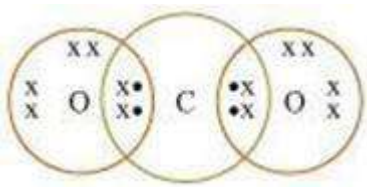
Chapter – 4

Carbon and its Compounds

In Text Questions-Pg-61

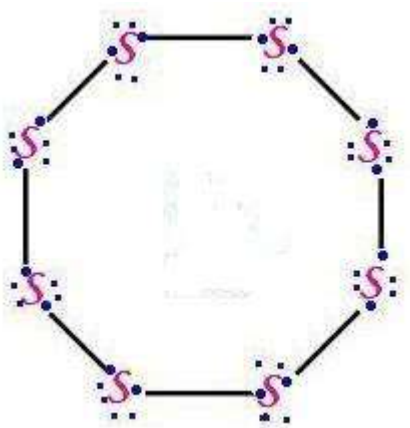
Q. 1 What would be the electron-dot structure of carbon dioxide which has the formula CO_2?

Answer: The electron-dot structure of carbon dioxide (CO_2) is:



Q. 2 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).

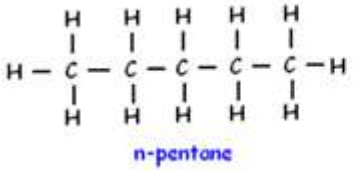
Answer: The electron- dot structure of Sulphur (S) is:



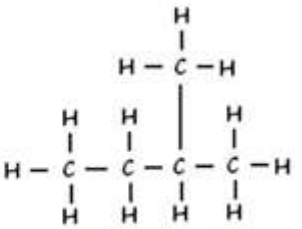
In Text Questions-Pg-68

Q. 1 How many structural isomers can you draw for pentane?

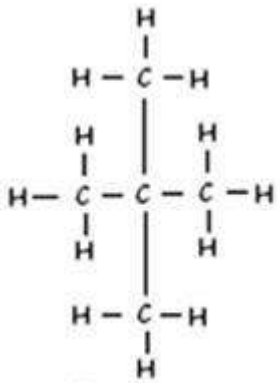
Answer: Three structural isomers are possible for pentane (C_5H_{12}). These are-



n-pentane



Iso-pentane



Neo-pentane

Q. 2 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 lead to the formation of large number of carbon compounds are as follows:

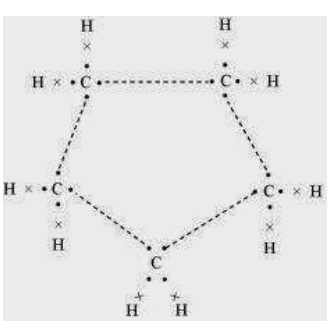
(i) Catenation: It is ability to form bonds with other atoms of carbon.

(ii) Tetravalency: Since carbon has a valency of four, it is capable of bonding with four other atoms.

Q. 3 What will be the formula and electron-dot structure of cyclopentane?

Answer: The molecular formula of cyclopentane is C_5H_{10}.

The electron-dot structure of cyclopentane is:



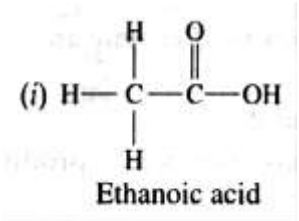
Q. 4 Draw the structures for the following compounds:

(i) Ethanoic acid (ii) Bromopentane

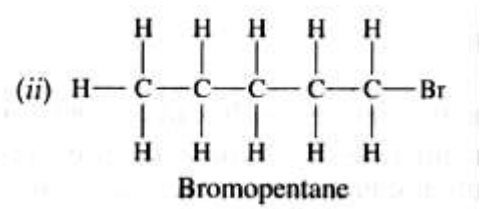
(iii) Butanone (iv) Hexanal

Are structural isomers possible for bromopentane?

