Carbon And Its Compounds

Multiple Choice Questions

Question 1.
Carbon exists in the atmosphere in the form of
A. carbon monoxide only

B. carbon monoxide in traces and carbon dioxide

C. carbon dioxide only

D. coal

Answer:
Carbon exists in the atmosphere in the form of Carbon dioxide in air (0.03 % only). Carbon also occurs in the form of minerals such as carbonates, fossil fuels and other organic compounds. Carbon monoxide is produced by the incomplete combustion of carbon due to limited supply of oxygen. It is pollutant that is formed when hydrocarbons such as petrol and diesel are burnt. Carbon monoxide is short-lived and is oxidized into carbon dioxide.

Question 2.
A molecule of ammonia (NH_3) has
A. only single bonds

B. only double bonds

C. only triple bonds

D. two double bonds and one single bond

Answer:
A molecule of ammonia (NH_3) has only single bonds. Since the valency of nitrogen is 3, one atom of nitrogen combines with three atoms of hydrogen in a molecule of ammonia. An atom of nitrogen can form three covalent bonds.

Question 3.
Which of the following statements are usually correct for carbon compounds? These

(i) are good conductors of electricity

(ii) are poor conductors of electricity

(iii) have strong forces of attraction between their molecules

(iv) do not have strong forces of attraction between their molecules
A. (i) and (iii)

B. (ii) and (iii)

C. (i) and (iv)

D. (ii) and (iv)

Answer:
Carbon compounds are poor conductors of electricity because they form covalent bonds. In such bonds, there are no free electrons left as all are used in making the bond. Hence carbon compounds do not dissociate into ions and hence are poor conductors of electricity. Moreover, covalent bonds do not have strong forces of attraction. A covalent bond is also known as a molecular bond.

Question 4.
Buckminsterfullerene is an allotropic form of
A. Phosphorus

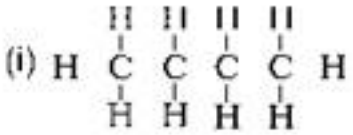
B. Sulphur

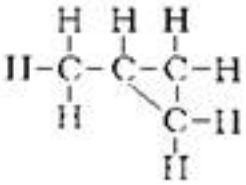
C. Carbon

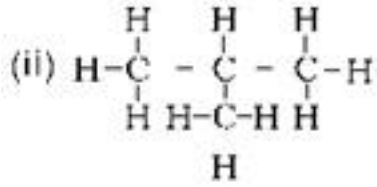
D. Tin

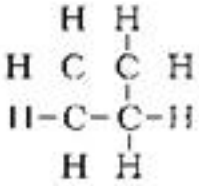
Answer:
Buckminsterfullerene is an allotropic form of carbon (C60). It was discovered in 1985. Sixty carbon atoms form the shape of a ball with a carbon atom at each corner of the 20 hexagons and 12 pentagons. Each carbon atom has three bonds.

Question 5.
Which of the following are correct structural isomers of butane?

(i) 

(iii) 

(ii) 

(iv) 

A. (i) and (iii)

B. (ii) and (iv)

C. (i) and (ii)

D. (iii) and (iv)

Answer:
The chemical formula of butane is C4H10. Structural formulae in other options (iii) and (iv) show only 8 hydrogen atoms. Isomers are molecules that contain the same number of atoms of the same elements but differ in structural arrangement and properties. Isomers have same chemical formula.

Question 6.

$$CH_3 - CH_2 - OH \xrightarrow{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3 - COOH$$

In the above given reaction, alkaline KMnO4 acts as
A. reducing agent

B. oxidising agent

C. catalyst

D. dehydrating agent

Answer:
In this reaction, alkaline KMnO4 acts as an oxidising agent. It adds oxygen to ethanol resulting in formation of ethanoic acid. An oxidizing agent adds oxygen or takes electrons from other substances.

Question 7.

Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of
A. Addition reaction

B. Substitution reaction

C. Displacement reaction

D. Oxidation reaction

Answer:
This reaction is an example of addition reaction (also known as hydrogenation reaction). In this reaction oil which is unsaturated hydrocarbon reacts with hydrogen in the presence of a catalyst (palladium or nickel) to form fats which are saturated hydrocarbon.

Question 8.
In which of the following compounds, — OH is the functional group?
A. Butanone

B. Butanol

C. Butanoic acid

D. Butanal

Answer:
The alcohols are organic compounds. They all contain the functional group –OH. This group possess the properties of alcohols. The names of alcohols end with '-ol' – e.g., ethanol, butanol.

Question 9.
The soap molecule has a
A. hydrophilic head and a hydrophobic tail

B. hydrophobic head and a hydrophilic tail

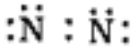
C. hydrophobic head and a hydrophobic tail

D. hydrophilic head and a hydrophilic tail

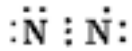
Answer:
The soap molecule has a hydrophilic head and a hydrophobic tail. When soap is mixed into the water, the soap molecules arrange themselves into tiny clusters called 'micelles'. The hydrophilic parts of the soap (water-loving) molecules point outwards, forming the

outer surface of the micelle. The hydrophobic parts (oil-loving) group together on the inner side. Micelles can trap fats in the center and helps to get rid of oil and dirt.

Question 10.
Which of the following is the correct representation of electron dot structure of nitrogen?

A. 

B. 

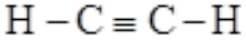
C. 

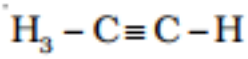
D. 

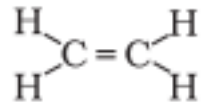
Answer:
An electron dot structure represents the valence electrons as dots placed around the chemical symbol. Electrons are placed up to two on each side of the symbol for a maximum of eight, which is the number of electrons in a filled s and p shell.

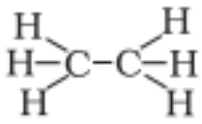
Nitrogen has 5 valence electrons. When we draw the Lewis structure for Nitrogen we draw 5 ‘dots’ or valence electrons around the element symbol (N).

Question 11.
Structural formula of ethyne is

A. 

B. 

C. 

D. 

Answer:
The chemical formula of Ethyne is C2H2, the structure of which is shown in option ‘a’.

Question 12.
Identify the unsaturated compounds from the following:

(i) Propane

(ii) Propene

(iii) Propyne

(iv) Chloropropane
A. (i) and (ii)

B. (ii) and (iv)

C. (iii) and (iv)

D. (ii) and (iii)

Answer:
Alkanes such as propane are saturated hydrocarbons. An unsaturated compound contains carbon-carbon double bonds or triple bonds, such as those found in alkenes (propene) or alkynes (propyne), respectively.

Question 13.
Chlorine reacts with saturated hydrocarbons at room temperature in the
A. absence of sunlight

B. presence of sunlight

C. presence of water

D. presence of hydrochloric acid

Answer:
Saturated hydrocarbons reacts with chlorine at room temperature in the presence of sunlight to form alkyl chloride by displacement reaction.

Question 14.
In the soap micelles
A. the ionic end of soap is on the surface of the cluster while the carbon chain is in the interior of the cluster.

