

Introduction
Combustion ; fuels and
Flame

1) Combustible substances :-

Substances which burn in air to produce heat and light are called **combustible substances**.

Eg :- wood, coal, charcoal, kerosene, petrol, diesel, liquified petroleum gas (LPG), compressed natural gas (CNG) etc.

Wood



Coal



LPG



Kerosene



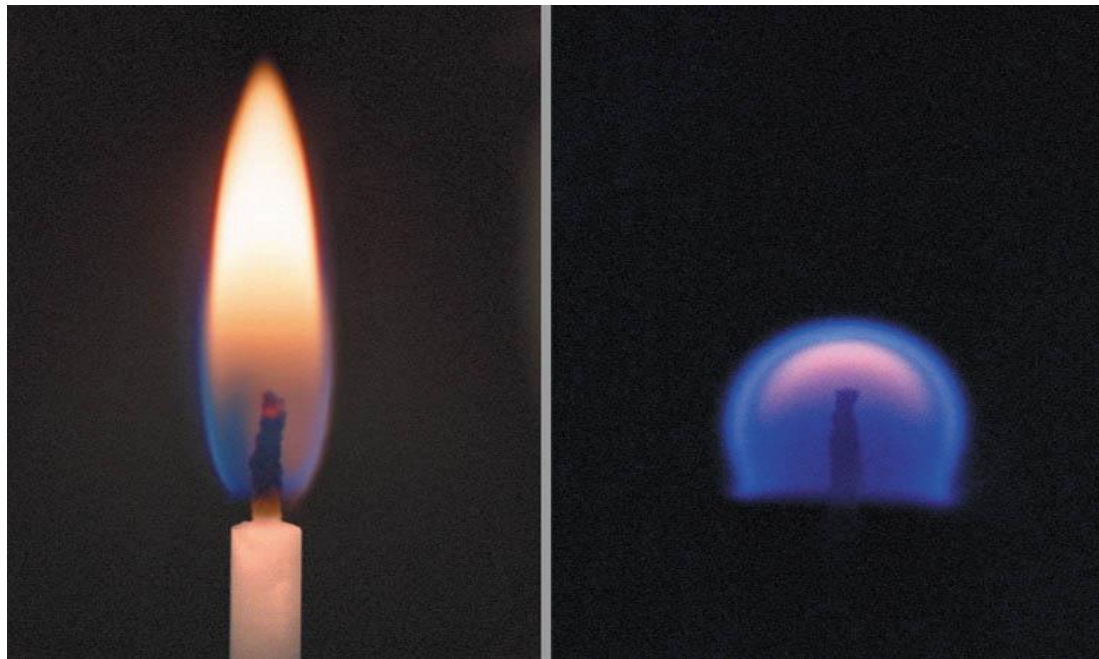
2) Combustion :-

The chemical process in which a substance reacts with oxygen to produce heat is called **combustion**.

