NCERT CBSE Solutions for Class 10 Science Chapter 4

Carbon and its Compounds

Back of Chapter Questions

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

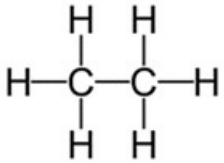
   (A) 6 covalent bonds.

   (B) 7 covalent bonds.

   (C) 8 covalent bonds.

   (D) 9 covalent bonds.

   Solution: (B)



   As is visible in the above structure, there are 6 covalent bonds between carbon and hydrogen and 1 covalent bond between carbon and carbon. Hence, there are a total of 7 covalent bonds

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

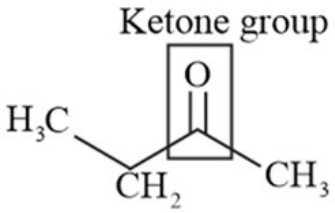
   (A) Carboxylic acid.

   (B) Aldehyde.

   (C) Ketone.

   (D) Alcohol.

   Solution: (C)



   The functional group present in butanone is of ketone.

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.

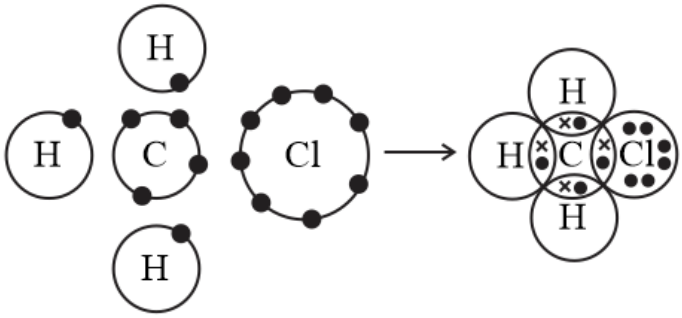
Solution: (B)

While cooking, if the bottom of the vessel is getting blackened on the outside, it indicates that the fuel is not burning completely. The blackening part happens due to the settling of soot which are unburnt carbon particles. Formation of soot is observed when incomplete combustion of fuels take place.

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

Solution:

Carbon has four electrons in its valence shell. To completes its octet, it shares its four electrons with other atoms to create four bonds, thus becoming stable. The bonds that are formed by sharing electrons are known as covalent bonds.



In CH_3Cl, carbon requires 4 electrons to complete its octet, while each hydrogen atom requires one electron to complete its duplet. Also, chlorine requires an electron to complete the octet.

Therefore, all of these share the electrons and as a result, carbon forms 3 bonds with hydrogen and one with chlorine.

5. Draw the electron dot structures for

(i) Ethanoic acid.

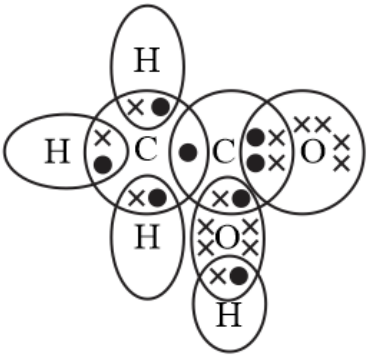
(ii) H_2S

(iii) Propanone.

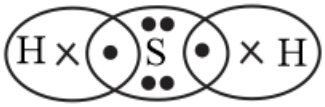
(iv) F_2

Solution:

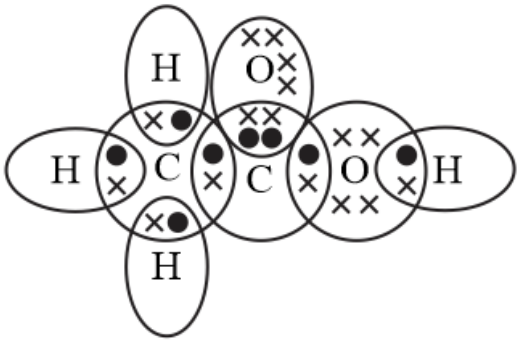
(i) Ethanoic acid



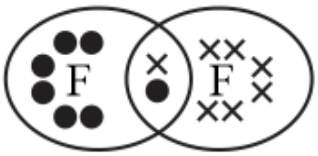
(ii) H_2S



(iii) Propanone



(iv) F_2



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

Solution:

A homologous series is a series of carbon compounds in which the consecutive compounds differ by a formula of $-CH_2$ or an atomic mass 14 amu. The compounds of a particular group have the same functional group which leads to identical chemical properties. But, as the compounds have different masses, a slight gradation in physical properties is observed.