B. ionic end of soap is in the interior of the cluster and the carbon chain is out of the cluster.

C. both ionic end and carbon chain are in the interior of the cluster

D. both ionic end and carbon chain are on the exterior of the cluster

Answer:
The soap molecule has a hydrophilic head and a hydrophobic tail. When soap is mixed into the water, the soap molecules arrange themselves into tiny clusters called 'micelles'. The hydrophilic parts of the soap (water-loving) molecules point outwards, forming the outer surface of the micelle. The hydrophobic parts (oil-loving) group together on the inner side. Micelles can trap fats in the center and helps to get rid of oil and dirt.

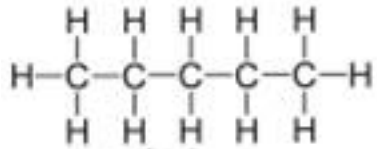
Question 15.
Pentane has the molecular formula C5H12. It has
A. 5 covalent bonds

B. 12 covalent bonds

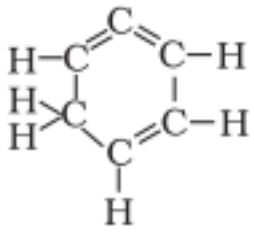
C. 16 covalent bonds

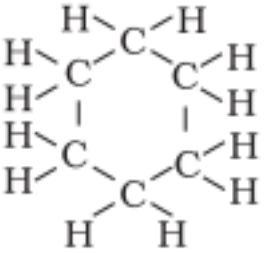
D. 17 covalent bonds

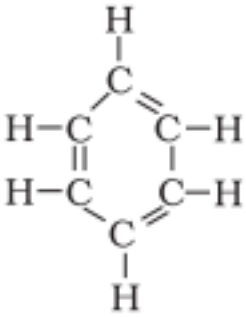
Answer:
Pentane has 16 covalent bonds. The structural diagram is as follows:

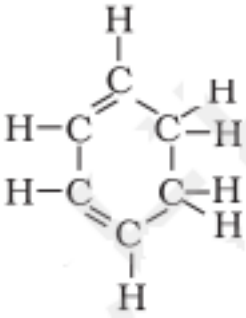

Pentane

Question 16.
Structural formula of benzene is

A. 

B. 

C. 

D. 

Answer:
The chemical formula of benzene is C6H6.

The benzene ring consists of six carbon atoms bonded in a hexagon ring. Each carbon is bonded to one hydrogen. There are three alternating double bonds between carbon atoms. This reveals that each carbon is bonded to 3 others.

Question 17.
Ethanol reacts with sodium and forms two products. These are
A. sodium ethanoate and hydrogen

B. sodium ethanoate and oxygen

C. sodium ethoxide and hydrogen

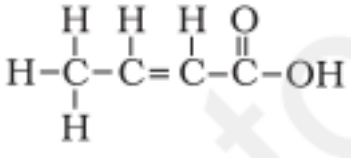
D. sodium ethoxide and oxygen

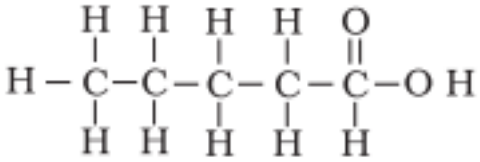
Answer:
When a small piece of sodium reacts with ethanol, a colourless solution of sodium ethoxide, CH3CH2ONa is obtained. It also gives off bubbles of hydrogen gas. Sodium ethoxide is known as an alkoxide.

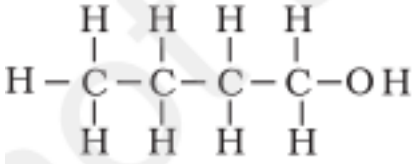
This following equation shows this reaction:

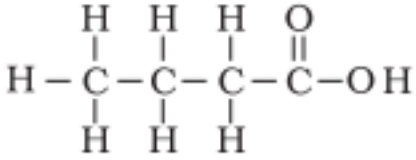
$2CH3CH2OH + 2Na \rightarrow 2CH3CH2ONa + H_2$

Question 18.
The correct structural formula of butanoic acid is

A. 

B. 

C. 

D. 

Answer:
Butanoic acid has the structural formula: C3H7COOH ($CH_3CH_2CH_2$-COOH).

Question 19.
Vinegar is a solution of
A. 50% – 60% acetic acid in alcohol

B. 5% – 8% acetic acid in alcohol

C. 5% – 8% acetic acid in water

D. 50% – 60% acetic acid in water

Answer:
Vinegar is a solution of 5% - 8% acetic acid in water. Acetic acid is the solute and water is the solvent.

Question 20.
Mineral acids are stronger acids than carboxylic acids because

(i) mineral acids are completely ionised

(ii) carboxylic acids are completely ionised

(iii) mineral acids are partially ionised

(iv) carboxylic acids are partially ionised
A. (i) and (iv)

B. (ii) and (iii)

C. (i) and (ii)

D. (iii) and (iv)

Answer:
Acids ionize in a solution. Strength of an acid is determined by the ability to furnish H+ions in a solution. A strong acid such as mineral acids dissociate completely to furnish H+ions whereas weaker acids such as carboxylic acids do not dissociate completely to furnish H+ions. Hence, mineral acids are more acidic than carboxylic acids.

Question 21.
Carbon forms four covalent bonds by sharing its four valence electrons with four univalent atoms, e.g. hydrogen. After the formation of four bonds, carbon attains the electronic configuration of
A. helium

B. neon

C. argon

D. krypton

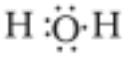
Answer:

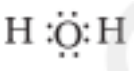
After the formation of four bonds, carbon attains the electronic configuration of neon, the nearest noble gas or inert gas.

Electronic configuration of carbon (C) = 2, 4. When it reacts with hydrogen, it forms methane (CH4). Carbon forms four covalent bonds by sharing its four valence electrons. Now, electronic configuration of C in CH4 = 2, 8. Therefore, after the formation of four bonds, carbon attains the electronic configuration of neon with the atomic number 10.

Question 22.
The correct electron dot structure of a water molecule is

A. 

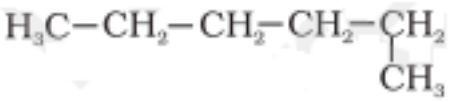
B. 

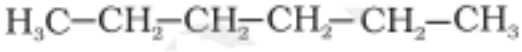
C. 

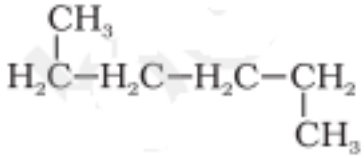
D. 

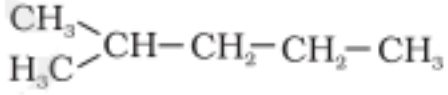
Answer:
Oxygen (O) has 6 valence electrons and hydrogen (H) has 1. All the 8 electrons must be arranged in pairs so that oxygen completes the octet structure (8 electrons in its valence cell). Each hydrogen has now 2 electrons in its valence shell.

