Chapter – 4 Carbon and Its Compounds

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Q1. What would be the electron-dot structure of carbon dioxide which has the formula CO_2?

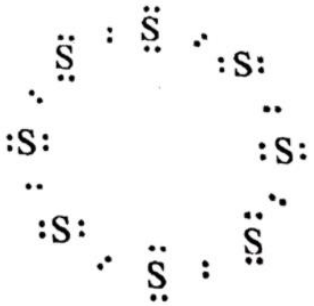
Answer:

The electron-dot structure for carbon dioxide (CO_2 *or* $O = C = O$) is:

Q2. What would be the electron-dot structure of a molecule of sulphur which is made up of eight atoms of sulphur? (Hint: the eight atoms of sulphur are joined together in the form of a ring).

Answer:

A sulphur atom has 6 outermost electrons. Eight sulphur atoms combine by sharing two electrons among themselves to form a ring type sulphur molecule, S_8.



Electron-dot structure of sulphur molecule, S_8

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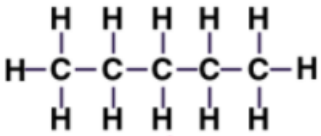
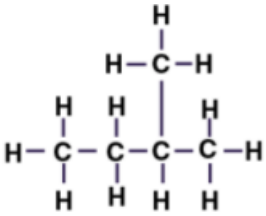
Q1. How many structural isomers can you draw for pentane?

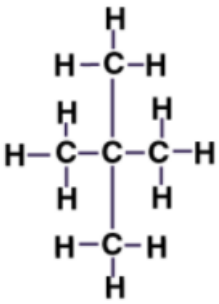
Answer:

We can draw 3 structural isomers for pentane.

The molecular formula of pentane is C_5H_{12}. It has 5 carbon atoms. We will arrange these 5 carbon atoms in different possible ways to obtain all the isomers of pentane.


n-pentane


Iso-pentane


Neo-pentane

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

Answer:

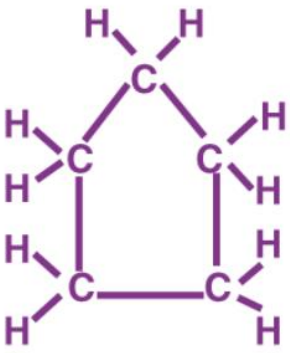
The two properties of carbon which form large number of carbon compounds are:

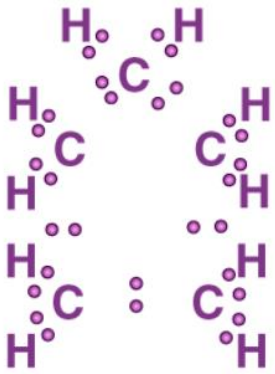
i) Catenation – self-linking of carbon atoms to form chains of carbon atoms.
ii) Tetravalency – carbon atom having a large valency of 4 can form covalent bonds with a number of carbon atoms as well as with a larger number of other atoms such as hydrogen, oxygen, nitrogen, sulphur, chlorine and many more atoms.

Q3. What will be the formula and electron-dot structure of cyclopentane?

Answer:

The molecular formula of cyclopentane is C_5H_{10}. Cyclopentane has 5 carbon atoms in the form of a pentagonal ring which are connected by single bonds. The structural formula and electron-dot structure of cyclopentane are given alongside.