For example, methane, ethane, propane, butane, etc., are all part of the alkane homologous series.

The general formula of this series is C_nH_{2n+2}

Methane: CH_4

Ethane: CH_3CH_3

Propane: $CH_3CH_2CH_3$

As is evident, the difference between methane and ethane or between ethane and propane is of a $-CH_2$ group which has a mass of 14 amu.

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

Solution:

Ethanol is a liquid at room temperature with a pleasant odour while ethanoic acid has vinegar-like smell. The melting point of ethanoic acid is $17°C$ and that for ethanol is $-114.1°C$. This is below room temperature and hence, ethanol freezes during winters.

Ethanoic acid reacts with metal carbonates and metal hydrogen carbonates to form salt, water and carbon dioxide gas while ethanol does not react with them.

Metal carbonate / metal hydrogen carbonate + ethanoic acid → Salt + Water + Carbon dioxide

$2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$

Metal Carbonate / Metal Hydrogen carbonate + Alcohols → No reaction

For example, $CH_3CH_2OH + Na_2CO_3 \rightarrow$ No reaction

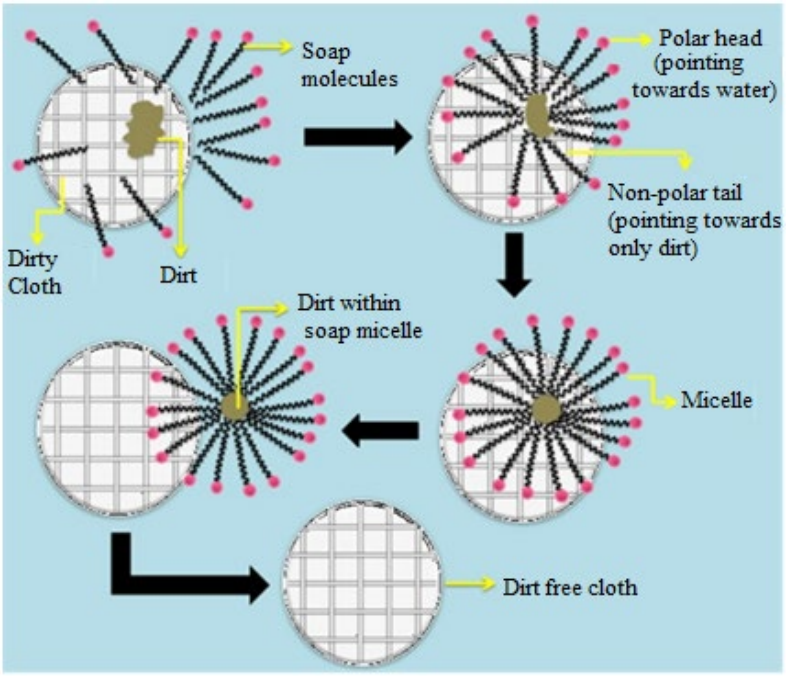
8. Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Solution:

Micelle formation takes place when soap is added to water. A soap molecule is a long chain molecule with one end having an alkyl group, which is hydrophobic,

and the other end has $SO_4^- Na^+$, which is hydrophilic. The $SO_4^- Na^+$ can be considered as the head of soap molecules and due to its ionic nature, it gets dissolved in water whereas the carbon chain dissolves in oil.

No, micelle formation does not take place in ethanol because the alkyl chain of soap becomes soluble in alcohol. Micelle can be formed only around suspended molecules of oil in water solution. Ethanol acts as a very good solvent and is able to dissolve even oil, thus forming a clear solution.



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

Solution:

Most of the carbon compounds give out a large amount of heat and light when burnt in air (combustion reaction). Saturated hydrocarbons burn with a clean flame and no smoke is produced. The carbon compounds which are used as a fuel, have high calorific values. Due to this high calorific value, carbon and its compounds are used as fuels for most applications.