Question 23.
Which of the following is not a straight chain hydrocarbon?

A. 

B. 

C. 

D. 

Answer:
A straight chain hydrocarbon is one that is made from carbon atoms that are joined to not more than two other carbon atoms.

A branched chain hydrocarbon is one that is made from carbon atoms where at least one carbon atom is joined to more than two other carbon atoms.

Question 24.
Which among the following are unsaturated hydrocarbons?

(i) $H_3C - CH_2 - CH_2 - CH_3$

(ii) $H_3C-C\equiv C-CH_3$

(iii) $H_3C-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

(iv) $H_3C-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

A. (i) and (iii)

B. (ii) and (iii)

C. (ii) and (iv)

D. (iii) and (iv)

Answer:
In these options, carbon atoms show double bond and triple bonds; hence these are unsaturated hydrocarbons.

Unsaturated hydrocarbons are hydrocarbons that form double or triple covalent bonds with other carbon atoms. Those hydrocarbons that have at least one carbon-to-carbon double bond are called alkenes. Those hydrocarbons with at least one carbon-to-carbon triple bond are called alkynes.

Question 25.
Which of the following does not belong to the same homologous series?
A. CH4

B. C2H6

C. C3H8

D. C4H8

Answer:
follows the general formula C*n*H*2n*, whereas other options follow the general formula C*n*H*2n+2*.

A homologous series is a series of carbon compounds that differ in the number of carbon atoms they have but possess the same functional group. Methane, ethane, propane, butane are part of alkane homologous series. The homologous series of a class of alcohols has the hydroxyl functional group.

Question 26.
The name of the compound CH3 — CH2 — CHO is
A. Propanal

B. Propanone

C. Ethanol

D. Ethanal

Answer:
The functional group – CHO is used with the compounds ending with suffix 'al'.

Propanal (also known as propionaldehyde) is an organic compound with the formula CH3CH2CHO. It is a saturated 3-carbon aldehyde. It is also a structural isomer of acetone. It is colourless liquid with a fruity smell.

Question 27.
The heteroatoms present in CH3 — CH2 — O — CH2 — CH2Cl are

(i) oxygen

(ii) carbon

(iii) hydrogen

(iv) chlorine
A. (i) and (ii)

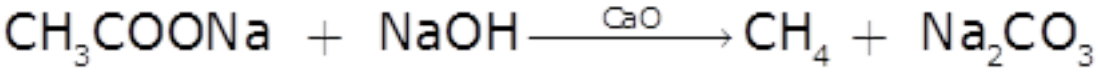
B. (ii) and (iii)

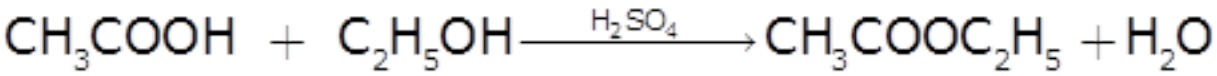
C. (iii) and (iv)

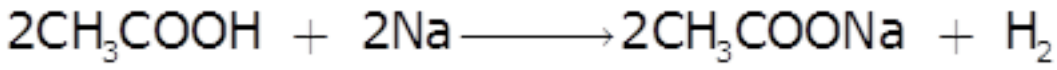
D. (i) and (iv)

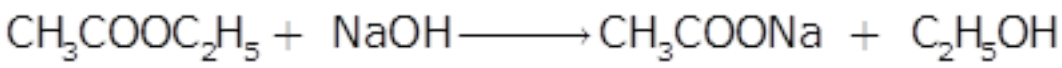
Answer:
Oxygen and chlorine are heteroatoms.
A heteroatom is any atom other than carbon or hydrogen in a molecular structure.

Question 28.
Which of the following represents saponification reaction?

A. 

B. 

C. 

D. 

Answer:
Soaps are made by the process of saponification. Soaps are sodium or potassium salts of long chain fatty acids. When triglycerides in fats react with aqueous NaOH or KOH, they are converted into soap and glycerol. This is called saponification or alkaline hydrolysis of esters.

Question 29.
The first member of alkyne homologous series is
A. ethyne

B. ethene

C. propyne

D. methane

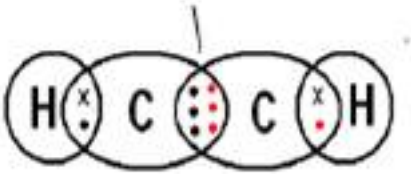
Answer:
Ethyne (C2H2) is the first member of alkyne homologous series.

Short Answer Questions

Question 1.
Draw the electron dot structure of ethyne and also draw its structural formula.

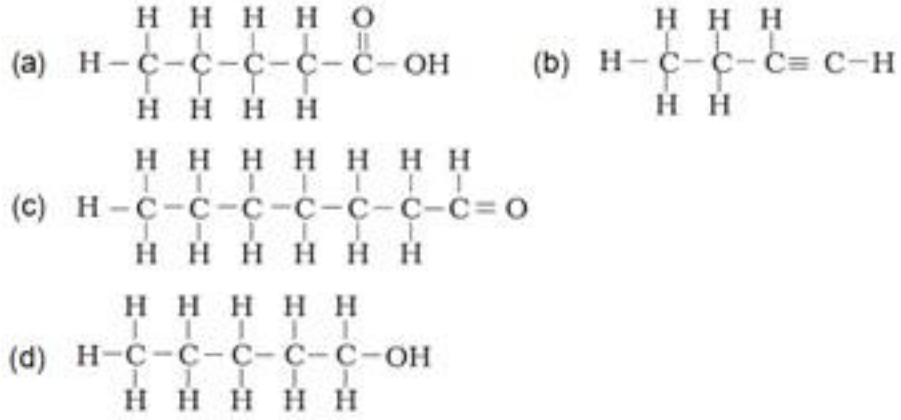
Answer:

Sharing of three pair of electrons

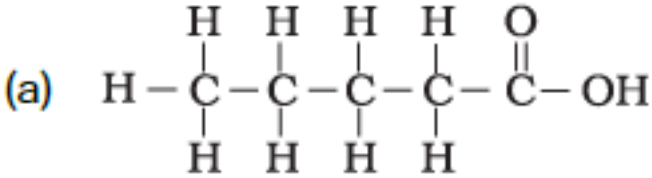


Ethyne (also known as acetylene) is the simplest alkyne. Its molecular formula is C2H2. The structural formula for ethyne is

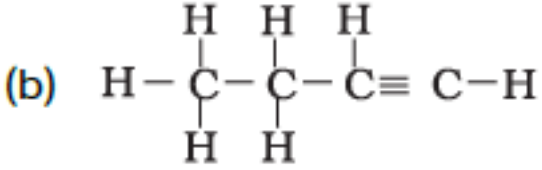
Question 2.
Write the names of the following compounds.