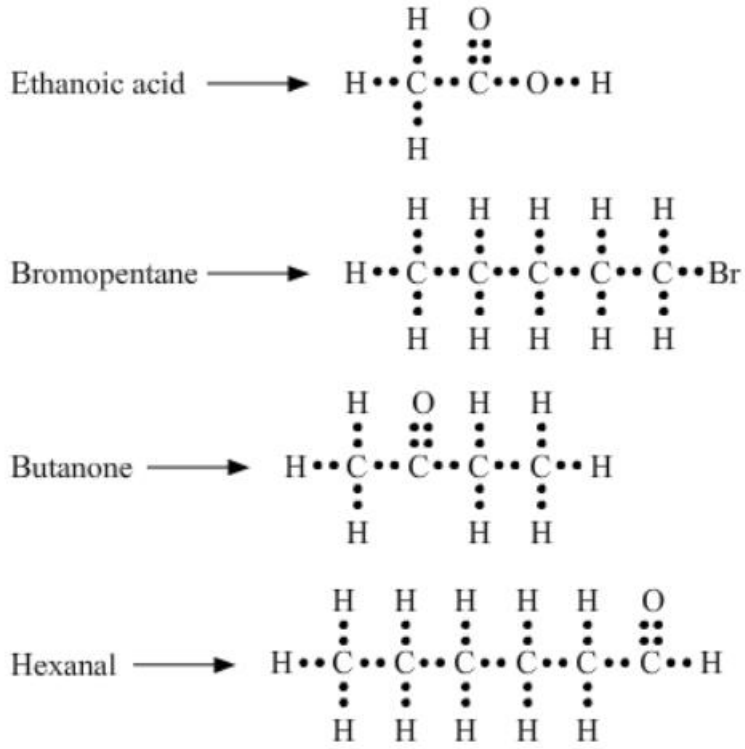

Structural formula of cyclopentene (C_5H_{10})


Electron-dot structure of cyclopentene (C_5H_{10})

Q4. Draw the structure for the following compounds:

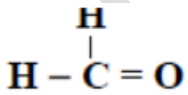
i) **Ethanoic acid**
ii) **Bromo pentane**
iii) **Butanone**
iv) **Hexanal**

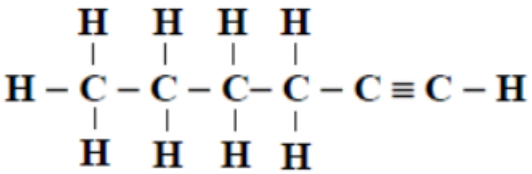
Answer:



Q5. How would you name the following compounds?

i. $CH_3 - CH_2 - Br$

ii. 

iii. 

Answer:

i) It has 2 carbon atom, hence its parent hydrocarbon is ethane, this compound also has a bromo group (Br) attached to one carbon atom. So, the name of this compound will be bromo-ethane.

ii) The compound has 1 carbon atom, so its parent alkane is methane. It has also an aldehyde group which is represented by the ending 'al'. now, replacing last 'e' of methane by 'al', the name of this compound becomes 'methanal'.

iii) This compound has 6 carbon atoms in it, so its parent alkane is hexane. It has also a triple bond in it which is indicated by the suffix 'yne'. Now, replacing the 'ane' of hexane by 'yne', the name of above compound becomes 'hexyne'.

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Q1. Why is the conversion of ethanol to ethanoic acid an oxidation reaction?

Answer:

The formula of ethanol is CH_3CH_2OH whereas that of ethanoic acid is CH_3COOH. These formulae show that a molecule of ethanol contains only 1 oxygen atom (O) whereas a molecule of ethanoic acid contains 2 oxygen atoms (OO). This means that oxygen is added during the conversion of ethanol into ethanoic acid. Now, by definition, addition of oxygen to a substance is called oxidation. So, the conversion of ethanol into ethanoic acid is an oxidation reaction because oxygen is added to ethanol during this reaction.

Q2. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

Answer:

Ethyne is an unsaturated hydrocarbon containing high percentage of carbon in it.

i) When a mixture of ethyne and pure oxygen is burnt, then ethyne burns completely producing an extremely hot blue flame which can be used for welding metals.

ii) If, a mixture of ethyne and air is burnt, then incomplete combustion of ethyne takes place, because of insufficient oxygen of air, producing a yellow, sooty flame which is not hot enough to weld metals.

Class 10 Science NCERT Textbook – Page No. 74

Q1. How would you distinguish experimentally between an alcohol and a carboxylic acid?

Answer:

An alcohol is neutral compound and carboxylic is acidic in nature which is distinguish between an alcohol and a carboxylic acid by using sodium hydrogen carbonate as:

We take the alcohol and the carboxylic acid in two separate test-tubes and add some sodium hydrogen-carbonate solution to each test-tube.

a) The organic compound which produces brisk effervescence on adding sodium hydrogen carbonate due to the evolution of carbon dioxide gas will be a carboxylic acid.
b) The organic compound which has no effect on sodium hydrogen-carbonate will be an alcohol.

Q2. What are oxidising agents?

