6 CARBON

6.1

You must have seen the black substance produced after burning wood. Try to mark with this on paper and also put a mark on the paper with a lead pencil. Do you know which substance causes these black marks. Are the two marks the same? Let us see some other such substances.

Activity 1

Materials required: Earthen lamp, Metallic spoon or glass slide, cotton wick, mustard oil, match box.

Put some mustard oil in a earthen lamp. Dip the cotton wick in it so that it soaks the oil. Now burn this wick and collect the smoke on a glass slide (fig 6.1). Observe the product on the glass slide and try to answer the following questions in your copy.

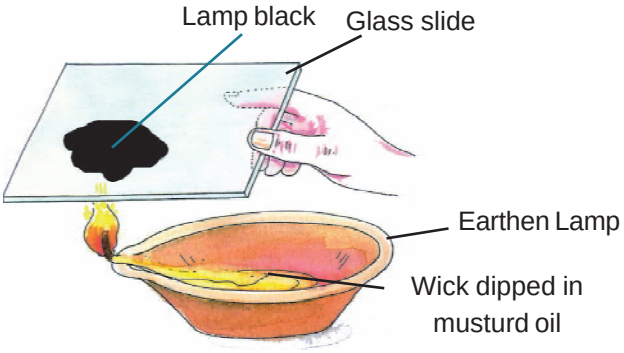


Fig 6.1 Making lamp black

1. What is the colour of the layer deposited on the glass?

2. What do you call this substance?

Activity 2

Materials required: Pencil shaving, heating apparatus, match box, boiling test tube made of hard glass and cork

Take the pencil shaving in a boiling test tube and close it with a cork. Heat the test tube on a candle or burner (fig 6.2) and observe what happens to the shaving in the test tube. Answer the following questions as per the observations.

1. What is the colour of the residue in the test tube?

2. What do you call this substance?

The black product formed in activity 1 and 2 are black coloured and are known as **lamp black** (Kajal) and **wood charcoal** respectively. Charcoal from sugar is called **sugar charcoal** and that from bones is known as **bone charcoal**. Charcoal,graphite, lamp black all are made of carbon. Beside these, coal and diamond are also made of carbon.

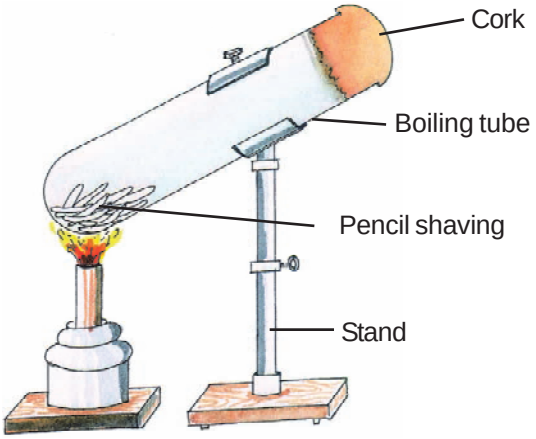


Fig 6.2 Making charcoal from wood shaving

Let us compare their properties :

Table 6.1

S.No.	Form of Carbon	Appearance	Hardness	Electric conductivity	Heat conductivity
1.	Diamond	Colourless, transparent, crystal, shines in light.	Hardest	Bad conductor	Very good conductor
2.	Graphite	Shining black, solid	Soft, smooth, slippery	Good conductor	Normal conductor
3.	Coal	Black, Flaky	Soft	Bad conductor	Bad conductor
4.	Lamp black	Black powder	Soft	Bad conductor	Bad conductor
5.	Wood charcoal	Black	Soft	Bad conductor	Bad conductor

The different forms of carbon have different physical properties. If they are burnt in sufficient air, then all will burn to form carbon dioxide.That means their chemical properties are same.

Different forms of an element having different physical properties but the same chemical properties are called **allotropes**. In this way the property of an element having different forms is called **allotropy**.

Carbon is not the only element, which shows allotropy, phosphorous, sulphur, tin: all show allotropy in their solid forms.

