Carbon Chemistry Questions with Solutions

Q1: Which of the following statements are correct for carbon compounds?
(i) Most carbon compounds are good conductors of electricity.
(ii) Most carbon compounds are poor conductors of electricity.
(iii) Force of attraction between molecules of carbon compounds is not very strong.
(iv) Force of attraction between molecules of carbon compounds is very strong.

(a) (ii) and (iv)
(b) (ii) and (iii)
(c) (i) and (iv)
(d) (i) and (iii)

Answer: (b) (ii) and (iii)

Q2: Why does carbon form compounds mainly by covalent bonding?
(a) There are four electrons in the outermost shell of carbon.
(b) It requires a large amount of energy to form C^{4+}.
(c) It shares its valence electrons to complete its octet.
(d) All the above.

Answer: (d) All the above.

Q3: In a diamond, each carbon atom is bonded to four other carbon atoms to form
(a) a hexagonal array
(b) a structure of a ring
(c) a structure in the shape of a football
(d) a rigid three-dimensional structure

Answer: (d) a rigid three-dimensional structure

Q4: A soap molecule has a
(a) hydrophobic head and a hydrophobic tail
(b) hydrophobic head and hydrophilic tail
(c) hydrophilic head and a hydrophobic tail
(d) hydrophilic head and hydrophilic tail

Answer: (c) hydrophilic head and a hydrophobic tail

Q5: —CHO represents the functional group
(a) aldehydes
(b) carboxylic acid

(c) alcohols
(d) esters

Answer: (a) aldehydes

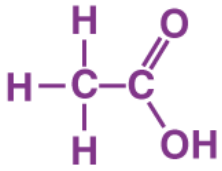
Q6: Why is carbon so important?

Answer:

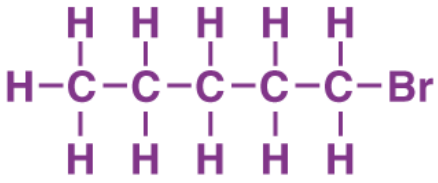
All known biological systems require carbon, and life would not be possible without it. Besides food and wood, carbon is found in hydrocarbons such as fossil fuel, methane gas, and crude oil. Carbon fibres have many applications because they are strong, lightweight, and long-lasting materials. Tennis rackets, fishing poles, and even airplanes and rockets are made with these fibres. Drilling and cutting rocks are done with industrial diamonds.

Q7: Draw the structures for the following compounds:
(i) Ethanoic acid
(ii) Bromopentane
(iii) Butanone
(iv) Hexanal

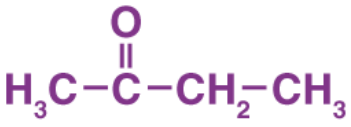
Answer:



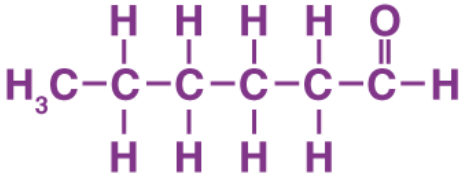
Ethanoic acid



Bromopentane



Butanone



Hexanal

Q8: A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

Answer:

When ethyne is burned in the air, incomplete combustion occurs, resulting in a sooty flame due to a lack of oxygen in the air.

However, when ethyne is burned in oxygen, it produces a clean flame with a high temperature (3000°C) due to complete ethyne combustion.

As a result, this oxy-acetylene flame is employed for welding because air cannot reach such a high temperature. As a result, welding with a combination of ethyne and air is not recommended.

Q9: Why is the conversion of ethanol to ethanoic acid an oxidation reaction?

Answer:

The following is the procedure for converting ethanol to ethanoic acid:

$$CH_3CH_2OH + KMnO_4(Alkaline) \rightarrow CH_3COOH$$

If you look closely at the above modification, you'll note that one extra O atom has been added to the ethanol molecule, and two H atoms have been removed to convert it to ethanoic acid. Oxidation is the process of introducing O and removing H.

Q10: How would you distinguish experimentally between an alcohol and a carboxylic acid?

Answer:

The functional group OH is found in alcohols, while COOH is found in carboxylic acids.

