

Class 9 Science Chapter 13 - Carbon : An Important Element

Question 1:

Select the proper option and complete the statements

(single, all, double, ionic, carbon, give and take, hydrogen, multiple, share, most, covalent)

- A carbon atom forms a bond with other atoms. In this bond the two atomselectrons.
- All the carbon bonds in a saturated hydrocarbon electrons.
- At least one carbon bond in an unsaturated hydrocarbon is
- is the essential element in all the organic compounds.
- The element hydrogen is present in organic compound.

ANSWER:

- A carbon atom forms a covalent bond with other atoms. In this bond the two atoms share electrons.
- All the carbon bonds in a saturated hydrocarbon share electrons.
- At least one carbon bond in an unsaturated hydrocarbon is double.
- Carbon is the essential element in all the organic compounds.
- The element hydrogen is present in all organic compound.

Question 2:

Answer the following questions

- Why are carbon and its compounds used as fuels?
- In which compound forms does carbon occur?
- Write the uses of diamond.

ANSWER:

a. Carbon and its compounds are used as fuels because most of the carbon compounds produce lot of heat and energy when burnt in air i.e. they have high calorific value.

b. Carbon occurs in the following compounds:

Hydrocarbons: These are organic compounds which are made up of carbon and hydrogen.

CO₂: Carbon also exists as carbon dioxide and occurs in the air in free state. It is also found as a salt in chalk and limestone. It is given out during combustion of wood, fossil fuel etc.

CH₄: Carbon also exists as methane.

c. Uses of diamonds are as follows:

- used in ornaments
- used in glass cutting and rock drilling machines
- diamond dust is used for polishing other diamonds
- diamond is used to make windows giving protection from radiation in space and in artificial satellites
- diamond knives are used in eye surgery

Question 3:

Explain the difference:

- Diamond and graphite.
- Crystalline and non-crystalline forms of carbon.

ANSWER:

a.

Parameter	Diamond	Graphite
Structure	Eight sides forming double pyramids. Each carbon atom is held firmly in place by four bonds of neighbouring carbon atoms.	Carbon atoms are arranged in flat planes of hexagonal rings, stacked on top of each other.
Nature	Colourless and the hardest substance known	Soft, greyish and slippery to touch
Refractive index	2.5	Opaque
Specific gravity	3.52	2.53
Conductivity	Bad conductor of electricity	Good conductor of heat and electricity
Chemical activity	Chemically inert under ordinary conditions as there are no free electrons available	Slightly more reactive than diamond

b.

Amorphous solids		Crystalline solids	
i	They have an irregular shape.	i	They have a definite characteristic geometrical shape.
ii	They have only short-range order in the arrangement of constituent particles.	ii	They have long-range order in the arrangement of constituent particles.
iii	They gradually melt and soften over a range of temperature.	iii	They have sharp and characteristic melting points.
iv	When cut with a sharp-edged tool, they cut into two pieces with irregular shapes.	iv	When cut with a sharp-edged tool, they split into two pieces with plain and smooth newly-generated surfaces.
v	They do not have definite heat of fusion.	v	They have definite and characteristic heat of fusion.
vi	They are isotropic in nature.	vi	They are anisotropic in nature.
vii	They are pseudo solids or super-cooled liquids.	vii	They are true solids.

Question 4:

Write scientific reasons

- a. Graphite is a conductor of electricity.
- b. Graphite is not used in ornaments.
- c. Limewater turns milky when CO_2 is passed through it.
- d. Biogas is an eco-friendly fuel.

ANSWER:

- a. Graphite is a good conductor of electricity because there are free electrons present between its layers. These free electrons move continuously within the entire layer and thus lead to conduction of electricity.
- b. Graphite is not used in making ornaments because it is soft, brittle and slippery. It cannot be moulded like gold and silver and neither does it possess lustre which is a desired characteristic in jewellery.
- c. When carbon dioxide gas is passed through lime water, it turns milky due to the formation of calcium carbonate.



- d. Biogas is an eco-friendly fuel because it helps to reduce the greenhouse gas emissions and our dependency on fossil fuels. It is produced from decomposition of organic matter, thus is an effective way of disposal of organic waste.

Question 5:

Explain the following.

