Carbon : An important element

Exercises

Q. 1. Select the proper option and complete the statements

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

A. A carbon atom forms a …… bond with other atoms. In this bond the two atoms …. electrons.

B. All the carbon bonds in a saturated hydrocarbon .....…. electrons.

C. At least one carbon bond in an unsaturated hydrocarbon is ….

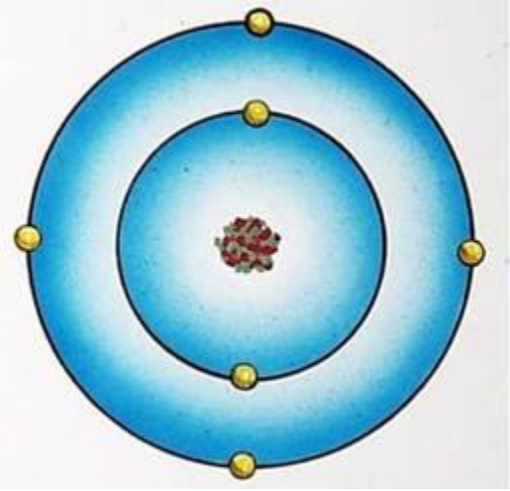
D. …. is the essential element in all the organic compounds?

E. The element hydrogen is present in …. organic compound.

Answer : A. A carbon atom forms a covalent bond with other atoms. In this bond the two atoms share electrons.

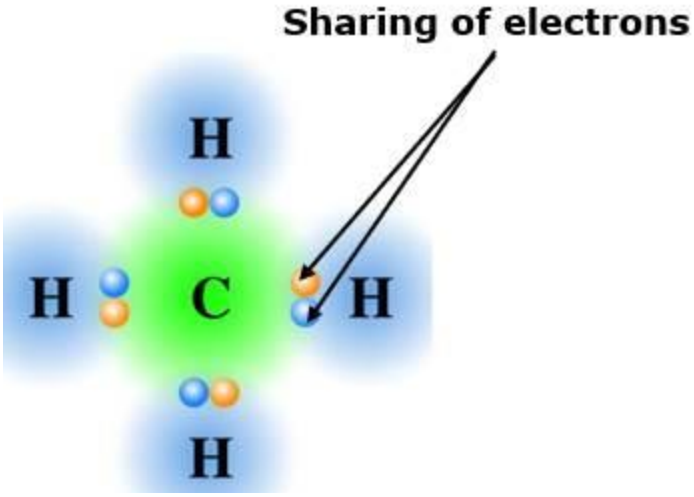
Explanation: A carbon atom forms a covalent bond with other atoms

because its outer shell is half full as shown in the figure below:



In the covalent bond, sharing of electrons takes place. For example:

CH_4



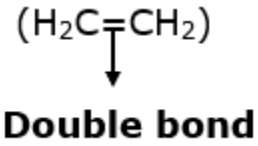
B. All the carbon bonds in a saturated hydrocarbon share electrons.

Explanation: The hydrocarbons having only single bonds between carbon atoms are called saturated hydrocarbons. Saturated form covalent bond (by sharing of electrons)

C. At least one carbon bond in an unsaturated hydrocarbon is double.

Explanation: Some hydrocarbons have a multiple bond between two carbon atoms. A multiple bond can be a double bond or a triple bond. Hydrocarbons having at least one multiple bond are called unsaturated hydrocarbons.

For example, ethene



D. Carbon is the essential element in all the organic compounds.

Explanation: A carbon atom exhibits a characteristic property. It can form a chain of carbon atoms by forming covalent bonds with other carbon atoms. Hence, it is the most essential element in the organic compounds.

E. The element hydrogen is present in most organic compounds.

Explanation: Along with carbon, the element hydrogen is also included in most organic compounds.

Q. 2 A. Answer the following questions

Why are carbon and its compounds used as fuels?

Answer : A. Carbon and its compounds used as fuels due to the following reasons:

1. When most of the carbon and its compounds is burnt in air, it gives a lot of heat, light and energy.

2. They have high calorific value. Thus, on burning in air, they give large amount of heat and energy.

3. When saturated hydrocarbon (hydrocarbon having single bond) is burnt in air, less smoke with a clean flame is produced.

Note: Calorific value is the amount of heat liberated in calories by the complete combustion of a combustible material with oxygen.

Q. 2 B. Answer the following questions

In which compound forms does carbon occur?