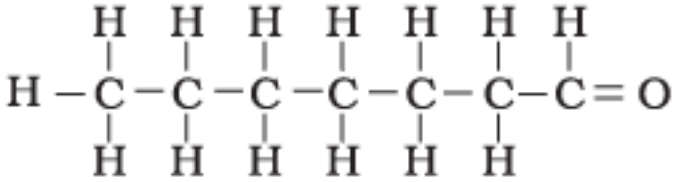
Answer:



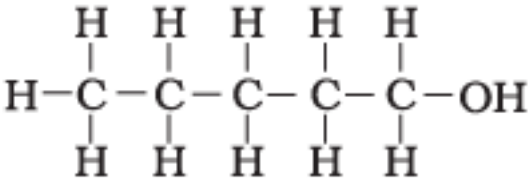
(a) Pentanoic acid



(b) Butyne

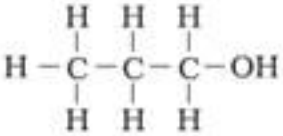
(c) 

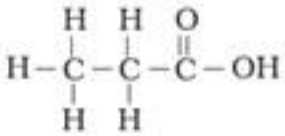
(c) Heptanal

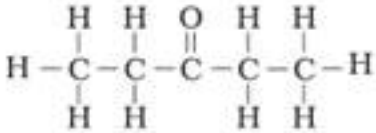
(d) 

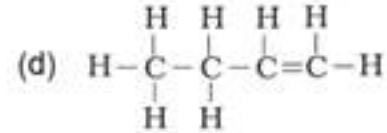
(d) Pentanol

Question 3.
Identify and name the functional groups present in the following compounds.

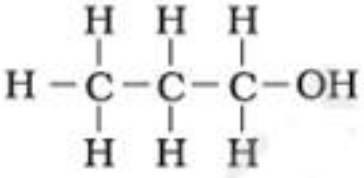
(a) 

(b) 

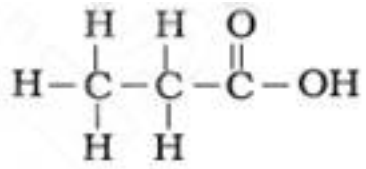
(c) 

(d) 

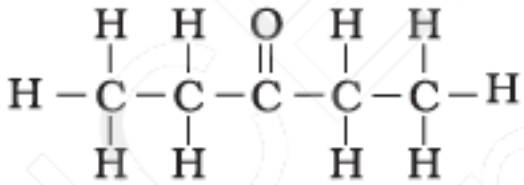
Answer:

(a) 

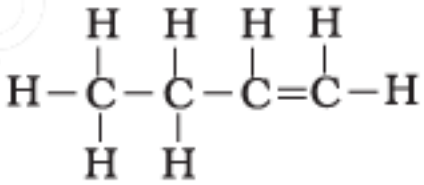
(a) Propanol (C3H7OH). It is commonly represented by the molecule propan-1-ol, a primary alcohol. It has –OH functional group.

(b) 

(b) Carboxylic acid. It is an organic compound that contains a carboxyl group [C(=O)OH]. The general formula of a carboxylic acid is R–COOH. It has –COOH functional group.

(c) 

(c) Ketone. It is an organic compound with the structure RC(=O)R'. Here R and R' can be a carbon-containing compounds. Ketones and aldehydes are simple compounds that contain a carbon–oxygen double bond (carbonyl group). It has carbon–oxygen double bond functional group.

(d) 

(d) Alkene. These are hydrocarbons that contain a carbon–carbon double bond. The number of hydrogen atoms in an alkene is just double the number of carbon atoms. For example, the number of hydrogen atoms in ethane (C2H4) is 4 and that of carbon is 2. In propene (C3H6), the number of hydrogen atoms is 6 and that of carbon is 3. It carbon-to-carbon double bond functional group.

Question 4.
A compound X is formed by the reaction of a carboxylic acid C2H4O2 and an alcohol in presence of a few drops of H2SO4. The alcohol on oxidation with alkaline KMnO4 followed by acidification gives the same carboxylic acid as used in this reaction. Give the names and structures of (a) carboxylic acid, (b) alcohol and (c) the compound X. Also write the reaction.

Answer:
(a) The name of carboxylic acid is ethanoic acid (CH3COOH).

(b) The name of alcohol is ethyl alcohol (C_2H_5OH).

(c) Compound X is ester ($CH_3\text{-}COOC_2H_5$).

Carboxylic acid with chemical formula ($C_2H_4O_2$) is Acetic acid ($CH_3\text{-}COOH$):
Ethyl alcohol on oxidation forms acetic acid.
$C_2H_5OH + KMnO_4 \rightarrow CH_3\text{-}COOH$
Carboxylic acids reacts with alcohols to forms ester.
$CH_3\text{-}COOH + C_2H_5OH \rightarrow CH_3\text{-}COOC_2H_5$ (Ethyl actetate)
Therefore, X = $CH_3\text{-}COOC_2H_5$

Question 5.
Why detergents are better cleansing agents than soaps? Explain.

Answer:
Soaps work better and effectively in soft water and not in hard water. This happens because soap forms precipitate (or scum) after reacting with magnesium and calcium ions present in hard water. Detergents work good in soft water as well as hard water because they do not form precipitate (or scum) even in hard water as calcium and magnesium salts are soluble in water. Hence, detergents form more lather and clean better than soaps.

Question 6.
Name the functional groups present in the following compounds:

(a) $CH_3CO\ CH_2CH_2CH_2CH_3$

(b) $CH_3CH_2CH_2\ COOH$

(c) $CH_3CH_2CH_2CH_2CHO$

(d) CH_3CH_2OH

Answer:
(a) $CH_3COCH_2CH_2CH_2CH_3$ (Ketone); Functional group: carbonyl, C=O.

(b) $CH_3CH_2CH_2COOH$ (Carboxylic acid); Functional group: carbonyl –C=O) + the hydroxyl –OH) = carboxyl.

(c) $CH_3CH_2CH_2CH_2CHO$ (Aldehyde); Functional group: carbonyl, –CHO. (i.e., an oxygen atom is attached to a carbon atom by a double covalent bond and a hydrogen atom is attached to the carbon atom)

(d) CH_3CH_2OH (Alcohol); Functional group: hydroxyl functional group (–OH)

Question 7.
How is ethene prepared from ethanol? Give the reaction involved in it.

Answer:
When ethanol is heated with excess of concentrated sulphuric acid (at 443 K); it produces ethene. This can be shown by following equation.

CH_3CH_2OH + hot conc. H_2SO_4 (at 443 K) → $H_2C = CH_2 + H_2O$

Concentrated phosphoric (V) acid, H_3PO_4, can be used instead of concentrated sulphuric acid.

Hydrolysis of ethanol takes place in this reaction.

Question 8.
Intake of small quantity of methanol can be lethal. Comment.

Answer:
If methanol is taken in large quantities, it gets converted into methanal or formaldehyde. This substance coagulates the cells of the body and blocks the optic nerve thus causing blindness. It is toxic and cancer-causing too. It is naturally present in small quantities in fruits and in human body.

Question 9.
A gas is evolved when ethanol reacts with sodium. Name the gas evolved and also write the balanced chemical equation of the reaction involved.

Answer:
When ethanol reacts with sodium, hydrogen gas (H_2) is evolved.