Answer:

The substances which give oxygen are called oxidising agents. Alkaline potassium permanganate and acidified potassium dichromate are oxidising agents as they give oxygen for oxidising other substances. For example, when ethanol is heated with alkaline potassium permanganate solution, it gets oxidised to ethanoic acid:

$$\underset{\text{Ethanol}}{CH_3 - CH_2OH} \xrightarrow[\text{Acidified } K_2Cr_2O_7 + \text{heat}]{\text{Alk. } KMnO_4 + \text{heat}} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

Since the oxygen required for the oxidation of ethanol to ethanoic acid has been given by alkaline potassium permanganate (alkaline $KMnO_4$) or acidified potassium dichromate (acidified $K_2Cr_2O_7$), hence both these substances are oxidising agents.

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Q1. Would you be able to check if water is hard by using a detergent?

Answer:

No, we are unable to check if water is hard by using a detergent because a detergent forms lather (or foam) easily even with hard water. Unlike a soap, the detergent does not form a scum with hard water.

Q2. People use a variety of methods to wash clothes. Usually after adding the soap, they beat the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes?

Answer:

It is necessary to agitate (or shake) to get clean clothes because the soap micelles which entrap oily or greasy particles on the surface of dirty cloth have to be removed from its surface. When the cloth wetted in soap solution is agitated (or beaten). The micelles containing oily or greasy dirty particles get removed from the surface of dirty cloth and go into water. And the dirty cloth gets cleaned.

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Q1. Ethane, with the molecular formula C_2H_6 has:

a) **6 covalent bonds**
b) **7 covalent bonds**
c) **8 covalent bonds**
d) **9 covalent bonds**

Answer: Option b)

Since, the structural formula of ethane has 6 $C-H$ covalent bonds and 1 $C-C$ covalent bond. Hence, the total number of covalent bonds is 6 + 1 = 7

Q2. Butanone is a four-carbon compound with the functional group:

a) **Carboxylic acid**
b) **Aldehyde**
c) **Ketone**
d) **Alcohol**

Answer: Option c)

Butanone is compound with four-carbon atoms and functional group ketone. Butan-one: one is the suffix used for the functional group ketone.

Q3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that:

a) **The food is not cooked completely**
b) **The fuel is not burning completely**
c) **The fuel is wet**
d) **The fuel is burning completely**

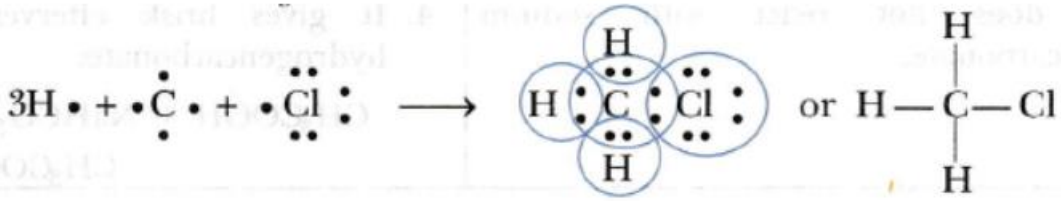
Answer: Option b)

The bottom of the vessel is blackened due to the incomplete combustion of the fuel. Hence, one can say fuel is not burning properly.

Q4. Explain the nature of the covalent bond by using the bond formation in CH_3Cl.

Answer:

CH_3Cl is methyl chloride. It is made up of one carbon atom, three hydrogen atoms and one chlorine atom. Carbon atom has 4 outermost electrons, each hydrogen atom has 1 outermost electron, and chlorine atom has 7 valence electrons. Carbon atom shares its 4 valence electrons with three hydrogen atoms and one chlorine atom to form CH_3Cl as shown:



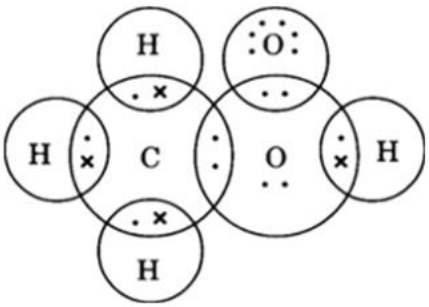
We can see from the above electron-dot structure of CH_3Cl that there are four pairs of shared electrons between carbon and other atoms. Each pair of shared electrons constitutes one single covalent bond. So, CH_3Cl has four single covalent bonds.