Answer : Carbon occurs in crystalline forms, non-crystalline(amorphous) forms and in hydrocarbons forms.

1. Carbon has three crystalline forms(allotropes) which are Diamond, Graphite and Fullerene.

2. Coal, charcoal, coke are the non-crystalline forms of carbon.

3. The two types of hydrocarbons forms in which carbon occur are saturated hydrocarbons and unsaturated hydrocarbons.

Q. 2 C. Answer the following questions

Write the uses of diamond.

Answer : Diamond is a crystalline form of carbon. Uses of diamond are the following:

1. Diamonds are used in making ornaments.

2. Diamonds are used in rock drilling and glass cutting machines.

3. To carry out eye surgery, diamond knives are used.

4. Diamond dust is used for polishing other diamonds.

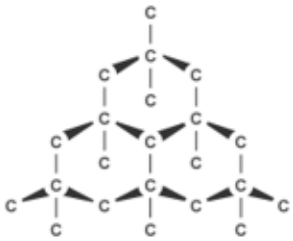
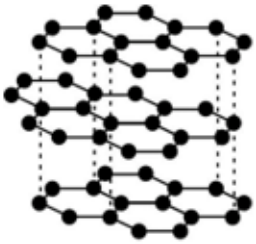
5. Diamond is used to make windows giving protection from radiation in space and in artificial satellites.

Q. 3. Explain the difference:

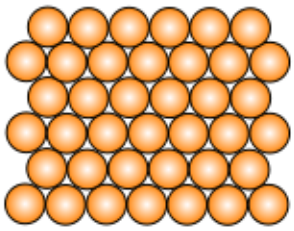
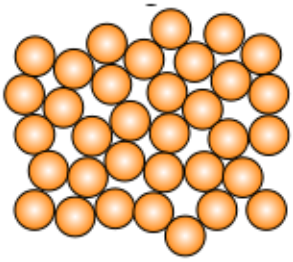
A. Diamond and graphite.

B. Crystalline and non-crystalline forms of carbon.

Answer : A. Difference between diamond and graphite:

Diamond	Graphite
1. In diamond, every carbon atom is bonded to four neighboring atoms by covalent bonds.	In graphite, every carbon atom is bonded to three other carbon atoms by covalent bonds.
2. Diamond exists in tetragonal three-dimensional structure.	Graphite exists in hexagonal layer structure.
3. Structure of diamond: 	Structure of graphite: 
4. Diamond has no free electrons moving inside, thus it is a bad conductor of electricity.	Free electrons move continuously within the entire layer of graphite; thus, it is a good conductor of electricity.
5. Pure diamond is the hardest natural substance.	Graphite is black, soft, brittle and slippery.

B. Difference between crystalline and non-crystalline forms of carbon:

Crystalline forms	Non-crystalline forms (amorphous forms)
1. A crystalline form has definite and regular arrangement of atoms.	A non-crystalline form has indefinite and irregular arrangement of atoms.
2. Structure of crystalline form: 	Structure of non-crystalline form: 
2. They have a definite geometrical shape.	They have irregular shapes.
3. They have sharp melting points.	They melt over a range of temperature.
4. Carbon exists in three crystalline forms which are diamond, graphite and fullerene.	Carbon exists in three amorphous forms which are coal, charcoal and coke.