This reaction can be shown by following equation.

$2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2ONa + H_2$

This is an oxidation-reduction reaction. Na is oxidized, and H is reduced.

Question 10.
Ethene is formed when ethanol at 443 K is heated with excess of concentrated sulphuric acid. What is the role of sulphuric acid in this reaction? Write the balanced chemical equation of this reaction.

Answer:
In this reaction, sulphuric acid is working as a dehydrating agent.

Sulphuric acid has a property to attract water. It removes water from other compounds without dissolving in it. Thus it is considered a good drying agent.

The chemical equation of this reaction is as follows:

$CH_3CH_2OH + \text{hot conc. } H_2SO_4 \text{ (at 443 K)} \rightarrow H_2C = CH_2 + H_2$

Question 11.
Carbon, Group (14) element in the Periodic Table, is known to form compounds with many elements. Write an example of a compound formed with

(a) chlorine (Group 17 of periodic table)

(b) oxygen (Group 16 of periodic table)

Answer:
(a) Carbon forms carbon tetrachloride (CCl_4) with chlorine. Carbon tetrachloride is used as a solvent for oils and fats. It is also used as a refrigerant.

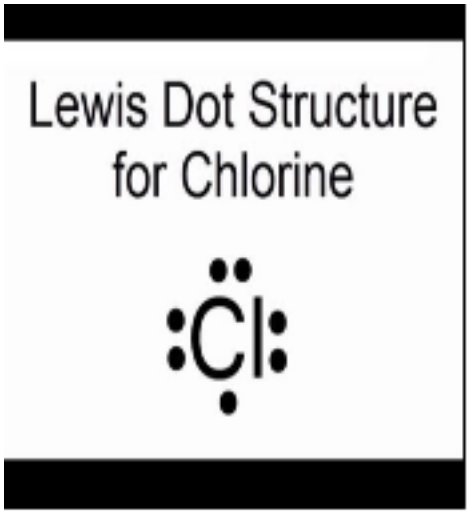
(b) Carbon forms carbon dioxide (CO_2) with oxygen. Solid carbon dioxide (i.e., dry ice) is used in large-scale refrigeration. It is also used in fire extinguishers.

Question 12.
In electron dot structure, the valence shell electrons are represented by crosses or dots.

(a) The atomic number of chlorine is 17. Write its electronic configuration?

(b) Draw the electron dot structure of chlorine molecule.

Answer:
(a) K, L, M – 2, 8, 7



Question 13.
Catenation is the ability of an atom to form bonds with other atoms of the same element. It is exhibited by both carbon and silicon. Compare the ability of catenation of the two elements. Give reasons.

Answer:
Both carbon and silicon show catenation. Carbon shows much more catenation than silicon or any other element as it is smaller in size. This feature helps to make strong C—C bonds whereas the Si—Si bonds are comparatively weaker as it is larger in size. This is the reason why long chain compounds of silicon are not as stable as those of carbon.

Question 14.
Unsaturated hydrocarbons contain multiple bonds between the two C atoms and show addition reactions. Give the test to distinguish ethane from ethene.

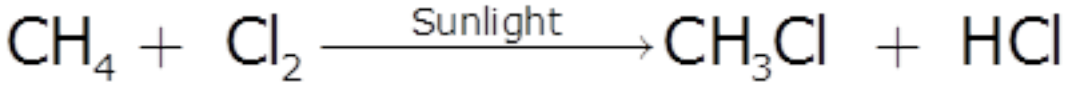
Answer:
To distinguish between saturated and unsaturated hydrocarbons, combustion test should be performed. A saturated hydrocarbon undergoes complete combustion and burns with blue flame. Also, it does not leave any residue behind after burning. On the contrary, a unsaturated hydrocarbon undergoes incomplete combustion and burns with yellow flame. Also, it leaves some residue behind after burning. Ethane is a saturated hydrocarbon. Thus, burns with a blue flame and does not leave residue behind. Ethene is an unsaturated hydrocarbon. Thus burns with a yellow flame and leaves some residue behind.

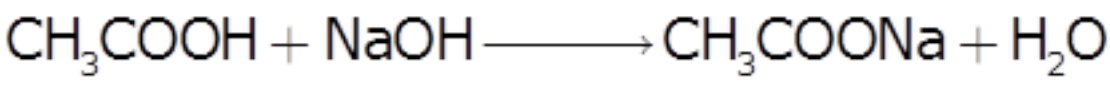
Question 15.
Match the reactions given in Column (A) with the names given in column (B).

Column (A)

(a) 

(b) 

(c) 

(d) 

Column (B)

(i) Addition reaction

(ii) Substitution reaction

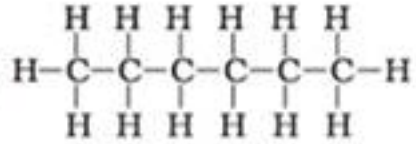
(iii) Neutralization reaction

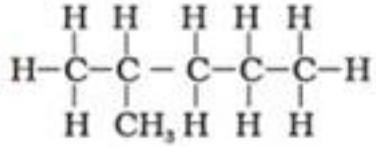
(iv) Esterification reaction

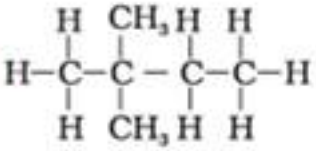
Answer:
(a) → (iv), (b) → (i), (c) → (ii), (d) → (iii)

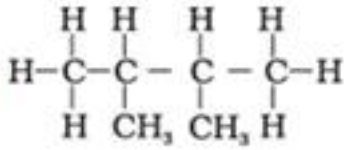
Question 16.
Write the structural formulae of all the isomers of hexane.

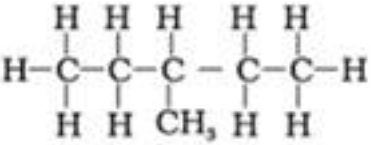
Answer:
There are 5 isomers of hexane. They are hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane, and 2,3-dimethylbutane. They are known as constitutional isomers because they each contain exactly the same number and type of atoms. In this case, six carbons and 14 hydrogens and no other atoms.

(a) 

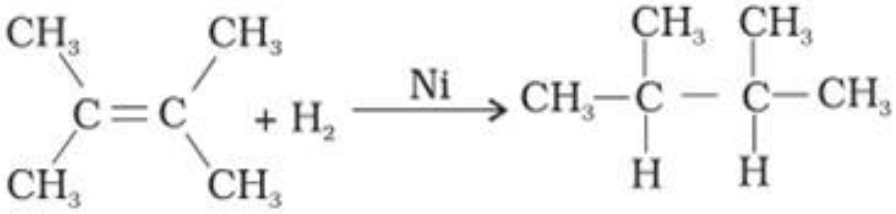
(b) 

(c) 

(d) 

(e) 

Question 17.
What is the role of metal or reagents written on arrows in the given chemical reactions?

(a) 

(b) $CH_3COOH + CH_3CH_2OH \xrightarrow{\text{Conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$

(c) $CH_3CH_2OH \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} CH_3COOH$

Answer:
A catalyst is a substance or material that will change the rate of reaction without it being consumed by the reaction.