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

Solution:

Soap does not work properly when the water is hard. Soap molecules are long carbon chains with sodium or potassium at the other end. When soap is added to hard water, calcium and magnesium ions present in hard water displace sodium or

potassium ions from the soap molecules forming an insoluble substance called scum. A lot of soap gets wasted in the process of scum formation.

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

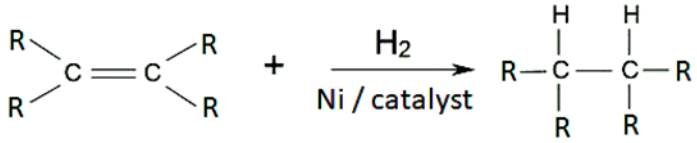
Solution:

Since soap is basic in nature, it will turn red litmus blue. However, the colour of blue litmus will remain blue because only an acidic substance can turn blue litmus into red.

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

Solution:

Hydrogenation is the process of addition of hydrogen. Unsaturated hydrocarbons (alkene or alkyne) are reacted with hydrogen in the presence of palladium and nickel catalyst to form saturated hydrocarbons.



This reaction is applied in the hydrogenation of vegetable oils, which contains long chains of unsaturated carbons.

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

Solution:

Saturated hydrocarbons (alkane general formula C_nH_{2n+2}) undergo substitution reactions.

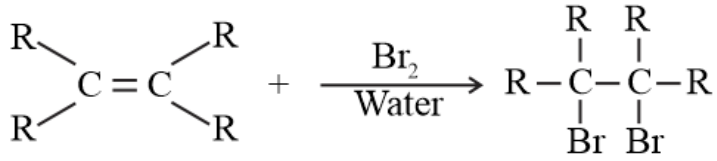
Being saturated hydrocarbons $C_2H_6, C_3H_8,$ and CH_4, the molecule already has maximum number of hydrogen atoms it can accommodate and thus, they do not undergo addition reactions.

Unsaturated hydrocarbons (alkenes C_nH_{2n} and alkynes C_nH_{2n-2}) undergo addition reactions. Being unsaturated hydrocarbons, C_3H_6 and C_2H_2, the double and triple bonds can be converted to single bonds and thus such compounds undergo addition reactions.

14. Give a test that can be used to differentiate between saturated and unsaturated hydrocarbons.

Solution:

Unsaturated carbon compounds undergo addition reactions where as saturated compounds do not undergo such reactions. When unsaturated carbon compounds react with bromine water, bromine gets added to unsaturated compounds. This turns the colour of the solution from brown to colorless.



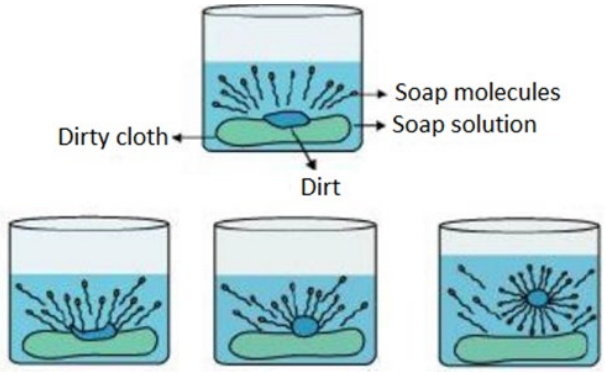
Saturated carbon compounds like alkane do not undergo such reactions and hence, are not able to decolorize the bromine water solution.

15. Explain the mechanism of the cleaning action of soaps.

Solution:

Cleansing action of soaps: The dirt present on clothes is organic (nonpolar) in nature and thus, insoluble in water. Therefore, it cannot be removed by only washing with water. A soap molecule is a long chain molecule with one end having an alkyl group, which is hydrophobic, and the other end has $SO_4^- Na^+$, which is hydrophilic.

When soap is dissolved in water, its hydrophobic end attaches themselves to the dirt and remove it from the cloth. Then, the molecules of soap arrange themselves in a structure called micelle, where the dirt gets trapped at the center of the cluster. These micelles remain suspended in the water and get washed away, leaving behind clean cloths.