Q. 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 due to the following reasons:

1. In graphite, carbon atoms are arranged in different layers.

2. In each layer, every carbon atom is linked to three neighboring carbon atoms.

3. Thus, the fourth electron of each carbon atom is free to move continuously within the entire layer.

4. Because of the presence of these free electrons in different layers, graphite becomes a god conductor of electricity.

B. Graphite is not used in ornaments due to the following facts:

1. For making ornaments, properties like transparency of substance, reflection of light and hardness should be present.

2. But in graphite, all these properties are absent.

3. It is soft, brittle, black and slippery in nature.

4. Thus, it is not used in making ornaments.

C. When limewater $(CaOH)_2$ is passed through CO_2, the following reaction takes place:

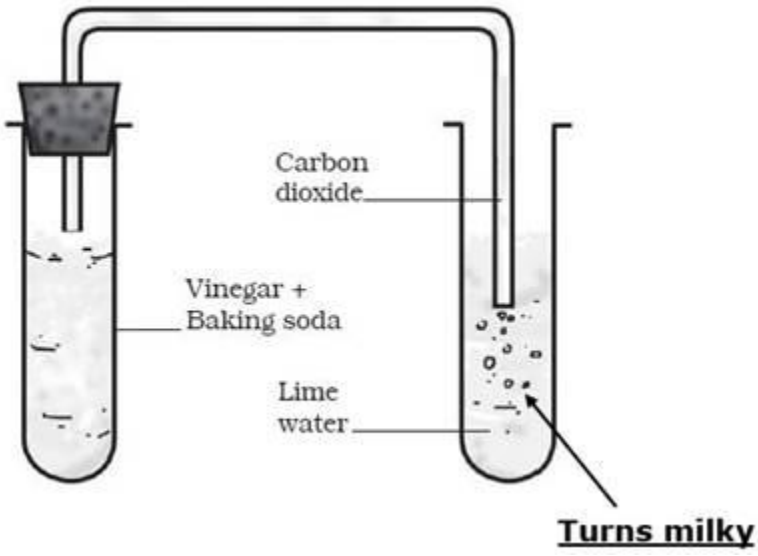
$(CaOH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Limewater Calcium

Carbonate

1. In this reaction, when limewater comes in contact with the gas released in the form of an effervescence, it turns milky. This is chemical test for carbon dioxide gas.

2. When limewater turns milky, it is confirmed that the effervescence is of carbon dioxide.



D. Biogas is an ecofriendly fuel:

a. Animal dung, dry leaves, wet garbage get decomposed by anaerobic microbes in a biogas plant.

b. This produces biogas (methane gas).

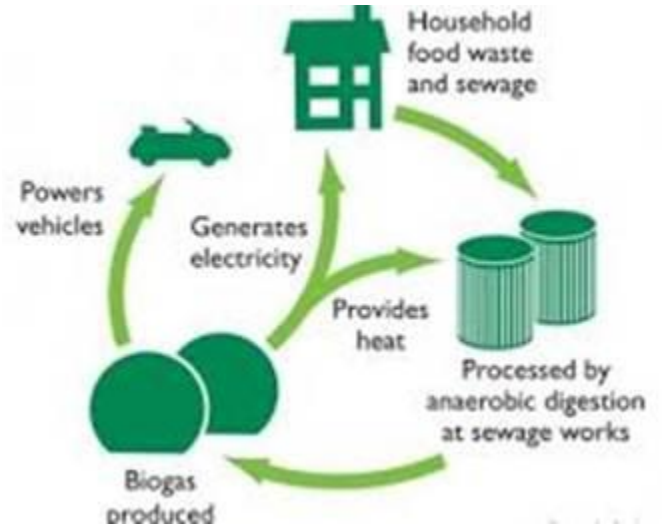
c. Biogas is a very cheap fuel option which is also used for cooking gas.

d. It is also used for production of an electricity.

e. Biogas contains about 55% to 60% methane and the rest is carbon dioxide.

f. Biogas is a very good manure and is convenient to use.

g. It is a very good manure.



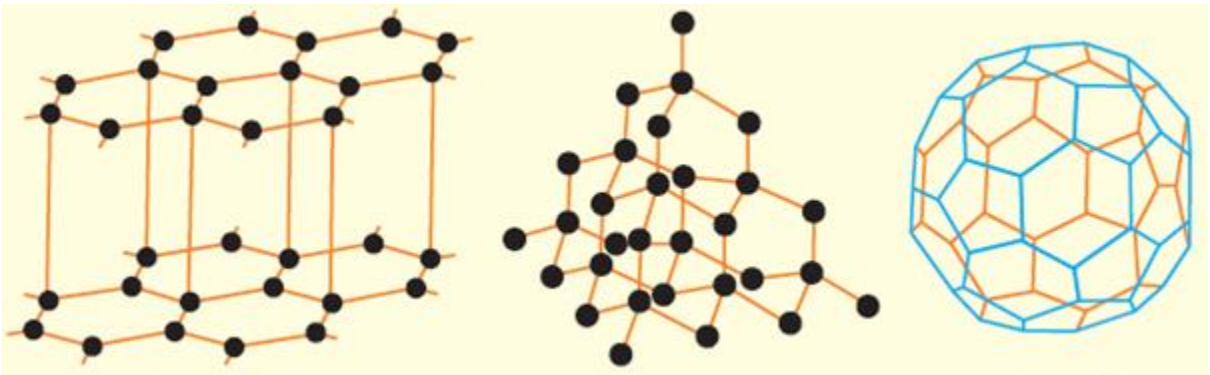
Q. 5 A. Explain the following.