(a) Nickel is working as catalyst. Ethene molecules are adsorbed on the surface of the nickel.

(b) Sulphuric acid is working as catalyst

(c) Potassium permanganate is working as oxidising agent that removes one or more electrons from another atom.

Long Answer Questions

Question 1.
A salt X is formed and a gas is evolved when ethanoic acid reacts with sodium hydrogen carbonate. Name the salt X and the gas evolved. Describe an activity and draw the diagram of the apparatus to prove that the evolved gas is the one which you have named. Also, write chemical equation of the reaction involved.

Answer:
Salt X is sodium ethanoate and the evolved gas is carbon dioxide.

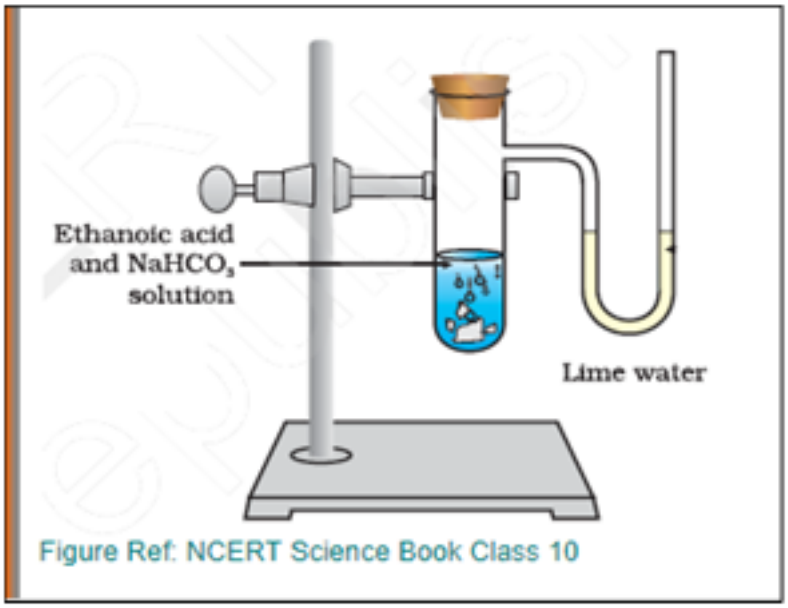


Figure Ref: NCERT Science Book Class 10

Procedure: Take a test tube and a bent tube. Take ethanoic acid or acetic acid (HC2H3O2) and sodium hydrogen carbonate or sodium bicarbonate (NaHCO3) solution in the test tube. Insert the bent tube in the cork and fit the cork at the mouth of the test tube. Fill lime water in the bent tube so that lime water is in the 'U' portion of this tube.

After some time, it is observed that the lime water turns milky. This confirms that the evolved gas is carbon dioxide (CO_2). Carbon dioxide always turns lime water milky.

This reaction can be shown by following equation.

$NaHCO_3 + HC_2H_3O_2 \rightarrow NaC_2H_3O_2 + H_2O + CO_2$

Question 2.
What are hydrocarbons? Give examples.

Answer:
Organic compounds that are made up of carbon and hydrogen atoms are called hydrocarbons. Some common examples of hydrocarbons are methane and ethane.

Methane is the main component of natural gas. It is also released into the atmosphere by crude oil production and other industrial activities and biological processes. Small amounts of methane are also produced in our body.

All hydrocarbons are converted to carbon dioxide and water after a series of reactions.

Based on the number of bonds between carbon atoms, hydrocarbons are of different types.

1. Hydrocarbons that have single bond between two carbon atoms are called alkanes. These are the least reactive of all the hydrocarbons. Examples: methane, ethane
2. Hydrocarbons that have a double bond between two carbon atoms are called alkenes. These are more reactive than alkanes. Examples: ethane, propene
3. Hydrocarbons that have a triple bond between two carbon atoms are called alkynes. These are the most reactive. They are commonly called as acetylenes. Examples: ethyne, propyne

Question 3.
Give the structural differences between saturated and unsaturated hydrocarbons with two examples each.

Answer:
In saturated hydrocarbons, all hydrogen atoms and carbon atoms are bonded together with single bonds. Methane and ethane are examples of saturated hydrocarbons.

Unsaturated hydrocarbons have double or even triple bonds between the carbon atoms.

Ethene and ethyne are examples of unsaturated hydrocarbons.

To distinguish between saturated and unsaturated hydrocarbons, combustion test can be performed. A saturated hydrocarbon undergoes complete combustion and burns with blue flame. Also, it does not leave any residue behind after burning. On the contrary, a unsaturated hydrocarbon undergoes incomplete combustion and burns with yellow flame. Also, it leaves some residue behind after burning. Ethane is a saturated hydrocarbon. Thus, burns with a blue flame and does not leave residue behind. Ethene is an unsaturated hydrocarbon. Thus burns with a yellow flame and leaves some residue behind.

Question 4.
What is a functional group? Give examples of four different functional groups.

Answer:
An atom or group of atoms in an organic compound that defines the structure of a family of compounds and determines the properties of the family is called the functional group.

A functional group is responsible for the characteristic property or behavior of a class of compounds. For example, hydroxyl (–OH) group in alcohols.

Examples of functional groups are: Hydroxyl group (–OH), Aldehyde group (–CHO), Ketone group (–CO) and carboxylic group (–COOH).

Question 5.
Name the reaction which is commonly used in the conversion of vegetable oils to fats. Explain the reaction involved in detail.

Answer:
The reaction which is commonly used in the conversion of vegetable oils to fats is called hydrogenation reaction. During this reaction, hydrogen is added to unsaturated hydrocarbons. This is an addition reaction which takes place in the presence of catalyst such as palladium or nickel. Catalysts are compounds that increase the rate of a reaction without being used up during the process. When the hydrogen molecule reacts with an unsaturated hydrocarbon, double bond changes to a single bond. This can be shown by following equation.

A simple hydrogenation reaction can be represented as:

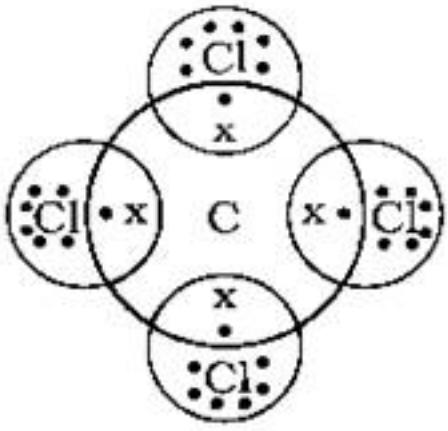
$H_2C=CH_2+H_2 \rightarrow CH_3CH_3 H_2C=CH_2+H_2 \rightarrow CH_3CH_3$

alkene + hydrogen = alkane

Vegetable oils are commonly called polyunsaturated because there are several double bonds in it. Vegetable oils may be converted from liquids to solids by the hydrogenation reaction. Hydrogenated fats and oils are common ingredients in many foods. They are used to extend the longevity of a food item and retain the food flavor for a longer time.