Q5. Draw the electron-dot structure for:

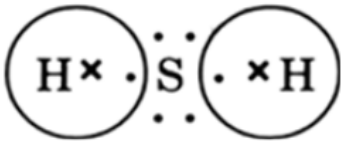
a) **Ethanoic acid**
b) **H_2S**
c) **Propanone**
d) **F_2**

Answer:

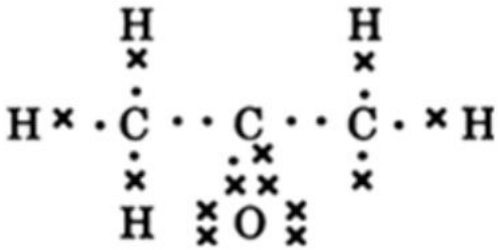
a) The electron-dot structure for ethanoic acid CH_3COOH:



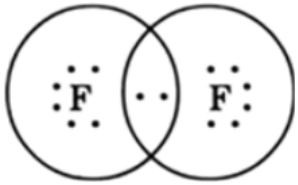
b) The electron-dot structure for hydrogen sulphide H_2S is:



c) The electron-dot structure for propanone CH_3COOH_3 is:



d) The electron-dot structure for fluorine F_2 is:



Q6. What is homologous series? Explain with an example.

Answer:

A homologous series is a group of organic compounds with similar structures and chemical properties in which the successive differ by $-CH_2$ group. The organic compounds of a homologous series are called homologous. All the homologous of a series contain the same functional group.

Example:

The compounds called alcohols form a homologous series. Methanol CH_3OH, ethanol C_2H_5OH, propanol C_3H_7OH and butanol C_4H_9OH are the first four members of the homologous series of alcohols:

Methanol CH_3OH

Ethanol C_2H_5OH

Propanol C_3H_7OH

Butanol C_4H_9OH

All these alcohols have similar structures having the same functional group (alcohol group: $-OH$) and show similar chemical properties. The formulae of the successive members of this homologous series of alcohols differ from each other by CH_2 group. Calculating the molecular masses of the above members of the homologous series of alcohols, we find that they differ from each other by 14 u.

Q7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

Answer:

a) Differences in physical properties:

i) **Smell.** Ethanol has a pleasant smell whereas ethanoic acid has a pungent smell.
ii) **Taste.** Ethanol has a burning taste whereas ethanoic acid has a sour taste.
iii) **Boiling points.** The boiling point of ethanol is low (being only 78^oC) whereas that of ethanoic acid is comparatively high (being 118^oC).

b) Differences in chemical properties:

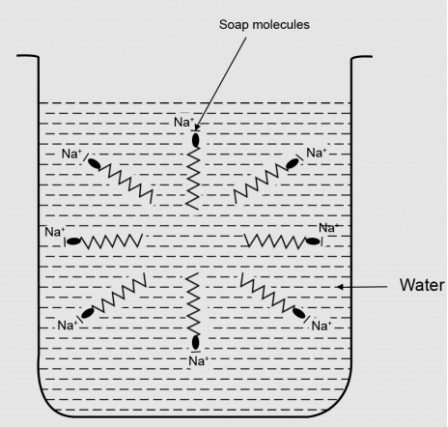
i) **Action on litmus.** Ethanol has no action on any litmus but ethanoic acid turns blue litmus to red.
ii) **Action on sodium hydrogen-carbonate.** Ethanol has no reaction with sodium hydrogen-carbonate but ethanoic acid gives brisk effervescence of carbon dioxide with sodium hydrogen-carbonate.

Q8. Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Answer:

The micelle formation occur when soap is added to water as the hydrocarbon chains of soap molecules are hydrophobic (water repelling) which are insoluble in water but the ionic ends of the soap molecules are hydrophilic (water attracting) and hence soluble in water.

In a soap micelle, the uncharged ends of the hydrocarbon chains are on the inside whereas the charged ionic ends are on the outside. A micelle is not formed in solvents like ethanol as hydrocarbons chains of soap molecules are soluble in organic solvents like ethanol.