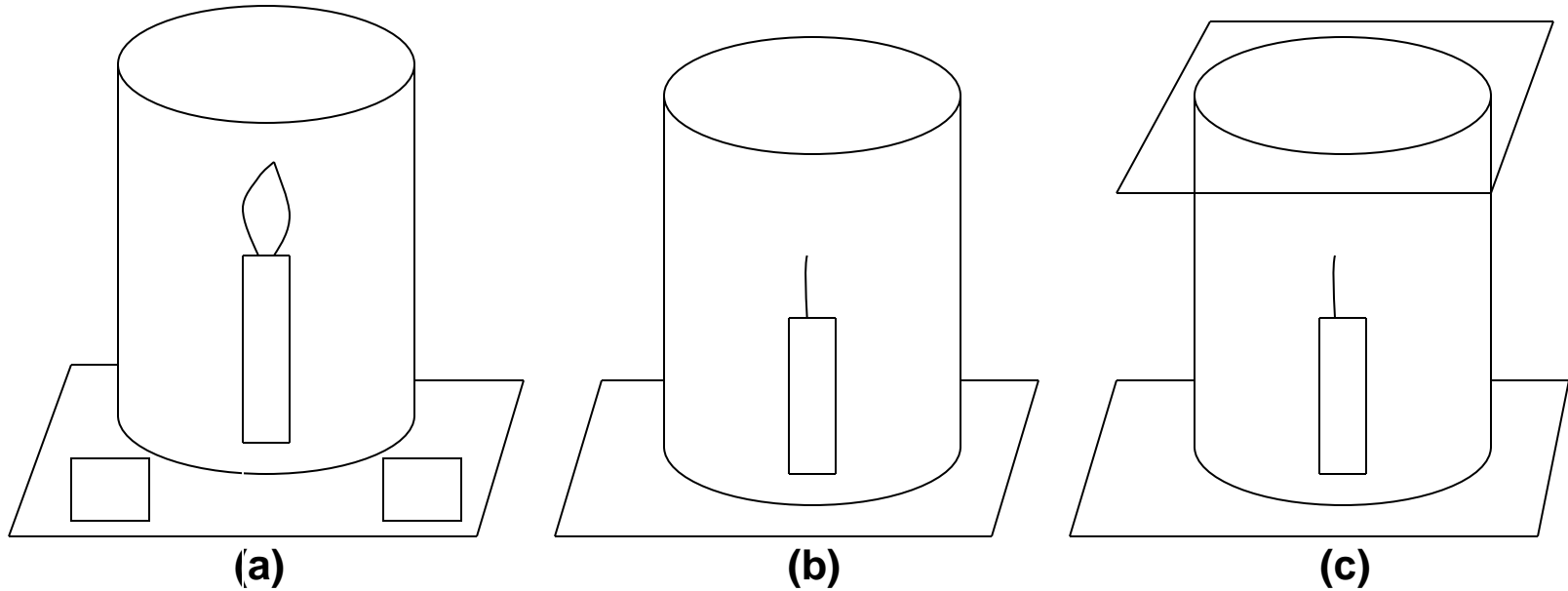
The substance which undergoes combustion is called a **combustible substance**. It is also called a **fuel**.

Sometimes light is also produced during combustion either as a flame or as a glow.

Air is necessary for combustion.



3) Air is necessary for burning :-



Fix a lighted candle on a table. Put a glass chimney over the table and rest it on a few wooden blocks in such a way so that air can enter the chimney. Observe what happens to the flame.

Now remove the blocks and let the chimney rest on the table. Again observe the flame.

Then put a glass plate over the chimney. Observe the flame again.

The candle burns freely in (a) because air enters the chimney from below.

The candle stops burning in (b) because air does not enter the chimney from below.

The candle does not burn in (c) because air is not available.

This shows that air is necessary for burning.

4) Ignition temperature :-

The minimum temperature at which a substance catches fire and burns is called its **ignition temperature**.

A substance will not catch fire and burn if its temperature is lower than its ignition temperature.

Different substances have different ignition temperatures.

Eg:- The ignition temperature of kerosene is less than the ignition temperature of wood.

Substances which have very low ignition temperature and can easily catch fire with a flame are called **inflammable substances**. Eg:- petrol, alcohol, LPG, CNG etc.



5) Conditions necessary for combustion :-

The conditions necessary for combustion are :-

- i) Fuel.**
- ii) Air (to supply oxygen).**
- iii) Heat (to raise the temperature beyond the ignition temperature.**

A substance will not burn without one or more of these conditions.

6) How do we control fire ?

The conditions necessary for producing fire are :-

- i) Fuel
- ii) Air (to supply oxygen)
- iii) Heat (to raise the temperature of the fuel beyond its ignition temperature).

Fire can be controlled by removing any one or more of these conditions.

A fire extinguisher cuts off the supply of air or brings down the temperature of the fuel or both and controls the fire.



7) Methods of controlling fire :-

i) By using water :-

Water is the most common fire extinguisher. It can be used only when materials like wood , paper etc. are on fire.

Water cannot be used if electrical equipments are on fire because water conducts electricity and can harm those trying to put out the fire.