Question 6.
Write the formula and draw electron dot structure of carbon tetrachloride.

Answer:
Carbon tetrachloride: CCl_4.



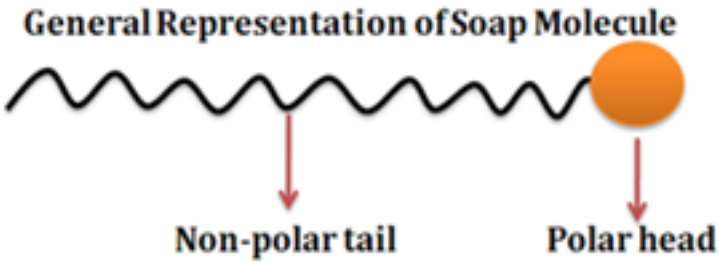
Carbon forms carbon tetrachloride (CCl_4) with chlorine. Carbon tetrachloride is used as a solvent for oils and fats. It is also used as a refrigerant.

Question 7.
What is saponification? Write the reaction involved in this process.

Answer:
Soaps are made by the process of saponification. Soaps are sodium or potassium salts of long chain fatty acids. When triglycerides in fats react with aqueous NaOH or KOH, they are converted into soap and glycerol. This is called saponification or alkaline hydrolysis of esters.

$CH_2COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$

The soap molecule has two parts: a polar group (-COO-Na+) and a non-polar group (R-hydrocarbon part). The polar group is called the head and the non-polar group is called the tail. Therefore, the soap molecule has a polar head and a non-polar hydrocarbon tail. The polar head is water loving in nature (hydrophilic) and the non-polar tail is water repelling (hydrophobic) in nature.



The saponification reaction is exothermic in nature.

Question 8.
Esters are sweet-smelling substances and are used in making perfumes. Suggest some activity and the reaction involved for the preparation of an ester with well labeled diagram.

Answer:
Esters are produced when carboxylic acids are heated with alcohols in the presence of an acid catalyst. The catalyst is usually concentrated sulphuric acid.

Activity:

1. Take a test tube and add ethanol (1 ml) and glacial acetic acid (1 ml) in it. Put a few drops of concentrated sulphuric acid in the test tube as well.

2. Now, heat the test tube in a water bath at about 60°C for about 15 minutes.

3. After heating, transfer the contents of the test tube into a beaker which is filled with about 50 ml water.

4. The product, that is obtained, smells sweet.

This is how esters are made.

Formation of esters can be shown by following equation:

$CH_3COOH + CH_3CH_2OH + \text{Conc. } H_2SO_4 \rightarrow CH_3COOCH_2CH_3 + H_2O$

Diagram:

Question 9.
A compound C (molecular formula, $C_2H_4O_2$) reacts with Na metal to form a compound R and evolves a gas which burns with a pop sound. Compound C on treatment with an alcohol A in presence of an acid forms a sweet smelling compound S (molecular formula, $C_3H_6O_2$). On addition of NaOH to C, it also gives R and water. S on treatment with NaOH solution gives back R and A. Identify C, R, A, S and write down the reactions involved.

Answer:
C is ethanoic acid or acetic acid (CH_3COOH).

R is sodium acetate or sodium ethanoate (CH_3COONa) and the gas evolved is hydrogen.

A can be methanol (CH_3OH) or ethanol (C_2H_5OH).

S is ester or methyl acetate (CH_3COOCH_3), an ester.

The reactions involved in this process are as follows:

1. $2CH_3COOH + 2Na \rightarrow 2CH_3COONa + H_2$

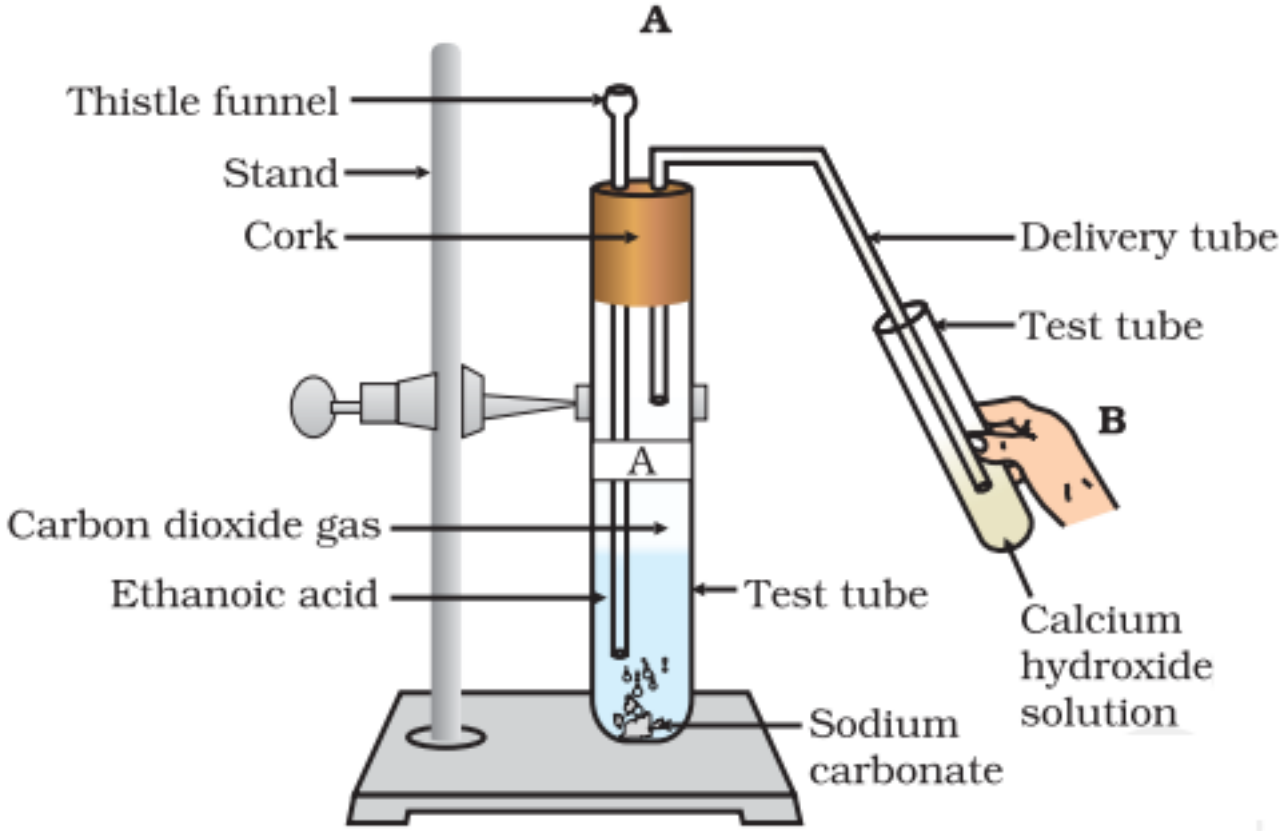
2. $CH_3COOH + CH_3OH + \text{Conc. } H_2SO_4 \rightarrow CH_3COOCH_3 + H_2O$

3. $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

4. $CH_3COOH + NaOH \rightarrow CH_3COONa + CH_3OH$

Question 10.
Look at figure given below and answer the following questions.
(a) What change would you observe in the calcium hydroxide solution taken in tube B?
(b) Write the reaction involved in test tubes A and B respectively.
(c) If ethanol is given instead of ethanoic acid, would you expect the same change?