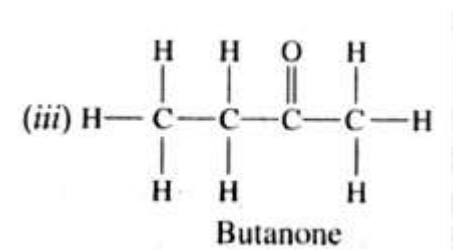
Answer: (i) The structure of ethanoic acid:



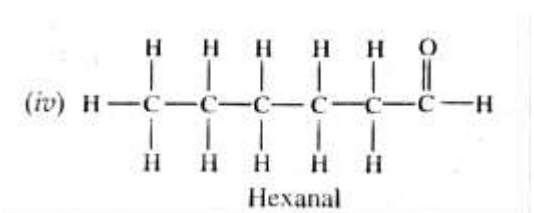
(ii) Structure of Bromopentane:



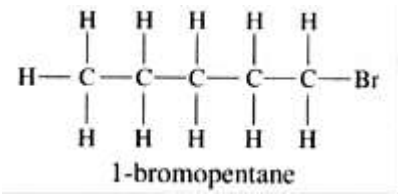
(iii) Structure of butanone:

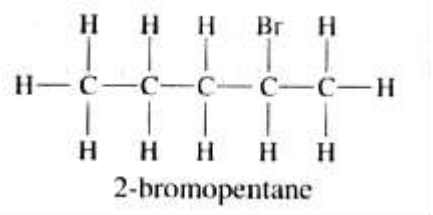


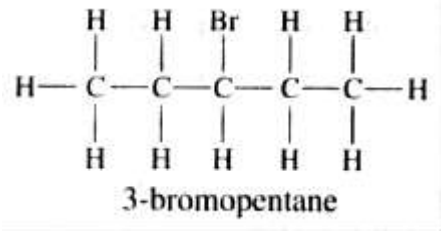
(iv) Structure of hexanal:



Yes, there are many structural isomers are possible for bromopentane. Among them, the structure of three isomers are given below:

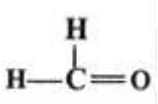

1-bromopentane

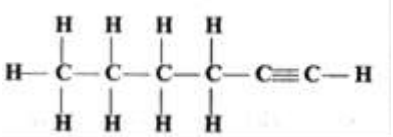

2-bromopentane


3-bromopentane

Q. 5 How would you name the following compounds?

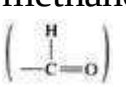
Answer: $CH_3—CH_2—Br$





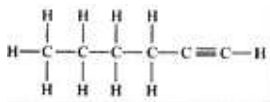
Answer:

(i) The compound ($CH_3—CH_2—Br$) contains 2 carbon atoms which means the parent hydrocarbon is ethane. It also contains a bromo group attached to one of the carbon atoms. Thus, the nomenclature of the compound is bromoethane.

(ii) The compound () contains 1 carbon atom which means the parent hydrocarbon is methane. It also contains a functional group called aldehyde group  which is represented by the adding a suffix 'al' at the end of name of the compound. Now, the name of carbon

chain is modified by deleting the last 'e' of methane and adding the suffix 'al'. Thus, the nomenclature of the compound is 'methanal'.

(iii) The compound contains 6 carbon atoms which

means the parent  hydrocarbon is hexane. It also contains a triple bond $(-C \equiv C-)$ in it which is represented by adding a suffix 'yne'. Now, replacing the 'ane' of hexane by 'yne', the name of above compound becomes 'hexyne'.

In Text Questions-Pg-71

Q. 1 Why is the conversion of ethanol to ethanoic acid an oxidation reaction?

Answer: The addition of oxygen to a substance is called oxidation. The conversion of ethanol to ethanoic acid is as follows:

$$CH_3-CH_2OH \xrightarrow[\text{Or acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

Since, in this reaction, one oxygen is added to ethanol, hence it is an oxidation reaction.

Q. 2 A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

Answer: A mixture of ethyne and air is not used for welding because when ethyne is burnt in air, it gives a sooty flame due to incomplete combustion which is not enough to melt metals for welding.