FULLERENE

In 1985 graphite was heated by chemists to a very high temperature and a new allotrope of carbon was made. The molecules of these are spherical and 60 carbon atoms

are joined together in it. This was named Fullerene after American architect Buckminster Fuller. In nature, it is found in the holes made by fallen meteors and ancient rocks. Now Fullerene having C-70, C-90 and C-120 carbon atoms are also discovered. In future Fullerene and its substance will be used in the manufacture of super conductors, semiconductors, lubricants, catalysts and electric wires. C-60 containing substances may also be used in the prevention and cure of AIDS (Fig. 6.3).

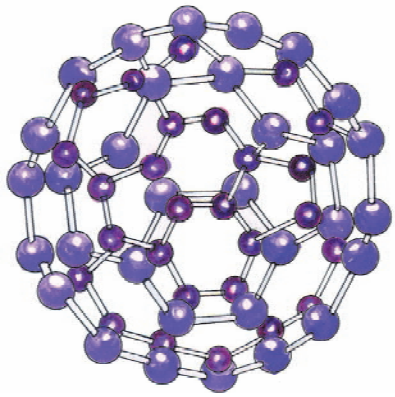


Fig 6.3 Fullerene

6.2 Uses of the allotropes of carbon

The substances given in table 6.1 has great importance in our daily life; Let us see where we use these :-

6.2.1 Diamond

(1) Diamond because of its lustre is a precious stone which is used in ornaments. The diamond is cut in such a way that each light ray which enters it has to reflect many times inside the diamond before it comes out. Because of this its surface appears shiny.

(2) Diamond is the hardest substance so it is used in the cutting of glass and in instruments used in drilling hard stones.

(3) Diamond is also used in some of the surgical instruments as knives, blades etc.

6.2.2 Graphite

(1) In making of pencil lead.

(2) As graphite has a very high melting point, it is used in making crucibles which can endure high temperature.

(3) As it is a conductor of electricity it is used as electrodes in dry cell.

(4) Graphite is used in the manufacture of black paint and printing ink.

(5) Graphite combines with plastic to form light weight, strong substance which is used in making fishing boats, cycle frames, parts of space shuttles, dish antenna and tennis rackets.

To make pencil lead, fine powder of graphite is mixed with fine soil and wax to form a paste. The paste is shaped into thin rods and dried. These dried up rods make the lead pencil.

6.2.3 Lamp black (Kajal)

(1) In making ink & black colour.

(2) As a supplement in tyres and plastic.

6.2.4 Coal

(1) As fuel

(2) In the extraction of some metals as iron.

6.2.5 Wood charcoal

(1) Being porous it is used as an absorbent of gas.

(2) To make sugar colourless and to remove coloured impurities from oils and fats.

NOW ANSWER THESE

(1) In which forms do we find carbon in our surroundings?

(2) What is allotropy?

(3) Write two uses of diamond?

(4) Write the methods of preparation of

(a) Wood charcoal (b) Lamp black (Kajal).

6.3 Presence of carbon

Carbon is an element, which is found in different allotropic forms in nature. Along with this, it is one of the main constituent of all living organisms (plants & animals).

Items which we daily use as paper, rubber, wood, tyre, pencil, cloth, oil, soap and fuel all contains carbon. Carbon in free state is present in diamond, graphite, coal etc. In combined form carbon is present in many substances as:

(1) Substance of carbon with oxygen and calcium is calcium carbonate. This is found in nature as limestone, chalk & marble.

(2) Main constituents of food as carbohydrates, fats, proteins, vitamins etc are all substances of carbon from which our body get energy.

(3) Carbon & Hydrogen in different proportions combine to form hydrocarbons as Methane, Ethane etc. In natural gas, cooking gas (LPG), petrol,

diesel, kerosene, paraffin wax, coal tar etc all have carbon in form of hydrocarbons.

Some allotropes & substances of carbon are used as fuel. Now you write names of some fuels, which are commonly used, in your house and note them in your copy.

6.4 Burning and Combustion

Some substances on burning evolves heat, light or even both the forms of energy. This burning process is called combustion. Come we will do an experiment to understand it.

