types of combustion :

We have learnt that all substances do not start burning at the same temperature. Similarly the rate at which the combustion takes place will also not be the same. Depending on the rate of combustion, it is classified into different types.

1) Slow combustion :

Have you observed the iron nails getting rusted? Have you observed the rate at which we respire? Are they fast or slow?

They are slow. Such type of combustion which takes place slowly is called **slow combustion**.

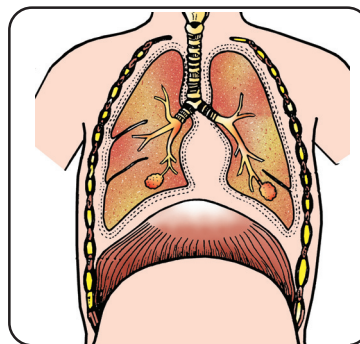


Fig. 4.9 Respiration.

Example : Carbohydrates which are constituents of our food get converted into glucose. Glucose is a human fuel in the sense that when it undergoes combustion it gives heat, water vapour and carbon dioxide. In this combustion there is no liberation of light energy.

2) Rapid combustion :

It is a form of combustion in which large amount of heat and light energy are released at once or almost instantly.

Example : lighting of a candle, igniting a gas stove, combustion of kerosene or petrol.



Fig. 4.10
Burning of gas in a burner.

3) Spontaneous combustion :

It is a form of combustion in which no external heat is given. Heat of the surrounding air itself is sufficient to start combustion.

Example : Burning of white phosphorus in air.



Fig. 4.11
White phosphorus.

Know this :

White phosphorus ignites at 30°C . it is insoluble in water. Hence it is stored under water. Water cuts off oxygen supply.

4) Explosion :

In explosion, combustion takes place very quickly liberating enormous amount of energy in the form of heat, light and sound in a short interval of time.

Example : bursting of crackers



Fig. 4.12 Crackers

Know this :

During an explosion gases expand rapidly, hence a sound is produced.

Controlled combustion :

The process of controlling the rate of combustion by controlling the combustible substance is called **controlled combustion**.

Example : The combustion in a gas stove, kerosene stove, fire wood.



Fig. 4.13
Gas stove

Know this :

Normally oxygen is required for combustion, but some types of combustion occur even in the absence of oxygen.

Example : When aluminium powder is sprinkled into a jar containing Chlorine gas, it burns brightly with sparks.

Fuel :

Fuel is a substance that produces heat and light energy on burning. Fuels are essential for combustion.

On the basis of physical states at room temperature fuels can be classified into three types.

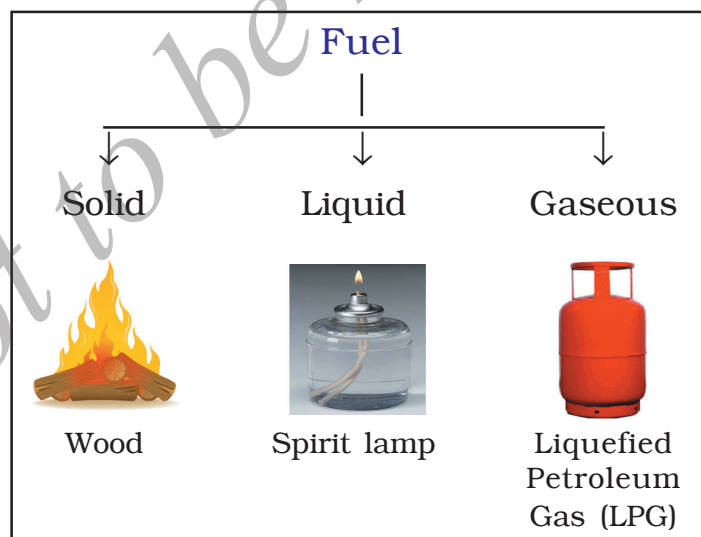


Fig. 4.14
Types of fuels

Example :

Solid fuel : wood, coal, paper, charcoal, paraffin, wax.

Liquid fuel : petrol, diesel, kerosene, methanol.

Gaseous fuel: gasoline, natural gas, propane, vapours from paint, coal gas, LPG.

Some of the fuels like petrol, diesel, Compressed Natural Gas (CNG), gasoline are used as fuels in automobiles as they burn quickly to produce large amount of heat energy. These fuels are also essential for vehicles in transportation.

Think :

During the burning of wet wood more smoke is produced. Why?

Think :

Fuel, be it solid or liquid has to reach gaseous state before combustion. Why ?

Know this :

Natural gas is mostly of methane. It is used as fuel (Compressed Natural Gas - CNG).

Activity 4.6 : List out the vehicles and liquid fuels used in them. One example is given.

Vehicle	Liquid fuels
1. Train	diesel
2.	
3.	
4.	
5.	

Remember :

- Combustion is a chemical reaction that gives heat and light.
- Components of combustion are fuel, heat and oxygen.
- The three components of combustion can be represented in a combustion triangle.
- Removing any one or more components of the triangle, prevents or extinguishes fire.
- The lowest temperature at which a substance starts burning is called its ignition temperature.
- On the basis of speed and amount of heat produced, combustion is classified into slow combustion, rapid combustion, spontaneous combustion and explosion.
- The process of controlling the rate of combustion by controlling the combustible substance is called controlled combustion.
- Fuel is a substance that produces heat and light energy on burning.
- Fuels exist in the form of solids, liquids and gases.

Tips :

- Do not play with the fire.
- Care should be taken while pulling the burning fire wood.

- As soon as you smell gas in your kitchen inform elders to take necessary precautions.
- Be careful while burning crackers.
- Do not overheat substances.

Exercises :

I. Choose the most appropriate answer and put a (✓) tick mark against it :

- Bursting of cracker is an example for
 (a) slow combustion (b) rapid combustion
 (c) explosion (d) spontaneous combustion
- Charcoal is an example for
 (a) solid fuel (b) liquid fuel
 (c) gas fuel (d) all the above

II. Fill in the blanks with suitable words :

- Fuel produces _____ and _____ energy on burning.
- Vapour from paint is an example for _____ fuel.
- Rusting of iron is a type of _____ combustion.

III. Match the types of combustion given in column 'A' with the examples given in column 'B' :

A	B
1. explosion	a) burning of phosphorus
2. rapid combustion	b) Photosynthesis
3. spontaneous combustion	c) respiration
4. slow combustion	d) bursting of crackers
	e) igniting a gas stove.

IV. Answer the following questions :

1. Mention the three components of a combustion triangle.
2. When water is poured on a burning object, it gets extinguished. Why?
3. What is combustion ?
4. Explain the different types of combustion with suitable examples.
5. What is controlled combustion ? Give an example.
6. What are fuels? Give an example for each type of fuel.
7. Suggest some alternative means of conserving fuel in your daily life.