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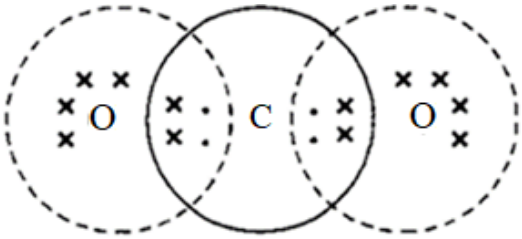
In-Text Questions

NCERT CBSE Solutions for Class 10 Science Chapter 4

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

Solution:

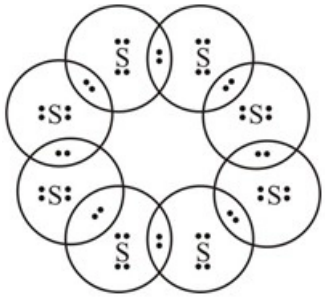
The electron dot structure of CO_2 is



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).

Solution:

The electron dot structure of a molecule of Sulphur which is made up of eight atoms of Sulphur is:



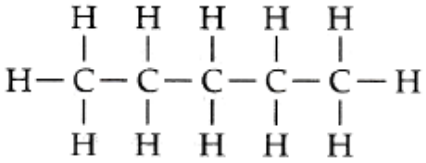
3. How many structural isomers can you draw for pentane?

Solution:

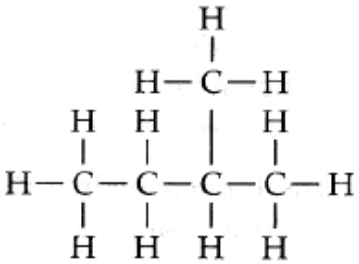
Three structural isomers can be drawn for pentane.

Pentane: C_5H_{12}

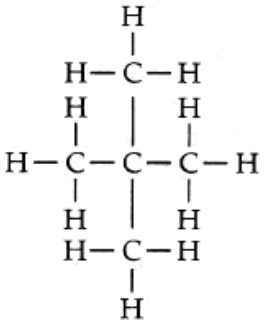
n -pentane



Iso-pentane



Neo-Pentane



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

Solution:

Carbon form large number of compounds due to the following properties:

(a) Catenation → Carbon shows the property of catenation which is the ability to form bonds with other carbon atoms forming long chains both branched and unbranched chains and rings.

(b) Tetravalency → Carbon has a valency of 4. So, it is capable of bonding with 4 other carbon atoms or atoms of other monovalent elements, giving rise to several compounds with specific properties depending on the elements present in the compound.

(c) Isomerism → Carbon compounds show the property of isomerism that is compounds having same molecular formula but different structural formula leading to differences in their properties.

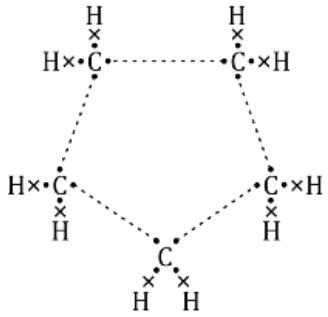
NCERT CBSE Solutions for Class 10 Science Chapter 4

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

Solution:

The formula of cyclopentane is C_5H_{10}.

The electron dot structure is



4. Draw the structures for the following compounds.

(i) Ethanoic acid

(ii) Bromopentane*

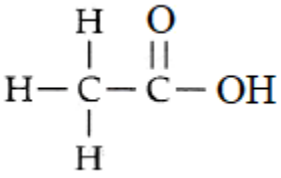
(iii) Butanone

(iv) Hexanal

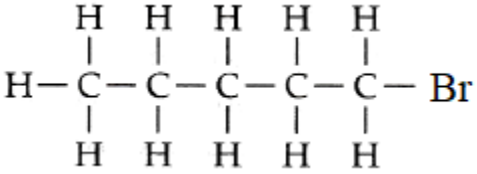
*Are structural isomers possible for Bromopentane?