Activity 3

Material required: Piece of Magnesium, Piece of Coal, chalk, small stone, match box, forceps and heating apparatus.

Hold each magnesium piece, coal piece, chalk and stone with the forceps over flame one by one and heat it. Observe carefully and answer the following questions.

(1) Which of these burn?

(2) Which of these do not burn?

Those substances which burn are called combustible substances as magnesium and coal. Stone, glass, cement etc do not burn, these are non-combustible substances.

Combustible substances combines with oxygen in the air to form oxides & liberate heat & light.

$2\,Mg + O_2 \longrightarrow 2MgO + heat + light$

Magnesium + Oxygen $\longrightarrow$ Magnesiun oxide + heat + light

$C + O_2 \longrightarrow CO_2 + heat + light$

Carbon + Oxygen $\longrightarrow$ Carbon dioxide + heat + light

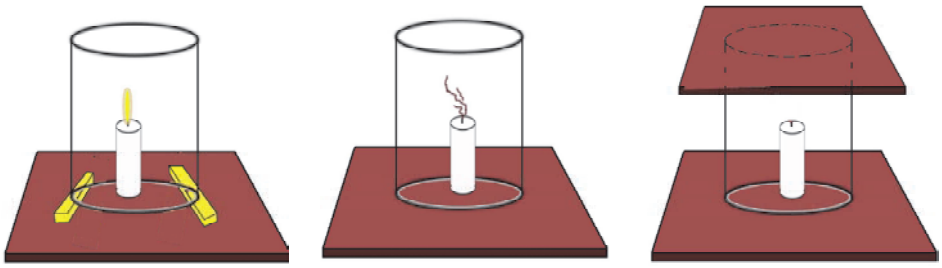
Therefore combustion is oxidation, which produces heat and light.

Come let's do an activity to understand if air is necessary for burning.

Activity 4

Materials required - Candles, matches, glass chimneys, two wooden blocks, glass plate.

Fix a burning candle carefully on a table. Put a glass chimney over the candle on the wooden blocks in such a way that air can enter the chimney (fig 6.4 a).Observe what happens to the flame. Now remove the blocks and let the chimney rest on the table (Fig. 6.4b). Now observe the flame again. Finally, put a glass plate over the chimney (fig. 6.4c). Watch the flame again. What happens in the three cases? Does the flame flicker off? Does it flicker and give out smoke? Does it burn unaffected? Can you infer anything at all about the role played by air in the process of burning?



a b c

Fig. 6.4 Air is essential for burning

We see that air is necessary for burning. In case (a) the candle burns unaffected. In case (b) the flame flickers and gives out smoke. In case (c) the flame is put off because air is not available for it to burn.

NOW ANSWER THESE.

(1) What is the name of the compound which is made of hydrogen and carbon?

(2) What is combustion?

(3) Write names of three combustible substances?

(4) Why are crackers and fuels not allowed to be carried in public vehicles?

Activity 5

Materials required: A piece of paper, a thick piece of wood, candles and matches.

Place the paper over the flame. What happens? Now place the block of wood over the flame. Does this also burn as quickly as paper?

The temperature at which a substance starts burning in presence of air is known as ignition temperature. The ignition temperature of paper is less than that of wood.

Petrol has lower ignition temperature than kerosene. As petrol vaporizes easily and catches fire quickly we do not use petrol in stoves.

You must have seen wood burning. At first it burns with a flame but later the flames are not seen. But camphor and wax burn with flame. When we put out the candle then you find white vapours evolving from it. Bring a lighted matchstick near this white vapour. The candles lights up.

Only those solids or liquid, which on heating produces vapours burn with a flame. So flame is that area where gaseous substances are combustible. So all combustible gaseous substances form flame.

Activity 6

Materials required: Candles, match box.

Burn the candle and observe its flame in semi darkness and draw a picture and note the different colours (fig. 6.5).