Water cannot be used to put out oil and petrol fires because they float on water and continue to burn.

ii) By using carbon dioxide:-

Carbon dioxide is the best fire extinguisher to put out fire caused by inflammable materials like oil and petrol and electrical equipments. Carbon dioxide is heavier than air and it covers the fire and cuts off the supply of oxygen and puts out the fire.

Carbon dioxide is stored at high pressure as liquid in cylinders. Chemicals like sodium bicarbonate (baking soda), potassium bicarbonate produce carbon dioxide near the fire.

8) Types of combustion :-

There are three main types of combustion. They are :-

- i) Rapid combustion
- ii) Spontaneous combustion
- iii) Explosion

Rapid combustion:- is combustion in which a substance burns rapidly and produces heat and light with the help of external heat.

Eg:- burning of LPG

Spontaneous combustion:- is combustion in which a substance burns spontaneously and produces heat and light without the help of external heat.

Eg:- phosphorus burns spontaneously at room temperature

Explosion:- is a combustion in which a substance burns suddenly and produces heat, light and sound with the help of heat or pressure.

Eg:- explosion of crackers on applying heat or pressure.

Types of combustion

Rapid combustion



Spontaneous combustion



Explosion



9) Flame :-

Flame :- is the zone of combustion of a combustible substance.

Substances which vapourise during burning produce flames.

Eg:- kerosene, wax etc.

Substances which do not vapourise during burning do not produce flames.

Eg:- coal, charcoal etc.