Differences between alcohol and carboxylic acid:

Test	Alcohol	Carboxylic acid
(i) Litmus test	No change in colour.	The blue litmus solution turns red.
(ii) Sodium hydrogen carbonate test	$C_2H_5OH + NaHCO_3 \rightarrow$ No reaction. No brisk effervescence.	$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$ Brisk effervescence due to evolution of CO_2.

(iii) Alkaline potassium permanganate	On heating, the pink colour disappears.	Nothing happens.

Q11: What is a homologous series? Explain with an example.

Answer:

A homologous series is a collection of organic compounds with identical structures and chemical characteristics that differ only in the $-CH_2$ group between them.

Some of the characteristics of homologous series are as follows:

(i) Same generic formula can be used to describe all members of a homologous series. The homologous series of alkanes, for example, has the general formula C_nH_{2n+2}, where 'n' specifies the number of carbon and hydrogen atoms in one molecule of alkane.

(ii) The chemical formulas of any two neighbouring homologues differ by one carbon atom and two hydrogen atoms.

(iii) Any two adjacent homologues have a molecular mass difference of 14u.

(iv) The chemical characteristics of all molecules in a homologous series are comparable.

(v) As molecular mass increases, the physical properties of members of a homologous series change gradually.

Methane, ethane, propane, butane, and other alkane homologous series compounds are examples.

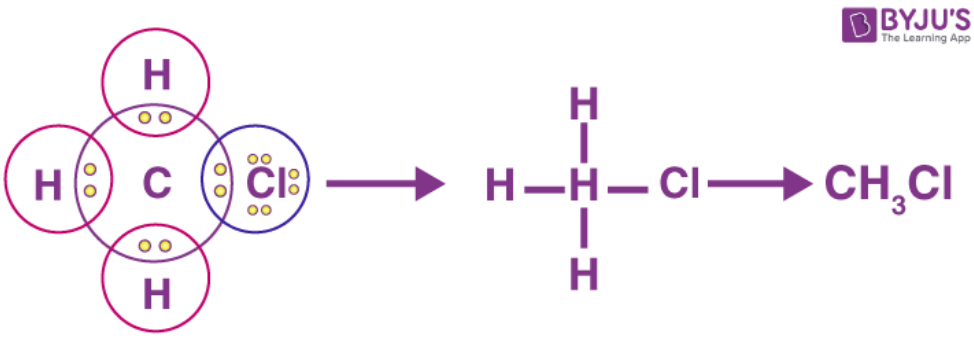
- Methane CH_4 (**n = 1**)
- Ethane CH_3CH_3 (**n = 2**)
- Propane $CH_3CH_2CH_3$ (**n = 3**)
- Butane $CH_3CH_2CH_2CH_3$ (**n = 4**)

There is a difference of one $-CH_2$ unit between each component.

Q12: Explain the nature of the covalent bond using the bond formation in CH_3Cl.

Answer:

Carbon cannot lose or gain four electrons because both processes demand more energy and would cause the system to become unstable. As a result, it completes its octet by sharing its four electrons with other carbon atoms or other element atoms. Covalent bonds are those that are generated when electrons are shared. Both atoms share valence electrons in covalent bonding, meaning the shared electrons belong to both atoms' valence shells.



Each hydrogen atom requires one electron to complete its duplet, while carbon requires four electrons to complete its octet. In addition, to complete the octet, chlorine requires one electron. As a result, all of these share electrons, and carbon creates three hydrogen bonds and one chlorine bond.

Q13: How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

Answer:

The physical and chemical properties that distinguish ethanol from ethanoic acid are listed in the table below.

Ethanol	**Ethanoic acid**
Ethanol is always a liquid at room temperature, with a melting point of 156 K and a boiling point of 351 K.	Because of its melting point of 16°C, ethanoic acid is also known as glacial acetic acid. When the weather gets chilly in the winter, it usually freezes.
Ethanol has a pleasant odour.	Ethanoic acid has a vinegar-like smell.
Carbonates and hydrogen carbonate do not react with ethanol. $CH_3CH_2OH + Na_2CO_3 \rightarrow$ No reaction	As seen in the reaction below, Ethanoic acid reacts with sodium bicarbonate. $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$