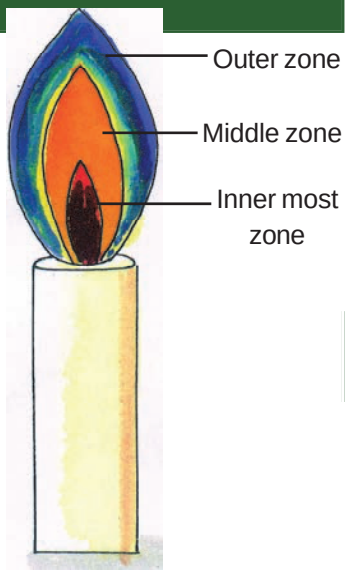


Fig 6.5 Flame of a candle

Activity 7

Materials required: Candles, match box, chips of wood.

Place a wooden chip on the upper part of the flame. Remove it and observe which part of it has blackened. Place the other chips on the middle & lower part of the flame and again observe the blackened portion and try to understand the difference (fig. 6.6).

From the experiment and observations we find that in a flame of candle there are three zone of different colours.

The inner most part is the darkest, it is the coldest part of the flame. In this zone there is the hot vapour of the combustible substance (wax). In this area there is no combustion because there is no oxygen.

The middle portion is the shining, bright zone. In this zone the fuel partly burns and forms carbon particles, which, shines when hot.

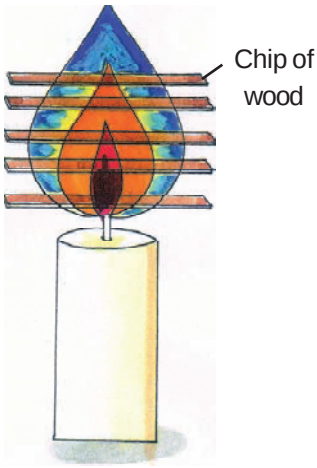


Fig 6.6 Experiment to find the different areas of the flame

The outer most part is slightly blue in colour. In this area the oxygen of the atmosphere mixes properly with the fuel and there is almost complete combustion. This is the hottest zone. Its maximum temperature it is about 1800°C.

Goldsmiths use flame of kerosene lamp to make ornaments in different forms out of gold and silver. With the help of a blowpipe they centralize the flame to a particular point. Air blown through blowpipes help the unburnt fuel to burn and makes the flame hotter.

NOW ANSWER THESE

(1) What are the favourable conditions for combustion?

(2) What is ignition temperature?

(3) From which substance does we get a flame?

(4) Which is the hottest zone of the flame?

(5) Draw a well labelled diagram of candle to depict various zones of flame.

6.5 Compounds of carbon

6.5.1 Carbon dioxide

Activity 8 (Demonstrated by the teacher)

Materials required: Test tubes, cork with a hole, bent glass tube, sodium carbonate (washing soda), lemon juice, fresh lime water, alkaline phenolphthalein.

Take some sodium carbonate in a test tube and arrange all the apparatus as shown in fig 6.7. Now put some lemon juice into the test tube. Perform the following tests on the gas evolved.

(1) Observe the colour of the gas. Do you find any colour? Does it have any odour?

(2) Bring a burning matchstick near the test tube with the collected gas. The matchstick is extinguished. What do you understand by this?

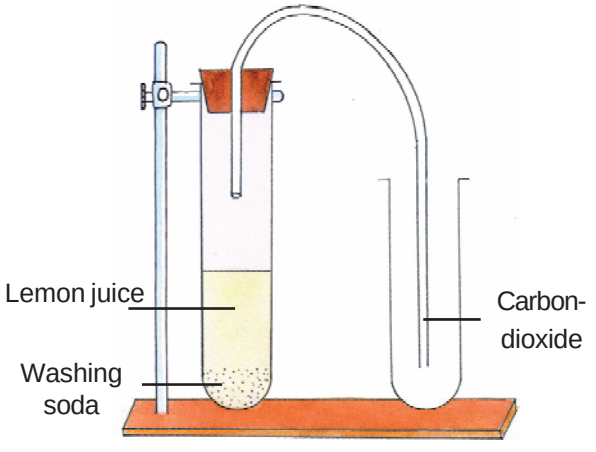


Fig 6.7 Preparation of carbon dioxide

(3) Take some fresh lime water in a test tube and pass the evolved gas into it. You will find that the limewater turns milky.