kerosene



wax



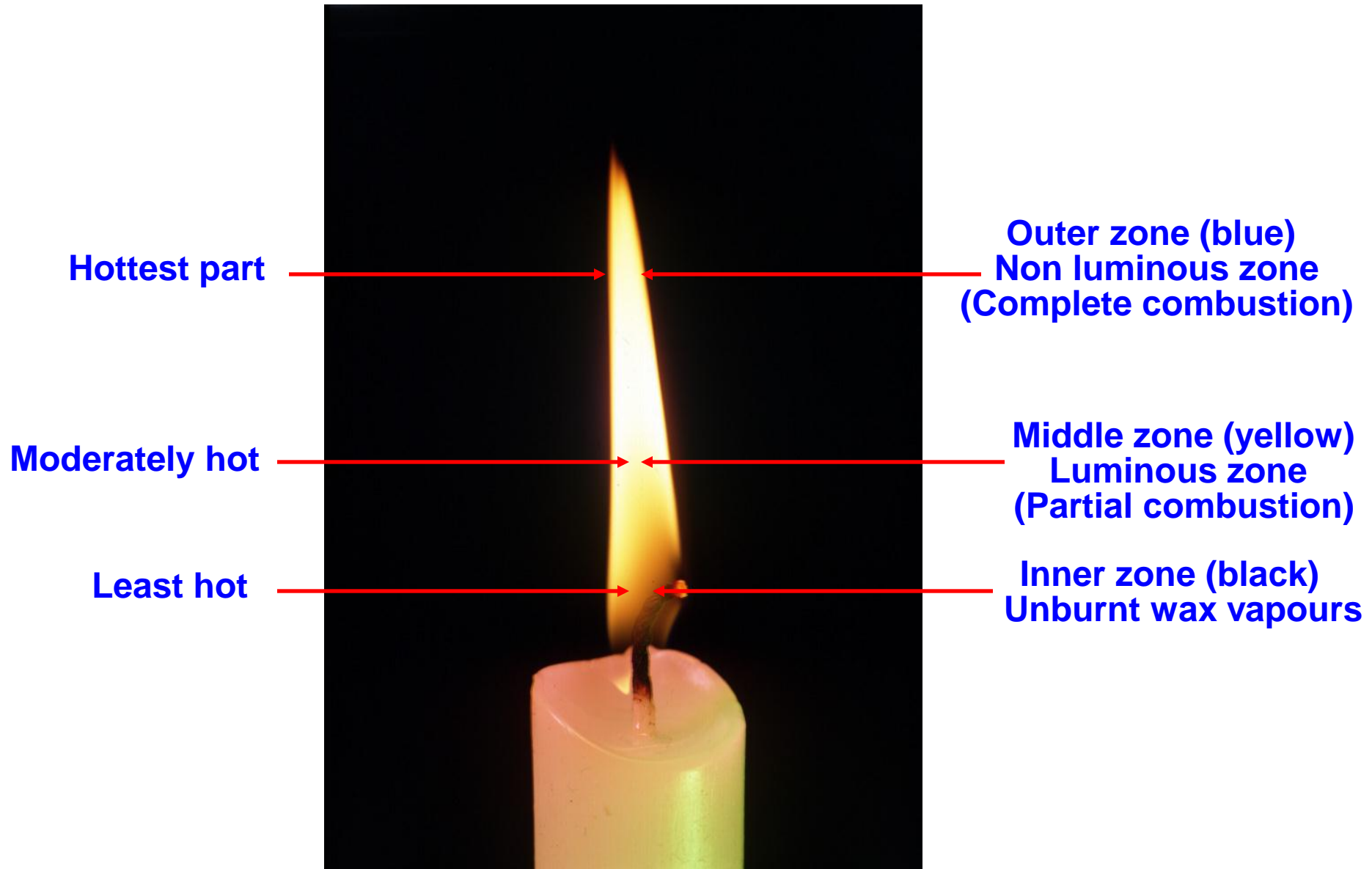
coal



charcoal



Structure of a candle flame



10) Structure of a candle flame :-

A candle flame has three main zones. They are:-

- i) Outer zone**
- ii) Middle zone**
- iii) Inner zone**

In the outer zone complete combustion of the fuel takes place and the colour of the flame is blue and is the hottest part of the flame. It is the non luminous part of the flame.

In the middle zone partial combustion of the fuel takes place and the colour of the flame is yellow and is moderately hot part of the flame. It is the luminous part of the flame.

In the inner zone there are unburnt vapours of the fuel and the colour is black and is least hot part.

11) Types of fuels :-

Fuels are of three main types. They are :-

- i) **Solid fuels** :- Eg:- wood, coal, charcoal etc.
- ii) **Liquid fuels** :- Eg:- kerosene, petrol, diesel etc.
- iii) **Gaseous fuels** :- Eg:- CNG, LPG, biogas, hydrogen etc.

Solid fuels



Liquid fuels



Gaseous fuels



12) Characteristics of a good fuel :-

The main characteristics of a good fuel are :-

- i) Is readily available.**
- ii) Is cheap.**
- iii) Is easy to store and transport.**
- iv) Burns at a moderate rate.**
- v) Produces a large amount of heat.**
- vi) Does not leave behind any undesirable substances.**
- vii) Does not cause pollution.**

13) Calorific value of a fuel :-

The calorific value of a fuel :- is the amount of heat energy produced on complete combustion of 1 kg of a fuel. The calorific value of a fuel is expressed in **kilojoule per kg.**

Calorific values of some fuels in kilojoule per kg

Cowdung cake	6000 - 8000
Wood	17000 - 22000
Coal	25000 - 33000
Petrol	45000
Kerosene	45000
Diesel	45000
Methane	50000
CNG	50000
LPG	55000
Biogas	35000 - 40000
Hydrogen	150000

Hydrogen has the highest calorific value among all fuels.

14) Harmful effects on the environment due to burning of fuels :-

- i) Fuels like wood, coal, petroleum release unburnt carbon particles which cause respiratory diseases like asthma.**
- ii) Incomplete combustion of fuels release carbon monoxide gas which is a very poisonous gas which can cause death.**
- iii) Burning of most fuels release carbon dioxide gas which causes rise in the temperature of the atmosphere. This is called **global warming**. It causes melting of polar ice, rise in sea level and flooding of coastal areas.**
- iv) Burning of coal and petroleum release oxides of sulphur and nitrogen which dissolve in rain water and forms **acid rain**. It is harmful for crops, soil and damages buildings.**