In Text Questions-Pg-74

Q. 1 How would you distinguish experimentally between an alcohol and a carboxylic acid?

Answer: Take the samples of alcohol and carboxylic acid in different test tubes and add some sodium hydrogen carbonated in both the tubes.

Carboxylic acid reacts with sodium hydrogen carbonate to give brisk effervescence of carbon dioxide gas but alcohol does not react with sodium hydrogen carbonate.

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$

$C_2H_5 + NaHCO_3 \rightarrow No\ reaction$

Q. 2 What are oxidising agents?

Answer: An oxidising agent is one which oxidises other substances by providing oxygen or removing hydrogen. Alkaline potassium permanganate and acidified potassium dichromate can be used as oxidising agents.

For example: Alkaline potassium permanganate or acidified potassium dichromate are oxidising alcohols to acids, that is, adding oxygen to the starting material.

$$CH_3-CH_2OH \xrightarrow[\text{Or acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

In Text Questions-Pg-76

Q. 1 Would you be able to check if water is hard by using a detergent?

Answer: Detergent gives lather with hard and soft water both, while a soap gives lather with soft water only. Thus, it is not possible to check the hardness of water by using a detergent.

Q. 2 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 to get clean clothes because the soap micelles which entrap oily dirt on the surface of dirty cloth have to be removed from its surface. When the dirty clothes are agitated in soap solution, the oily dirt particles entrapped by soap micelles get dispersed in water and the clothes get cleaned.

Exercise-Pg-77

Q. 1 Ethane, with the molecular formula C_2H_6 has:

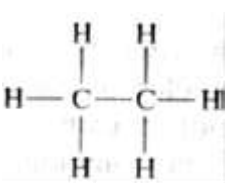
A. 6 covalent bonds

B. 7 covalent bonds

C. 8 covalent bonds

D. 9 covalent bonds

Answer: The number of covalent bonds in ethane (C_2H_6) is 7. Ethane is a saturated hydrocarbon in which all the carbon atoms are connected by only single bonds.



Q. 2 Butanone is a four-carbon compound with the functional group:

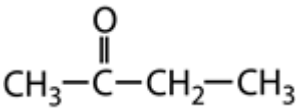
A. carboxylic acid

B. aldehyde

C. ketone

D. alcohol

Answer: Acetone ($CH_3CH_2COCH_3$) is an organic compound which contains a ketone as functional group.



Q. 3 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

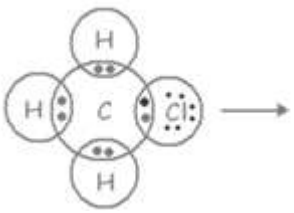
C. the fuel is wet

D. the fuel is burning completely

Answer: While cooking, if the bottom of the cooking utensil is getting blackened on the outside, it means that the fuel is not burning completely.

Q. 4 Explain the nature of the covalent bond by using the bond formation in CH_3Cl.

Answer: Carbon has four electron in its outermost shell and needs to gain or loss four electrons to attain noble gas configuration. To overcome this, carbon shares each of the four electrons with each of the three hydrogen atoms and one chloride atom. The bond that are formed by sharing electrons are known as covalent bond.



Q. 5 Draw the electron-dot structures for:

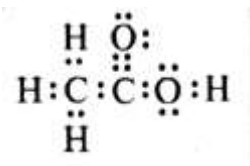
(a) Ethanoic acid

(b) H_2S

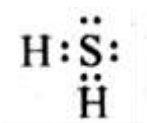
(c) Propanone

(d) F_2

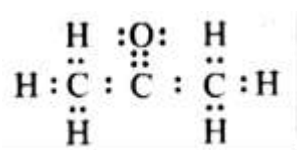
Answer: (a) The electron – dot structure for ethanoic acid (CH_3COOH):



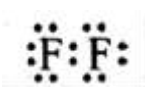
(b) The electron-dot structure for hydrogen sulphide (H_2S):



(c) The electron-dot structure for propane (CH_3COCH_3):



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



Q. 6 What is a homologous series? Explain with an example.

Answer: A series of organic compounds in which hydrogen in a carbon chain is replaced by the same functional group, is called homologous series. Any two adjacent homologues differ by ($-CH_2$) in their molecular formulae.