Solution:

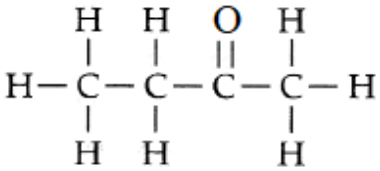
(i) Ethanoic acid CH_3COOH



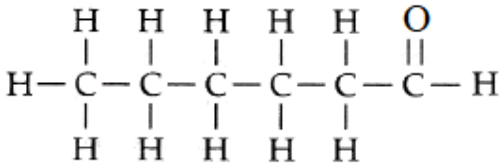
(ii) Bromopentane is $C_5H_{11}Br$



(iii) Butanone is $CH_3CH_2COCH_3$

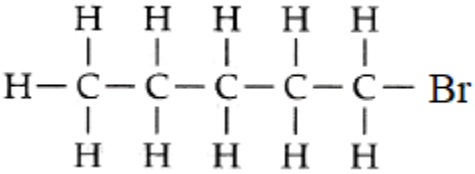


(iv) Hexanal [$C_5H_{11}CHO$]

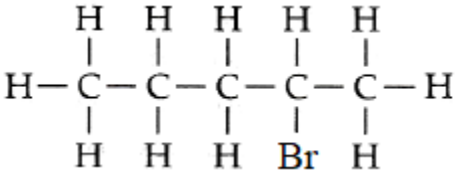


Structural isomers are possible for Bromopentane. They are:

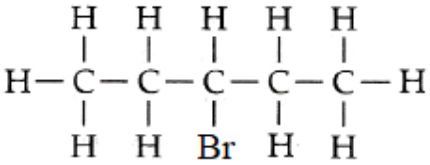
1-Bromopentane



2-Bromopentane



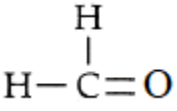
3-Bromopentane

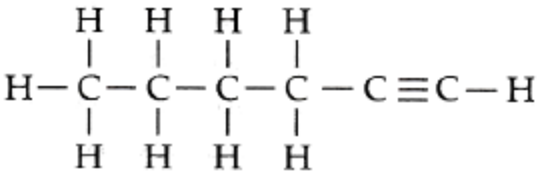


5. How would you name the following compounds?

(i) $CH_3—CH_2—Br$

(ii)





(iii)

Solution:

(i) Bromoethane

(ii) Methanal

(iii) Hex-1-yne

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

Solution:

Oxidation is adding of oxygen and removal of hydrogen. Conversion of ethanol to ethanoic acid is an oxidation reaction because oxygen is added to ethanol and hydrogen is removed from it to convert it to ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3-CH_2OH} \xrightarrow[(\text{or})\text{Acidified } K_2Cr_2O_7+\text{heat}]{\text{Alk.}KMnO_4+\text{heat}} \underset{\text{Ethanoic acid}}{CH_2COOH}$$

Here alkaline $KMnO_4$/acidified $K_2Cr_2O_7$ add oxygen to ethanol. So, they are the oxidizing agents for the above reaction.

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

Solution:

When pure oxygen is used ethyne burns completely producing large amount of heat and a blue flame. This heat generated from the reaction is sufficient for a metal to melt and hence welding can be done.

If air is used, incomplete combustion takes place giving a sooty flame and the heat produced is not enough to melt a metal. So, air cannot be used for welding.

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

Solution:

(a) Acid test: Take samples of alcohol and carboxylic acid in 2 test tubes and add sodium carbonate or sodium bicarbonate solution to each. The compound which will produce brisk effervescence of CO_2 gas will be acid.

(b) Alcohol test: Take small amount of ethanol and ethanoic acid in test tube A and B. Add 5% solution of alkaline potassium permanganate drop by drop to this solution and warm the rest tube.

The colour of potassium permanganate will disappear in test tube which contains alcohol.

11. What are oxidizing agents?

Solution:

The compounds which add oxygen to other substance are known as oxidizing agents. For example, alkaline potassium permanganate solution and acidified potassium dichromate, both can convert alcohol into carboxylic acid, i.e., ethanoic acid. They are examples of strong oxidizing agents.

$$\underset{\text{Ethanol}}{CH_3 - CH_2OH} \xrightarrow[\text{Acidified } K_2Cr_2O_7 + \text{heat}]{\text{Alk.}KMnO_4 + \text{heat}} \underset{\text{Ethanoic acid}}{CH_2COOH} + H_2O$$

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

Solution:

Detergent forms lather in both hard and soft water. So, it cannot be used to check hardness of water.

13. 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?

Solution:

Molecules of soap form micelles with dirt, such as grease. These micelles remain suspended as colloid. To remove dirt in the form of micelles from clothes, agitation is necessary to clean the clothes.

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