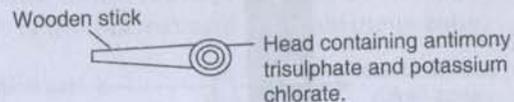
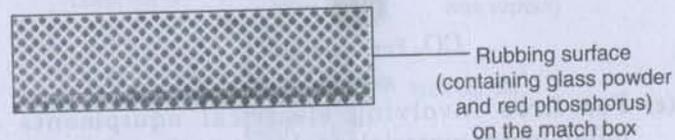


### Lesson at a Glance

- **Fuels:** Substances which provide energy on burning in air are called *fuels*. They may be of various types:
  - **Solid fuels** such as wood, coal, cowdung cakes, charcoal (prepared from wood)
  - **Liquid fuels** like kerosene (also known as *Mitti ka tel*), petrol and diesel.
  - **Gaseous fuels** such as CNG (Compressed Natural Gas), LPG (Liquid Petroleum Gas) and Coal Gas.
- **Combustion:** It is a chemical process in which a substance reacts with oxygen to give off heat. Sometimes light, either as a flame or as a glow is also given off during combustion.
- In the sun, heat and light are produced by *nuclear reactions*.
- **Ignition Temperature:** The lowest temperature at which a substance catches fire is known as its *ignition temperature*. A substance cannot catch fire or burn as long as its temperature is lower than its ignition temperature.
- **Contents of a Modern Match Stick**
  - Wooden match stick, that has **antimony trisulphate and potassium chlorate** at its head.



- The rubbing surface, present on the match box, has **powdered glass and a little red phosphorus**.



When the head of a match stick is rubbed against the rubbing surface—

Red phosphorus (of surface)  $\longrightarrow$  converts into white phosphorus

White phosphorus  $\xrightarrow[\text{with}]{\text{reacts}}$  Antimony trisulphide (in head)  
 $\longrightarrow$  starts combustion

- **Inflammable substances:** The substances that have temperature and can easily catch fire with a flame are known as *Inflammable substances*. For example: Alcohol, Petrol.
- **Fire Extinguishers:** A substance which disrupts the contact between air and the fire is called extinguisher.

(a) Water is very good substance in fire fighting as it cools down the fuel such as wood, because it cools down the fuel below its ignition temperature.

(b) Sand and soil may act as a good fire extinguisher particularly for burning oils.

(c) If the clothes of a person catch fire it may be put off with the help of blanket.

(d) **Water should not be used** to extinguish fire involving electrical equipments or oils.

In case of electrical fires, water may cause a shock to people fighting with fire.



CO<sub>2</sub> Fire extinguisher cylinder

- (e) For fires involving electrical equipments and inflammable materials such as petrol, **carbon dioxide (CO<sub>2</sub>) is the best extinguisher**. Carbon dioxide (CO<sub>2</sub>),

being heavier than oxygen, covers the fire like a blanket. As the contact between the fuel and oxygen is cut off, the fire is controlled.

Compressed CO<sub>2</sub> stored in a cylinder when released on a fire causes (i) formation of a blanket around the fire (ii) cools down the temperature of the fuel.

CO<sub>2</sub> does not harm electrical equipment.

- **Types of Combustions:**

(a) **Rapid combustion:** When combustion occurs rapidly/ immediately by applying a flame such as burning of LPG gas in kitchen stove, is known as *rapid combustion*.

(b) **Spontaneous combustion:** The combustion in which a material suddenly bursts into flames, without the application of any apparent cause is known as *Spontaneous Combustion*. For example, burning of phosphorus (white) at room temperature, without the effort of burning it.

(c) **Explosion:** When ignition of a substance such as cracker, a sudden reaction takes place with the release of heat and light and evolution of a large amount of gas takes place, such a combustion is called *explosion*.

- **Structure of a Flame:** Substances which form vapour during heating, burn with a flame. A flame is a region where combustion of gaseous substances or vapour takes place.

The flame has three distinct zones:

(i) **Black zone:** It is the *innermost zone of unburnt vapours*.

(ii) **Bright and Luminous (yellow) zone:** It is the middle zone. *Brightness of this zone is due to the glow of unburnt carbon particles.*

(iii) **Blue zone:** It is the outer zone of complete combustion. It is the hottest and non-luminous zone.

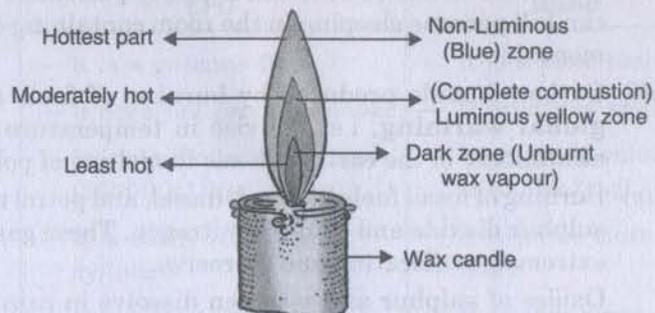


Fig. 6.1 Zones of a flame.

• **Factors which help combustion:**

- Combustible substance
- Oxygen
- Surface area of combustible substance. Larger the surface area, more is the rate of combustion.

That is why a block of wood or a log does not burn easily. On splitting the block of wood, its pieces give larger surface, so combustion becomes easier.

• **Ideal (a good) Fuel:** An ideal or a good fuel is one which is:

- readily available
- cheap
- it burns easily in air at a moderate rate.
- it produces a large amount of heat.
- it does not leave behind any undesirable substances.

There is probably no fuel that could be considered as an ideal fuel.