Diamond, graphite and fullerenes are crystalline forms of carbon.

Answer : A. Diamond, graphite and fullerene are the three crystalline forms of carbon.

1. A crystalline form has a definite and regular geometric pattern.

2. The structure of all the three crystalline forms has a definite shape, sharp edges and plane surfaces.



Graphite Diamond Fullerene

3. Graphite has a hexagonal layered structure.

4. Diamond has a tetragonal three-dimensional structure.

5. Fullerene exists in the form of buckyballs and buckytubes.

Q. 5 B. Explain the following.

Methane is called marsh gas.

Answer : Methane gas is also called "marsh gas" because it is the product of decay in swamps and marshes from organic material underwater and in the muck.
The main process for the production of methane is anaerobic digestion.

Q. 5 C. Explain the following.

Petrol, diesel, coal are fossil fuels.

Answer : Petrol, diesel, coal are fossil fuels because:

1. They are main source of heat and energy.

2. They release heat, light and energy when burnt in air.

3. They are formed from the decayed living organisms (plants and animals) that are present in the earth's crust.

Q. 5 D. Explain the following.

Uses of various allotropes of carbon.

Answer : Uses of various allotropes of carbon:

1. Diamond- It is used in making ornaments, rock drilling and glass cutting, artificial satellites etc.

2. Graphite- It is used in pencils, paints, polish, for making carbon electrodes, lubricants etc.

3. Fullerene- It is used as insulators, used as a catalyst in the water purification.

4. Coal- Coal is used in thermal power plants, used as fuel in factories and industries.

5. Coke- It is used as a reducing agent and a domestic fuel.

Note: Allotropes- Some elements occur in nature in more than one form. This property of elements is called allotropy. The elements which show this property are called allotropes.

Q. 5 E. Explain the following.

Use of CO_2 in fire extinguisher

Answer : CO_2 is used in fire extinguisher:

1. CO_2 is filled under pressure in the fire extinguisher.

2. When we decrease that pressure, it becomes gaseous and comes out forcefully.

3. The carbon dioxide displaces the oxygen (a main cause of fire to burn)

4. By removing oxygen, we can put out a fire.

5. The reaction taking place:

$$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + 2CO_2\uparrow$$

Q. 5 F. Explain the following.

Practical uses of CO_2.

Answer : Practical uses of CO_2:

1. The most important use of CO_2 is that plants use CO_2 in the process of photosynthesis.

2. Liquid CO_2 is used as solvent in dry cleaning.

3. CO_2 is used to make aerated drinks.

4. CO_2 is used in fire extinguisher to remove oxygen.

5. Solid CO_2 is used to keep milk and milk products cool while travelling.

Q. 6. Write two physical properties each.

A. Diamond
B. Charcoal
C. Fullerene

Answer : A. Two physical properties of diamond are:

1. Diamond is the hardest natural substance found in the earth and does not dissolve in any solvent.

2. Diamond does not show any change when treated with acids/bases.

B. Two physical properties of Charcoal are:

1. Charcoal when burnt produces bad heat and energy. It is also a bad conductor of electricity.

2. It is highly porous substance and has low density.

C. Two physical properties of Fullerene are:

1. Fullerenes dissolve in solvents like carbon disulphide (CS_2) and chlorobenzene.

2. One molecule of fullerene contains around 30 to 900 carbon atom.

Q. 7. Complete the following Chemical reactions.

1. .....+.....→ CO_2 + 2H_2O + Heat
2. .....+.....→ CH_3Cl + HCl
3. 2 NaOH + CO_2→.....+.....

Answer : 1. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + heat

Explanation:

When methane (CH_4) is burnt in the presence of oxygen to form evolve a bluish flame. In the above reaction, the methane burns completely.

2. $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

Explanation:

Methane(CH_4) and chlorine(Cl_2) gases react with each other in presence of UV light and form mainly methyl chloride (chloromethane – CH_3Cl) and hydrogen chloride. This reaction is called chlorination of methane.

3. $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

Explanation: When aqueous solution of sodium hydroxide is passed through carbon dioxide, it forms sodium carbonate (Na_2CO_3)

Q. 8 A. Write answers to the following in detail.

What are the different types of coal? What are their uses?

Answer : A. The different types of coal are peat, bituminous, anthracite and Lignite.

Peat- It is generally used as a fertilizer, as a packing material (due to its spongy nature).