- a. Diamond, graphite and fullerenes are crystalline forms of carbon.
- b. Methane is called marsh gas.
- c. Petrol, diesel, coal are fossil fuels.
- d. Uses of various allotropes of carbon.
- e. Use of CO_2 in fire extinguisher.
- f. Practical uses of CO_2

ANSWER:

- a. Diamond, graphite and fullerene are crystalline forms of carbon. They are allotropes of carbon and this property of carbon is termed as allotropy. These crystalline forms of carbon have a regular and definite geometrical shape, sharp edges and plane surfaces.
- b. Methane is called marsh gas because it is found at the surface of marshy places (a type of wetland, an area of land where water covers ground for long periods of time which are usually treeless and is dominated by grasses and herbaceous plants).
- c. Petrol, diesel, coal are fossil fuels because they are fuels obtained from fossils such as dead sea organisms, dead plants and animals, etc. is known as fossil fuel. They are formed from the dead remains of living organisms, both aquatic and terrestrial, which have been buried for millions of years under the ground.

d.

Allotropes of carbon	Uses of allotropes
1. Diamond	<ul style="list-style-type: none">• used in glass cutting and rock drilling machines• used in ornaments• diamond knives are used in the eye surgery• diamond dust is used for polishing other diamonds• used to make windows giving protection from radiation in space and in artificial satellites
2. Graphite	<ul style="list-style-type: none">• used for making lubricants• used for making carbon electrodes• used in pencils for writing• used in paints and polish• used in arc lamps which give a very bright light
3. Fullerene	<ul style="list-style-type: none">• used as insulators• used as a catalyst in water purification
4. Coke	<ul style="list-style-type: none">• used as fuel in factories and homes• used to obtain coke, coal gas and coal tar• used in thermal power plants for generation of electricity
5. Coal	<ul style="list-style-type: none">• used as fuel in factories and homes• used to obtain coke, coal gas and coal tar• used in thermal power plants for generation of electricity

e. CO₂ is used in fire extinguishers for various reasons but the main reason is that the carbon dioxide gas displaces the oxygen that's necessary to maintain combustion. It means that it cuts off the supply of oxygen which is required for combustion and also it has a cooling effect when it is released under high pressure. Other uses of carbon dioxide in fire extinguishers is

- it does not conduct electricity thus making it an ideal fire suppressant for use in electrical instruments like computers etc.
- it does not create any toxic or other by-products when used to suppress a fire.

f. The practical uses of CO₂ are:

- it is used for getting special effects of a mist in dramas and movies
- it is used to make aerated drinks
- solid carbon dioxide is used in cold storage and also to keep milk and milk products and frozen substances cool during transport
- liquid CO₂ is used as solvent in modern eco-friendly dry cleaning
- CO₂ obtained by chemical reaction or kept under pressure is used in fire extinguishers
- plants use CO₂ in air for photosynthesis

Question 6:

Write two physical properties each.

- Diamond
- Charcoal
- Fullerene

ANSWER:

a. Physical properties of diamond:

- It is the hardest naturally occurring substance.
- Pure diamond is colourless, transparent, but brittle solid.

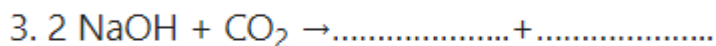
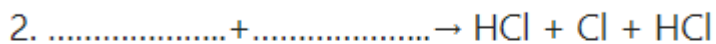
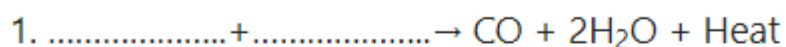
b. Physical properties of charcoal:

- It is a highly porous and brittle material
- It is a bad conductor of heat and electricity.

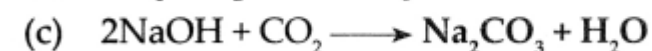
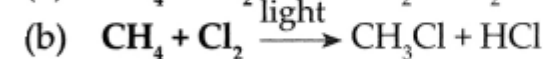
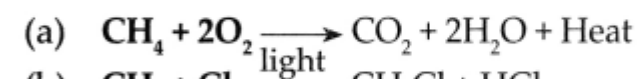
c. Physical properties of fullerene:

- They exist in the form of buckyballs and buckytubes.
- They are made up of 60 C atoms.

7. Complete the following Chemical reactions.



Answer:



Question 8:

Write answers to the following in detail.

- What are the different types of coal? What are their uses?
- How will you prove experimentally that graphite is good conductor of electricity?
- Explain the properties of carbon.
- Classify carbon.

ANSWER:

- a. The different types of coal are:

Peat: It is the first step of coal formation. It has high water content and less than 60% carbon content.