(d) How can a solution of lime water be prepared in the laboratory?



Answer:
(a) Calcium hydroxide solution will turn milky.

(b) $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$ (Test tube A)

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

The white colour of the liquid disappears with excess CO_2.

$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_2)_2$

(c) Ethanol (C_2H_5OH) does not react with sodium carbonate (Na_2CO_3). Hence no similar reaction takes place.

(d) For preparing lime water in the laboratory, calcium oxide (quick lime) is dissolved in water and the mixture is allowed to settle. The supernatant liquid is then decanted lime water is obatined.

Question 11.
How would you bring about the following conversions? Name the process and write the reaction involved.

(a) ethanol to ethene.

(b) propanol to propanoic acid.

Write the reactions.

Answer:
(a) Ethanol is dehydrated in the presence of concentrated sulphuric acid to obtain ethene.

This can be shown by the following equation:

$CH_3CH_2OH + \text{conc. } H_2SO_4 \rightarrow CH_2=CH_2 + H_2O$

(b) Propanol is oxidised by an oxidizing agent potassium permanganate to obtain propanoic acid.

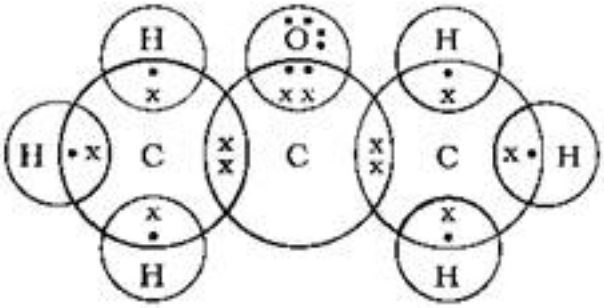
This can be shown by the following equation:

$CH_3CH_2CH_2OH + \text{alkaline } KMnO_4 \rightarrow CH_3CH_2OOH$

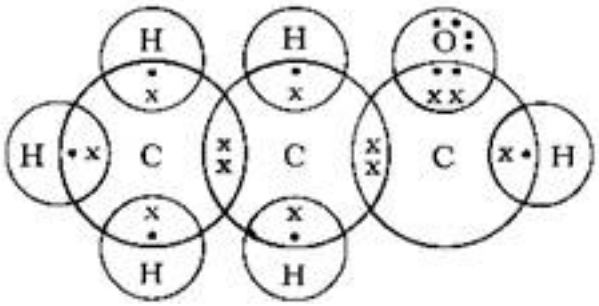
Question 12.
Draw the possible isomers of the compound with molecular formula C_3H_6O and also give their electron dot structure.

Answer:
Isomers are the molecules with same molecular formula but different structural formula.

Electron dot structure of propanone



Electron dot structure of propanol



Question 13.
Explain the given reactions with the examples
(a) Hydrogenation reaction
(b) Oxidation reaction
(c) Substitution reaction
(d) Saponification reaction
(e) Combustion reaction

Answer:
(a) Hydrogenation reaction: The reaction which is commonly used in the conversion of vegetable oils to fats is called hydrogenation reaction. During this reaction, hydrogen is added to unsaturated hydrocarbons. This is an addition reaction which takes place in the presence of catalyst such as palladium or nickel. Catalysts are compounds used to speed up the rate of a reaction without being eaten up during the process. When the hydrogen molecule reacts with an unsaturated hydrocarbon, double bond changes to a single bond. This can be shown by following equation.

A simple hydrogenation reaction can be represented as:

$H_2C=CH_2+H_2 \rightarrow CH_3CH_3 H_2C=CH_2+H_2 \rightarrow CH_3CH_3$

alkene + hydrogen = alkane

Vegetable oils are commonly called polyunsaturated because there are several double bonds in it. Vegetable oils may be converted from liquids to solids by the hydrogenation reaction. Hydrogenated fats and oils are common ingredients in many foods. They are used to extend the longevity of a food item and retain the food flavor for a longer time.

(b) Oxidation reaction: Oxidation is the loss of electrons during a reaction by a molecule, atom or ion. The opposite process is called reduction, which occurs when there is a gain of electrons during a reaction by a molecule, atom or ion. Metals such as sodium, magnesium, and iron are easily oxidized.

After oxidation, properties of an atom or compound change. For example, when an iron undergoes oxidation, it losses electrons. Unoxidized iron is a strong, while oxidized iron is a weak and brittle.

The following equation shows an oxidation reaction.$CH_3CH_2CH_2OH$ + alkaline $KMnO_4 \rightarrow$ CH_3CH_2OOH

(c) Substitution reaction: A substitution reaction is a reaction in which an atom or a group of atoms replaces other atom or atoms in reactants.

There are two types of substitution reactions: nucleophilic and electrophilic. In nucleophilic reactions, the new atom is electron-rich, while in electrophilic reactions, the new atom is electron-deficient.

CH_3Cl react with a hydroxy ion (OH^-) to produce CH_3OH and chlorine. This substitution reaction replaces the chlorine atom on the original molecule with the hydroxyl ion.

The following equation is an example of substitution reaction.$CH_4 + Cl_2$ + sunlight $\rightarrow$ $CH_3Cl + HCl$

(d) Saponification reaction: Soaps are made by the process of saponification. Soaps are sodium or potassium salts of long chain fatty acids. When triglycerides in fats react with aqueous NaOH or KOH, they are converted into soap and glycerol. This is called saponification or alkaline hydrolysis of esters.

$CH_2COOC_2H_5 + NaOH \rightarrow CH_3\ COONa + C_2H_5OH$

(e) Combustion reaction: Combustion reaction occurs when a hydrocarbon reacts with oxygen to produce carbon dioxide and water. It is usually accompanied by the production of heat and light. Combustion involves a reaction between any combustible substance and an oxidizing agent to form an oxidized product.

The following equation is an example of combustion.$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat and light

Question 14.
An organic compound A on heating with concentrated H_2SO_4 forms a compound B which on addition of one mole of hydrogen in presence of Ni forms a compound C. One mole of compound C on combustion forms 2 moles of CO_2 and 3 moles of H_2O. Identify the compounds A, B and C and write the chemical equations of the reactions involved.

Answer:
Compound A is ethanol (C_2H_5OH).

Compound B is ethane (C_2H_4).

Compound C is ethane (C_2H_6).

The following equations show the reactions involved in this process.

$C_2H_5OH + \text{conc. } H_2SO_4 \rightarrow C_2H_4 + H_2O$

$C_2H_4 + H_2 + Ni \rightarrow C_2H_6$

$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O + \text{Heat and light}$