Lignite- It is used in power generation (to generate electricity) and is used to create fertilizer products like anhydrous ammonia and ammonium sulphate.

Bituminous- It is mainly used for the combustion for coke, tar, coal, chemical and coke-oven gas. It is widely used for steam raising.

Anthracite- It is mostly used in metallurgical process and used in hand-fire furnaces.

Q. 8 B. Write answers to the following in detail.

How will you prove experimentally that graphite is good conductor of electricity?

Answer : Steps to prove that graphite conducts electricity:

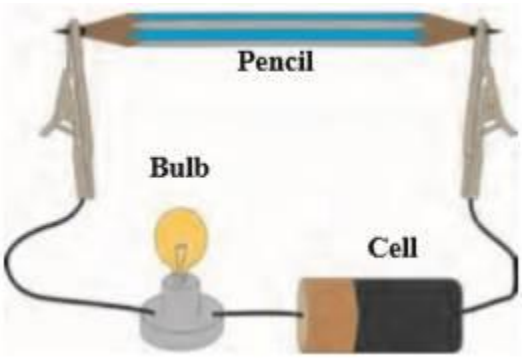
Step 1: Take a pencil and sharp it from both sides.

Step 2: Now, take two clips and join each with their respective leads of the pencil.

Step 3: Also join a small bulb in the setup and connect it with a battery cell.

Step 4: Assemble the apparatus properly as shown in thee figure below.

Step 5: Start the electric current in the circuit.



Observations: You will observe that the bulb starts to glow as soon as the current is applied. This proves that graphite is good conductor of electricity.

Q. 8 C. Write answers to the following in detail.

Explain the properties of carbon.

Answer : The properties of carbon are the following:

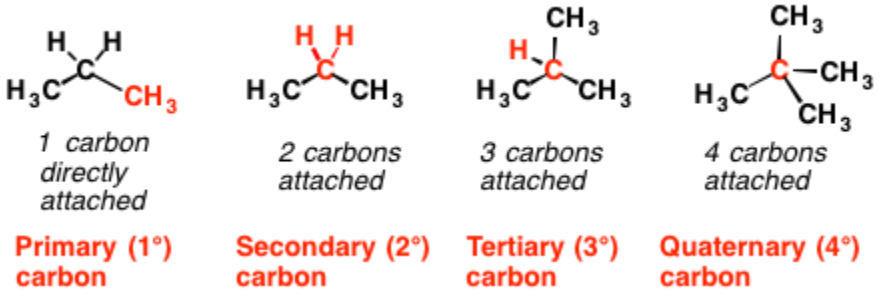
Carbon exists in two allotropic forms which are crystalline forms and another is non-crystalline forms.

1. In crystalline form, there is a definite and regular arrangement of atoms. 2. Carbon exists in three crystalline forms which are diamond, graphite and fullerene. 3. Diamond is the hardest substance among three crystalline forms. Graphite is soft and brittle. Fullerene is rarely found in the earth.	1. In non-crystalline form, there is indefinite and irregular arrangement of atoms. 2. Carbon exists in three non-crystalline forms (amorphous) which are coal, charcoal and coke. 3. Coal is a fossil fuel which is made of carbon, hydrogen, oxygen, nitrogen, phosphorus and Sulphur. 4. Charcoal is made from animals and plants. It is used as a fuel in industries and factories. 5. Coke is that pure coal which remains when coal gas has been taken away from the coal. It is used as domestic fuel.

Q. 8 D. Write answers to the following in detail.

Classify carbon

Answer : In saturated hydrocarbons (having single bond), carbon can be classified into primary carbon, secondary carbon, tertiary carbon and quarternary carbon.



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

Answer : Methods to verify the properties of carbon dioxide are:

1. By using limewater

Step 1: Take some limewater in a test tube.

Step 2: Take some baking soda in another test tube and add lemon juice to it. Fit the bent tube over it.

Step 3: Insert its other end into the lime water.

Observations: We will observe that limewater turns milky as it comes in contact with the released gas in the form of effervescence. When limewater turns milky, it is confirmed that the effervescence released is of carbon dioxide gas.

The reaction taking place:

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

2. Sodium carbonate is formed when carbon dioxide is passed through an aqueous solution of sodium hydroxide.

The reaction taking place:

$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

3. Sodium bicarbonate is formed on passing CO_2 through an aqueous solution of sodium carbonate.

The reaction taking place:

$Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$