Lignite: Lignite is a transformed form of peat and has around 25-35% of carbon content. It is a low quality brown coal with very little percentage of carbon in it. It is however used in the generation of electricity.

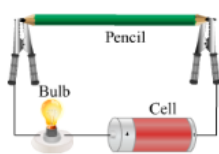
Bituminous: It is the most commonly found variety of coal in India is bituminous and has a carbon content of 70-90%. It is used for almost all daily requirements of coal.

Anthracite: It is the best known variety of coal found in India. It has a carbon content of more than 80% which makes it suitable for iron smelting.

- b. Graphite is a good conductor of electricity can be proved from the following experiment.

We would require some apparatus- pencil, electrical wires, battery/cell, small bulb.

Set up the apparatus as shown in the figure.



If the bulb glows on attaching the clips to both the ends of the graphite in the pencil, it means that graphite conducts electricity. If the bulb does not glow it means that graphite does not conduct electricity.

- c. Carbon has the following properties:

Physical properties:

Carbon is a soft, dull gray or black non-metal.

It exists in two forms i.e. crystalline and non crystalline forms. This property is termed as allotropy.

Chemical properties:

The chemical properties of carbon can be explained on the basis of reactions which carbon and its compound show.

1. Combustion reaction:

Carbon, in all its allotropic forms, burns in oxygen to give carbon dioxide along with the release of heat and light. This reaction is termed as combustion reaction.

The chemical equation to represent the burning of carbon is as follows:



2. Oxidation reaction: Pure carbon is oxidized to give carbon dioxide when burnt in air. Similarly, hydrocarbons can be easily oxidized on burning. Substances that have the ability to oxidize other substances are known as oxidizing agents. Alkaline potassium permanganate and potassium dichromate are examples of oxidizing agents. For example, the oxidation of ethanol in the presence of potassium permanganate leads to the formation of ethanoic acid.



3. Addition reaction: In an addition reaction, a substance is added to a hydrocarbon. A single product is obtained in this reaction. In unsaturated hydrocarbons, double or triple bonds are present. Atoms of different elements like hydrogen, chlorine, bromine etc. are added to these compounds across the double or triple bonds using different reagents and catalysts.

4. Substitution reaction: It is a type of reaction in which an atom or a group of atoms replaces another atom present in a molecule undergoing the reaction. For example, chlorine replaces hydrogen from methane in the presence of sunlight.



d. Carbon exists in two different forms i.e. allotropic and amorphous forms.

i. Crystalline forms:

Diamond: In diamond, each atom of carbon of the given crystal unit is surrounded by four other carbon atoms, which are joined by covalent bonds, such that they form a regular tetrahedron. The diamond crystal is a compact structure in which atoms of a single unit lie in different planes. Thus, the atoms cannot slip because of their different positions in different planes and hence, diamond is the hardest naturally occurring substance.

Graphite: In graphite, atoms of a single crystal are arranged in a hexagonal ring in a single plane. The bonds between the carbon atoms of two single crystals in the parallel planes are weak. Thus, one plane can easily slide over another plane by applying pressure. This is why graphite is soft and can be used as a lubricant.

Buckminsterfullerene: It is the third and the most recently discovered allotrope of carbon. Buckminsterfullerene is a cluster of sixty carbon atoms arranged in the form of a football. It is named after the American architect Buckminster Fuller, as it resembled the geodesic dome designed by him. Since it contains sixty carbon atoms, its chemical formula is C_{60} .

ii. Amorphous/Non-crystalline forms:

Charcoal: It is produced from the bones of animals, combustion of wood etc.

Coal: It is formed by decomposition of dead remains of plants when they got buried in the land owing to the high temperature and pressure conditions present there. Based on the content of carbon present, normally three types of coal deposits exist and these are as follows:

- Lignite with 25-35% of carbon content.
- Anthracite with carbon content of more than 80%.
- Bituminous coal with 60-80% carbon
- Peat with less than 60% carbon content.

9. How will you verify the properties of carbon dioxide?

Answer:

Properties of carbon dioxide can be verified in the following ways:

- When a burning candle is placed in a gas jar of carbon dioxide, it extinguishes indicating that carbon dioxide is a non-combustible gas and does not support combustion.
- When carbon dioxide gas is passed through lime water, it turns lime water milky due to the formation of insoluble calcium carbonate.
- Moist blue litmus turns red in a gas jar of carbon dioxide indicating, it is acidic in nature.
- Carbon dioxide is fairly soluble in water, it dissolves in water forming carbonic acid.