• **Calorific Value:** The amount of heat energy produced on complete combustion of 1 kg of a fuel is called its calorific value.

The calorific value of a fuel is expressed in a unit known as Kilojoule per kg (kJ/kg).

• **Burning of Fuels Leads to Harmful Products**

- Unburnt carbon particles produced by fossil fuels such as wood, coal and petroleum cause many respiratory diseases such as asthma.
- Incomplete combustion of carbon (fossil) fuel produces carbon monoxide (CO) which is a very poisonous gas. It can kill persons sleeping in the room containing carbon monoxide.
- Carbon dioxide produced by burning of fuels causes **global warming**, i.e. the rise in temperature of the atmosphere of the earth. It leads to melting of polar ice.
- Burning of fossil fuels like coal, diesel, and petrol release sulphur dioxide and oxides of nitrogen. These gases are extremely suffocating and corrosive.

Oxides of sulphur and nitrogen dissolve in rain water and form acids. Such rain is called **acid rain**. Acid rain is very harmful for crops, buildings and soil.

■ **TEXTBOOK QUESTIONS SOLVED** ■

**Q. 1.** List conditions under which combustion can take place.

**Ans.** Conditions necessary for combustion are:

- Presence of a combustible substance.
- Attainment of ignition temperature.
- Proper supply of air to provide oxygen.

**Q. 2.** Fill in the blanks.

- Burning of wood and coal causes \_\_\_\_ of air.
- A liquid fuel used in homes is \_\_\_\_.
- Fuel must be heated to its \_\_\_\_ before it starts burning.
- Fire produced by oil cannot be controlled by \_\_\_\_.

**Ans.** (a) pollution (b) kerosene.  
(c) ignition temperature (d) water.

**Q. 3.** Explain how the use of CNG in automobiles has reduced pollution in our cities.

**Ans.** The use of CNG in place of petrol and diesel reduce pollutions in following ways:

- It produces less carbon monoxide gas.
- It produces less carbon dioxide gas.
- It produces less amount of sulphur dioxide and nitrogen dioxide which cause acid rain.
- No residue remains after combustion.

**Q. 4.** Compare LPG and wood as fuels.

**Ans.** Differences:

LPG	Wood
— It is a gaseous fuel.	— It is a solid fuel.
— It does not produce smoke.	— It produces smoke.
— Its calorific value is more (55000 kJ/kg).	— Its calorific value is less (17000 kJ/kg).
— It is easily stored in cylinders.	— It requires more space to store.
— It does not cause any pollution.	— It causes more pollution.

Q. 5. Give reasons:

- Water is not used to control fires involving electrical equipment.
- LPG is a better domestic fuel than wood.
- Paper by itself catches fire easily whereas a piece of paper wrapped around an aluminium pipe does not.

Ans. (a) Water is a good conductor of electricity. It conducts electricity and may result electric shock.

(b) LPG has more calorific value and produces no pollution. So it is better domestic fuel than wood.

(c) The ignition temperature of paper is less, so it catches fire easily. It does not catch fire when wrapped around aluminium pipe because aluminium absorbs the heat, so paper does not attain its ignition temperature.

Q. 6. Make a labelled diagram of candle flame.

Ans.

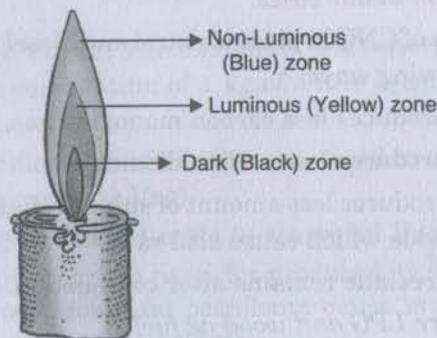


Fig. 6.2 Different zones of Candle flame

Q. 7. Name the unit in which the calorific value of a fuel is expressed.

Ans. Kilojoules per kg (kJ/kg)

Q. 8. Explain how  $\text{CO}_2$  is able to control fires.

Ans. (i)  $\text{CO}_2$  forms a blanket around fire due to which supply of air is stopped.

(ii)  $\text{CO}_2$  also brings down the temperature of the fuel.

Q. 9. It is difficult to burn a heap of green leaves but dry leaves catch fire easily. Explain.

Ans. The green leaves contain some water due to which the ignition temperature of leaves increases and they do not catch fire easily while dry leaves have no water, so they catch fire easily.

Q. 10. Which zone of a flame does a goldsmith use for melting gold and silver and why?

Ans. A goldsmith uses the outer zone (non-luminous zone) of a candle flame to melt gold and silver because it is the hottest zone and has more temperature.

Q. 11. In an experiment 4.5 kg of a fuel was completely burnt. The heat produced was measured to be 180,000 kJ. Calculate the calorific value of the fuel.

Ans. Total mass of fuel = 4.5 kg

Total heat produced = 180,000 kJ

Heat produced by burning 1 kg of fuel =  $180,000 \text{ kJ} / 4.5 \text{ kg}$   
 $= 40,000 \text{ kJ/kg}$ .

So, calorific value of fuel = 40,000 kJ/kg.

Q. 12. Can the process of rusting be called combustion? Discuss.

Ans. The process of rusting cannot be called combustion because in this process no heat and light is produced. Due to this reason iron is not considered as combustible substance.

Q. 13. Abida and Ramesh were doing an experiment in which water was to be heated in a beaker. Abida kept the beaker near the wick in the yellow part of the candle flame. Ramesh kept the beaker in the outermost part of the flame. Whose water will get heated in a shorter time?

Ans. The water heated by Ramesh will get heated in a shorter time because he kept his beaker near the hottest zone of the flame.