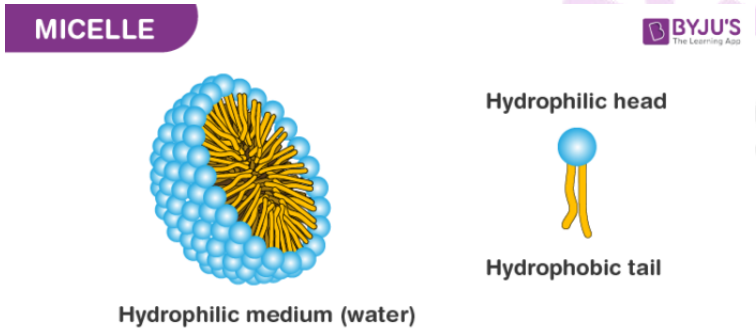
Q14: When soap is added to water, why does micelle production occur? Is it possible to produce a micelle in other solvents, such as ethanol?

Answer:

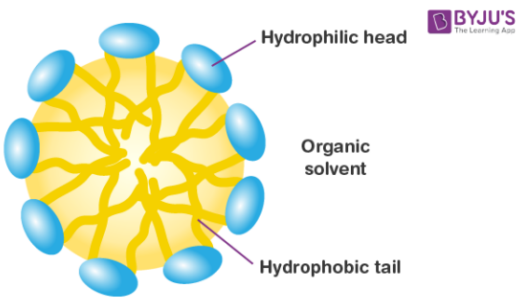
A soap is long-chain fatty acid sodium or potassium salt. One end is polar, whereas the other is non-polar. The polar end is hydrophilic in nature, meaning it is drawn towards water. The non-polar end is hydrophobic but lipophilic, meaning that it is drawn towards hydrocarbons.

Soap molecule

When soap is put into water, the soap molecules form a cluster to keep the non-polar portion out of the water, with the non-polar ends in the cluster's core and the polar ends on the cluster's surface. The hydrophobic ends of the clusters attach themselves to the dirt on garments since it is organic in nature and insoluble in water.



The micelle is a cluster structure in which dirt is trapped. Because the alkyl chain of soap becomes soluble in alcohol, micelle formation does not occur.



Q15: What is hydrogenation? What is its industrial application?

Answer:

In the presence of a catalyst, hydrogenation is an addition reaction between hydrogen and other molecules.

The addition of two hydrogen atoms across the double bond of ethene results in the formation of saturated ethane. Because the energy of the reactants is greater than the energy of the product, the reaction is more favourable. This reaction represents an exothermic reaction.

$$CH_2 = CH_2 \rightarrow CH_3CH_3$$

The following are examples of industrial applications:

(a) Alkenes are converted to alkanes.

(b) To make vegetable ghee out of vegetable oils

Practise Questions on Carbon

Q1: When ethanol is heated with con, sulphuric acid at 170°C, it gets converted into ethene. In this reaction, concentrated sulphuric acid acts as
(a) catalyst
(b) oxidising agent
(c) dehydratory agent
(d) reducing agent.

Answer: (a) catalyst

Q2: What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?

Answer:

The following are two characteristics of carbon that lead to a large variety of compounds:

(i) Catenation, the ability to establish bonds between carbon atoms.

(ii) Tetravalency: Carbon has a valency of four and can connect with four other atoms.

Q3: Which of the following hydrocarbons undergo addition reactions:
C_2H_6, C_3H_8, C_3H_6, C_2H_2, and CH_4

Answer:

Only unsaturated hydrocarbons undergo addition reactions. As a result, only C_3H_6 and C_2H_2 undergo addition reactions.

Q4: Why are carbon and its compounds used as fuels for most applications?

Answer:

Carbon and its compounds are used as fuels for the reasons listed below:

1. Due to the high ratio of carbon and hydrogen, they produce a lot of heat when burned.

2. Carbon compounds used as fuel have a high calorific value and ignition temperature and are easy to handle.

3. They have controllable combustion. Carbon and its compounds are therefore utilised as fuels.

Q5: Explain the formation of scum when hard water is treated with soap.

Answer:

Calcium and magnesium salts are usually found in hard water. A precipitate is formed when soap molecules combine with calcium and magnesium salts. This precipitate forms an off-white coating on top of the water. Scum is the term for this layer. Because scum forms in hard water, soaps lose their cleansing ability.