All the compounds of a homologous series show similar chemical properties.

Example of homologous series: Alkynes.

All the members of homologous series of alkynes have similar structure and similar chemical properties, so they can be grouped together into the homologous series. The general formula of homologous series of alkynes is C_nH_{2n-2}. Where, n is the number of carbon atoms in alkyne molecule. The members of alkyne homologous series are:

- Ethyne (C_2H_2)-First member of alkyne homologous series.
- Propyne (C_3H_4)-Second member of alkyne homologous series.
- Butyne (C_4H_6)-Third member of alkyne homologous series.
- Pentyne (C_5H_8)-Four member of alkyne homologous series.
- Hexyne (C_6H_{10})-Five member of alkyne homologous series.

Q. 7 How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?

Answer: (a) Differences in physical properties:

(i) Ethanol has a pleasant smell whereas ethanoic acid has the smell of vinegar.

(ii) Ethanol has a burning taste whereas ethanoic acid has a sour taste.

(iii)The boiling point of ethanol is low (351 K) whereas that of ethanoic acid is comparatively high (391 K).

(b) Differences in chemical properties:

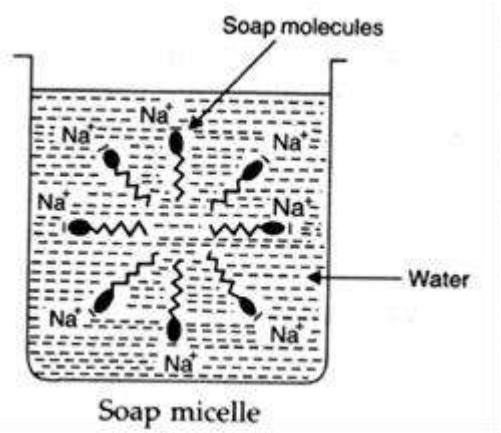
(i) Ethanol has no action on any litmus paper but ethanoic acid turns blue litmus to red.

(ii) Ethanol has no reaction with sodium hydrogencarbonate but ethanoic acid gives brisk effervescence of carbon dioxide with sodium hydrogencarbonate.

Q. 8 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: A soap is a sodium or potassium salt of long chain fatty acids. It has one polar end and one non-polar end. Polar end is hydrophilic in nature whereas non-polar end is hydrophobic. When soap is added to water, it forms a colloidal suspension in water in which the soap molecules cluster together to form spherical aggregates called micelles. In a soap micelle, soap molecules are arranged radially with hydrocarbon ends directed towards the center and ionic ends directed outwards.

No, micelle will not be formed in other solvents such as ethanol.



Q. 9 Why are carbon and its compounds used as fuels for most applications?

Answer: Carbon and its compounds are used as fuels because they give a lot of heat and light when burnt in air.

(i) When carbon is burned in air, it produces carbon dioxide gas and releases a lot of heat:

$$\underset{Carbon\ (coal)}{C} + \underset{Oxygen\ (From\ air)}{O_2} \xrightarrow{Burning} \underset{Carbon\ dioxide}{CO_2} + Heat$$

(ii) When a carbon compound methane is burned in air, it produces carbon dioxide and water vapour, and releases a lot of heat:

$$\underset{Methane\ (Natural\ gas)}{CH_4} + \underset{Oxygen\ (From\ air)}{2O_2} \xrightarrow{Burning} \underset{Carbon\ dioxide}{CO_2} + \underset{(Water)}{2H_2O} + Heat$$

Q. 10 Explain the formation of scum when hard water is treated with soap.

Answer: Soap does not work properly when hard water is used. Hard water contains salt of calcium and magnesium. When soap is added with hard water, a large amount of soap in water reacts with the calcium and magnesium ions of hard water to form an insoluble precipitate called scum. This makes the cleaning of clothes difficult.