Soap micelle

Q9. Why are carbon and its compounds used as fuels for most applications?

Answer:

Carbon and its compounds are used as fuels as they burn in air releasing excess of heat energy.

Example –

i) When carbon in the form of coal is burned in air, it forms carbon dioxide gas and releases a lot of heat:

$$C + O_2 \longrightarrow Burning \longrightarrow CO_2 + Heat$$

ii) When a carbon compound methane in the form of natural gas is burned in air, it forms carbon dioxide and water vapour, and releases a lot of heat:

$$CH_4 + 2O_2 \longrightarrow Burning \longrightarrow CO_2 + 2H_2O + Heat$$

Q10. Explain the formation of scrum when hard water is treated with soap.

Answer:

Hard water contains calcium and magnesium salts. When soap is treated with hard water, then the calcium and magnesium ions of hard water react with soap to form an insoluble precipitate called ‘scrum’. The scrum is formed because the calcium the calcium and magnesium salts are insoluble in water.

Q11. What change will you observe if you test soap with litmus paper (red and blue)?

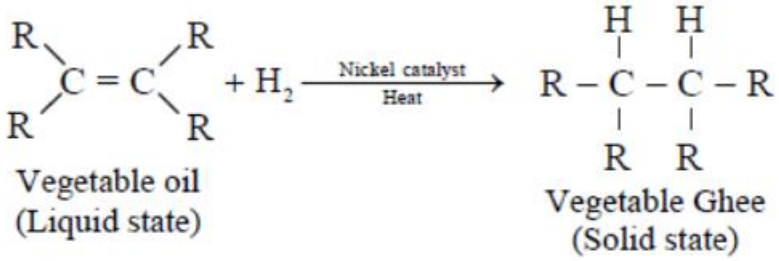
Answer:

Soap solution is alkaline so turn red litmus paper to blue and have no effect on blue litmus paper.

Q12. What is hydrogenation? What is its industrial application?

Answer:

The addition of hydrogen to an unsaturated compound in the presence of nickel (or palladium) catalyst to obtain a saturated compound is called hydrogenation. Hydrogenation is used in industry to prepare vegetable ghee from vegetable oils. The vegetable oils like groundnut oil are unsaturated compounds. When the liquid vegetable oil is heated with hydrogen in the presence of finely divided nickel as catalyst, then a saturated solid fat called vegetable ghee is formed which is called hydrogenation of oils:



Q13. Which of the following hydrocarbons undergo addition reactions?

$$C_2H_6, C_3H_8, C_3H_6, C_2H_6, and\ CH_4$$

Answer:

The unsaturated hydrocarbons (alkenes and alkynes) undergo addition reaction. Out of the above hydrocarbons C_3H_6 is an alkene whereas C_2H_6 and C_2H_2 will undergo addition reactions.

Q14. Give a test that can be used to differentiate chemically between butter and cooking oil.

Answer:

Butter is an animal fat which contains saturated fatty acids. Cooking oil is a vegetable oil which contains unsaturated fatty acids. Now, unsaturated compounds decolourise bromine water whereas saturated compounds do not. So, we can distinguish between butter and cooking oil by the bromine water test. We take a little of butter and cooking oil in two separate test-tubes and add some red-brown coloured bromine water to them. The test-tube in which the bromine water gets

decolourised contains cooking oil. The test-tube in which the bromine water does not get decolourised contains butter.

Q15. Explain the mechanism of the cleaning action of soap.

Answer:

When soap is dissolved in water forming colloidal suspension in water in which they cluster together to form spherical micelles. In a soap micelle, the soap molecules are arranged with hydrocarbons ends towards the centre and ionic ends outwards.

When a dirty cloth is put in water containing dissolved soap, then the hydrocarbon ends of the soap molecules in the middle attach to the oil or grease particles present on the surface of dirty cloth. So the soap micelle traps the oily or greasy particles by using its hydrocarbons ends. The ionic ends of the soap molecules in the micelles, remain attached to water. When the dirty cloth is agitated in soap solution, the oily and greasy particles on its surface and entrapped by soap micelles get dispersed in water due to which the soap water becomes dirty but the cloth gets cleaned. The cloth is cleaned thoroughly by rinsing in clean water a number of times.