(4) In a different test tube take some alkaline phenolphthalein and pass the evolved gas. By the change in the colour of phenolphthalein can you say if the gas has a acidic or an alkaline nature?

In the experiment carbon dioxide gas is evolved, which is colourless and odourless gas. This gas neither burns nor does it support combustion. When carbon dioxide is passed into fresh lime water, insoluble calcium carbonate is formed, due to which the solution turns milky.

Alkaline phenolphthalein (pink) turns colourless when carbon dioxide is passed into it. It shows acidic nature. Due to its acidic nature it reacts with alkalies and forms salt and water.

$$CO_2 + 2NaOH \longrightarrow Na_2CO_3 + H_2O$$

Carbon dioxide + Sodium hydroxide $\longrightarrow$ Sodium carbonate + water

Uses of Carbon dioxide

(1) Carbon dioxide does not support combustion. This property is used in fire extinguisher to extinguish fire.

(2) The gas evolved on opening soft drink bottle is carbon dioxide. It gives a strong taste to the soft drink.

(3) On burning of the fuel and through respiration carbon dioxide is liberated into the atmosphere which is used by green plants in presence of sunlight to make food by the process of photosynthesis.

(4) Carbon dioxide is used in the manufacture of sodium carbonate and sodium hydrogen carbonate.

(5) When carbon dioxide is cooled it solidifies and this solid carbon dioxide is called dry ice. It is used as a coolant.

6.6 Catching Fire

You might have heard that when the clothes of a person catch fire, the person is covered with a blanket. Now you know that air is essential for burning. When the person is covered with a blanket, the burning clothes lose contact with air, due to which fire is extinguished. We burn crackers during our festivals. On burning crackers light, noise and many gases are produced. Sometimes this can also be a reason for burning. If you get burnt accidently, get first aid immediately and then consult the doctor.

Have you heard of forest fires? Due to extreme summer heat, dry grass catches fire at some places. From the grass it spreads to the trees and very soon the whole forest is on fire. It is very difficult to control such fires.

6.6.1 How do we control fire?

You must have seen or heard on TV and read in newspapers of fire breaking out in homes, shops and factories. Every town/city/village has a fire extinguishing service, which helps in controlling fire when it breaks out. Find out the telephone number of the fire extinguishing service of your area.

6.6.2 How does a fireman extinguish fire?

You know that to initiate fire three things are essential; they are fuel, air and heat. You can control fire by removing one or more of these things. Fire extinguishers usually control fires either by cutting off the air supply or by reducing the heat of the fuel or both. But in most cases, removing the fuel or reducing its heat is not possible.

Do you know about fire extinguishers? What are the various fire extinguishing systems used at the public places in your neighbourhood? Find out and write about them.

NOW ANSWER THESE

(1) Why does limewater turn milky on passing carbon dioxide through it?

(2) What is dry ice? What is its use?

(3) Which gas is produced after chemical reaction in a fire extinguisher? Why is this gas used to extinguish fire?

WE HAVE LEARNT

- Carbon is a non-metallic element.
- Carbon shows allotropy. Its different allotropic forms are diamond, graphite, charcoal, lampblack and coal.
- Different forms of the same element having different physical properties but same chemical properties are called allotropic forms. In this way the property of having different forms of an element is called allotropy.
- Fullerene is a newly discovered allotropic form of carbon.

- In free state, carbon is found in the form of diamond, graphite, coal etc and in substance form as calcium carbonate, carbohydrates, fats, proteins, vitamins etc.
- Substances which burn are called combustible substances and which do not burn are known as non-combustible substances.
- Carbon combines with hydrogen in different proportions to form hydrocarbons.
- Combustion is a process of oxidation and it liberates heat and light .
- Flame is that area where there is combustion of gaseous substances.
- In the flame on a candle there are three distinctive zones.

  (a) Inner dark zone.

  (b) Middle shining bright zone.