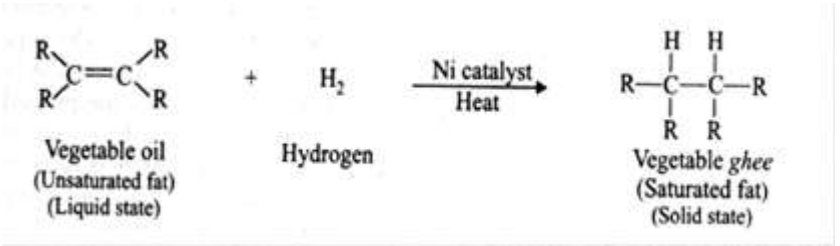
Q. 11 What change will you observe if you test soap with litmus paper (red and blue)?

Answer: Since soap is basic in nature, it will turn red litmus paper blue. However, blue litmus paper will remain blue when tested with soap solution.

Q. 12 What is hydrogenation? What is its industrial application?

Answer: The addition of hydrogen to an unsaturated hydrocarbon in the presence of nickel (or palladium) catalyst to obtain a saturated hydrocarbon is called hydrogenation.

This reaction is commonly used in hydrogenation of vegetable oil into vegetable ghee (solid fat).



Q. 13 Which of the following hydrocarbons undergo addition reactions?

C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4

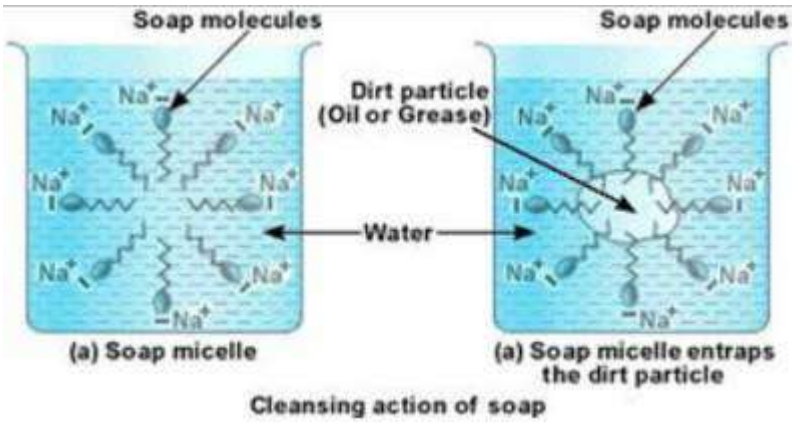
Answer: Unsaturated hydrocarbons (alkenes and alkynes) will give addition reactions. Being unsaturated hydrocarbons, C_3H_6 (alkene) and C_2H_2(alkyne)will give addition reactions.

Q. 14 Give a test that can be used to differentiate chemically between butter and cooking oil.

Answer: Take butter and cooking oil in two separate test tubes and add bromine water in both the tubes. Cooking oil decolourises the bromine water which means it is an unsaturated compound whereas butter does not decolourise the bromine water showing it is a saturated compound.

Q. 15 Explain the mechanism of the cleaning action of soap.

Answer: Soaps are molecules in which the two ends have differing properties, one is hydrophilic, that is, it dissolves in water, while the other end is hydrophobic, that is, it dissolves in hydrocarbons. When soap is at the surface of water, the hydrophobic 'tail' of soap will not be soluble in water and the soap will align along the surface of water with the ionic end in water and the hydrocarbon 'tail' protruding out of water.



Cleansing action of soap

Inside water, these molecules have a unique orientation that keeps the hydrocarbon portion out of the water. This is achieved by forming clusters of molecules in which the hydrophobic tails are in the interior of the cluster and the ionic ends are on the surface of the cluster. This formation is called a micelle. Soap in the form of a micelle is able to clean, since the oily dirt will be collected in the center of the micelle. The ionic ends in the micelles remain attached to water. When the dirty clothes are agitated in soap solution, the oily dirt particles entrapped by soap micelles get dispersed in water and the clothes get cleaned.