  (c) Outer light-bluish zone.
- In the reaction with sodium carbonate and lemon juice we get carbon dioxide gas. This gas does not help in burning and is acidic in nature.
- Carbon dioxide is used in soft drinks, as coolants, fire extinguisher and dry ice.

QUESTION FOR PRACTICE

1. Choose the correct answer :-

1. Graphite is not used :-

   (a) As lubricant (b) In electrodes

   (c) In pencil lead (d) In cutting instrument.

2. Carbon dioxide converts blue litmus into red, thus it is an :-

   (a) Acidic oxide (b) Alkaline/basic oxide

   (c) neutral oxide (d) none of these.

3. Carbon allotrope with 60 atom is :-

   (a) Fullerene (b) Graphite

   (c) Diamond (d) Charcoal

4. Dry ice is :-

   (a) Solid CO_2 (b) liquid CO_2

   (c) Gaseous CO_2 (d) Solid CO

5. The hardest substance in nature is :-

   (a) Graphite (b) Stone

   (c) Diamond (d) Charcoal

6. Which zone of the flame has the highest temperature?

(a) Inner dark zone (b) Shining and bright middle zone

(c) Light blue zone (d) Unlighted zone

7. Allotropy is a characteristic of : -

(a) Element (b) Compound

(c) Mixture (d) All of the se

2. Fill in the blanks :-

1. Combination of _____ produces flame.
2. Because of its softness _____ is used in pencil lead.
3. _____ is the hardest allotropic form of carbon.
4. Carbon dioxide is a _____ , _____ gas.

3. Say whether the following statements are correct or wrong. Correct the wrong statements.

1. Both graphite and diamond have the same element, carbon in it.
2. Diamond is a good conductor of electricity.
3. The light blue zone in flame is in the middle of the flame.
4. Combustion doesn't take place in the outer zone of the flame.
5. Carbon dioxide is of alkaline nature.

4. Match the following :-

Lamp black and charcoal	-	Solid carbon dioxide
Made of 60 carbon atoms	-	Oxidation
Hardest substance	-	Carbon allotrope
Dry ice	-	Fullerene
Combustion	-	Diamond

5. Answer the following questions :-

(1) What do you understand by allotropy? What are the different allotropes of carbon? Write two uses of each?

(2) How will you differentiate between graphite and diamond?

(3) What is Fullerene? What are its main uses?

(4) Draw a labelled diagram showing the preparation of carbon dioxide.

(5) What is dry ice? What are its important uses?

(6) What are the main parts of candle flame? Explain with a diagram.

(7) Give the reason :-

(a) Diamond is used in ornaments.

(b) Diamond is used in cutting instruments.

(c) Graphite is used as lubricant.

(d) Graphite is used in electrodes.

(e) Petrol is not used in cooking stoves.

(8) The colour of flame in Fatima's gas stove is blue and Rajesh's is yellow. Who will cook faster and why ?

(9) Why doesn't charcoal burn with flames?

(10) Can blue flame be formed inside in the candle. Justify.

TRY TO DO THIS ALSO :

Fire extinguisher -

Place a short candle and a slightly taller candle in a small bowl filled with baking soda. Place the bowl at the bottom of a larger bowl as shown in fig. 6.8. Light both the candles. Then pour vinegar into the smaller bowl containing baking soda. Take care not to pour vinegar on the candles. Observe the reaction that takes place and answer the following -

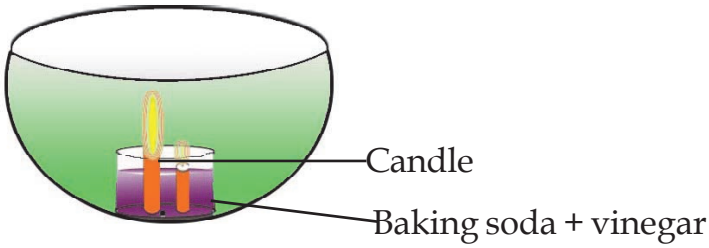


Fig. 6.8 Fire extinguisher

1. What happens to the candles?
2. Why does it happen?
3. In what order does it happen?