CLASS 10TH CHEMISTRY WORKSHEET CHAPTER – ORGANIC CHEMISRTY

Intext Questions 1

Question 1

(a) What are organic compounds?

(b) What is vital force theory? Why was it discarded?

Answer

(a) Organic compounds are the compounds of carbon excluding oxides of carbon, metallic carbonates and related compounds like metal cyanides, metal carbides, etc.

(b) As organic compounds were obtained straight from nature and there was no known method of preparing them in the laboratory, hence it was believed that they were the products of some **vital force** of nature. This theory was known as vital force theory.

This theory was soon discarded when in 1828, Friedrich Wohler demonstrated that an organic chemical (urea) could be produced in the laboratory.

Question 2

(a) Name a few sources of organic compounds.

(b) Give the various applications of organic chemistry.

Answer

(a) Sources of organic compounds are:

1. Plants
2. Animals
3. Coal
4. Petroleum
5. Fermentation
6. Wood
7. Synthetic methods

(b) Organic chemistry is used in the manufacturing of soaps, shampoos, powders, and perfumes. The clothes we wear, the food we eat i.e., carbohydrates, proteins, fats, vitamins etc.,fuels we use, natural gas, petroleum products, medicines, explosives, dyes, insecticides,etc., are all organic compounds. There is hardly any walk of life where we do not use organic compounds.

Question 3

Organic chemistry plays a key role in all walks of life. Discuss

Answer

Organic chemistry is extremely useful to us in our daily life.

The soaps and shampoos we use while taking bath, the powders, perfumes, etc., we apply on the body, the clothes we wear, food we eat i.e., carbohydrates, proteins, fats, vitamins etc., fuels we use, natural gas, petroleum products, medicines, explosives, dyes, insecticides, etc., are all organic compounds. There is hardly any walk of life where we do not use organic compounds.

Question 4

Carbon shows some unique properties, name them.

Answer

Unique properties of carbon are :

1. Tetravalency of carbon
2. Catenation

Question 5

Explain the following:

(a) Tetravalency

(b) Catenation

Answer

(a) **Tetravalency** : Carbon has four valence electrons (At. no. of C = 6; Electronic Config. 2,4). Since it can neither lose nor gain electrons to attain octet, it forms covalent bonds by sharing it's four electrons with other atoms. This characteristics of the carbon atom , by virtue of which it forms four covalent bonds , is called the tetravalency of carbon.

(b) **Catenation** : The property of **self linking** of atoms of an element through covalent bonds in order to form straight chains, branched chains and cyclic chains of different sizes is known as **catenation**.

Question 6

Write any four properties of organic compounds that distinguish them from inorganic compounds.

Answer

Characteristics	Organic compounds	Inorganic compounds
Presence of carbon	Carbon is necessary element in every organic compound	Carbon is not an essential element in inorganic compound
Solubility in water	They generally do not dissolve in water.	They generally dissolve in water.
Solubility in organic solvents	They dissolve in organic solvents like alcohol, benzene and chloroform.	All inorganic compounds do not dissolve in organic solvents.
Melting and boiling point	They have low m.p. and b.p. and easily decompose on heating.	They have high m.p. and b.p. and usually do not decompose on heating.

Question 7

Why are organic compounds studied as a separate branch of chemistry?

Answer

The unique nature of carbon atom (catenation and tetravalency) gives rise to the formation of a large number of compounds. More than 5 million organic compounds are known today and thousand are added every year. Hence, it demands a new field of chemistry i.e., organic chemistry.

Question 8

What are hydrocarbons? Compare saturated and unsaturated hydrocarbons?

Answer

Hydrocarbons are compounds that are made up of only carbon and hydrogen atoms.

Saturated Hydrocarbons	Unsaturated Hydrocarbons
All the four valencies of each carbon atom are satisfied by forming single covalent bonds with carbon and with hydrogen atoms.	The valencies of at least two carbon atoms are not fully satisfied by the hydrogen atoms.
Carbon atoms are joined only by a single covalent bond.	Carbon atoms are joined by double covalent bonds >C=C< or triple covalent bonds -C≡C-
They are less reactive due to the non-availability of electrons in the single covalent bonds, and therefore they undergo substitution reaction.	They are more reactive due to the presence of electrons in the double or the triple bond, and therefore undergo addition reaction.

Question 9

Give reason for the existence of the large number of organic compounds.

Answer

Carbon shows unique properties of tetravalency and catenation. Due to this unique nature of carbon atoms, they form single, double and triple covalent bonds with other carbon atoms and a variety of other elements. Carbon atoms have

the ability to form stable bonds with other atoms resulting in the formation of long chains, branched structures, and cyclic compounds. These properties of carbon atom gives rise to the formation of a large number of compounds.

Question 10

Give at least one example in each case to show the structure of:

(a) Single bond compound

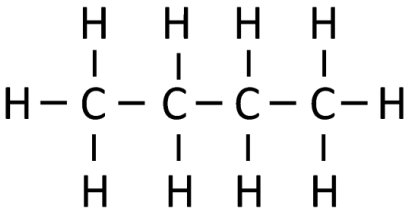
(b) Double bond compound

(c) Triple bond compound

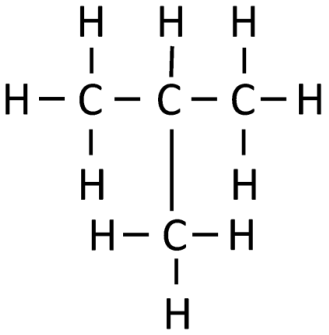
Answer

(a) Single bond compound : C_4H_{10} has two chain isomers

1. n-butane

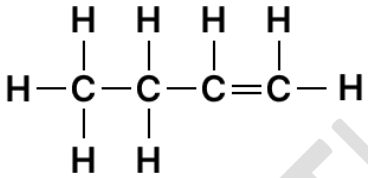


2. Isobutane

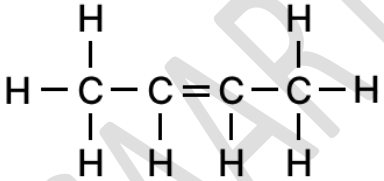


(b) Double bond compound : C_4H_8 has two position isomers

1. But-1-ene

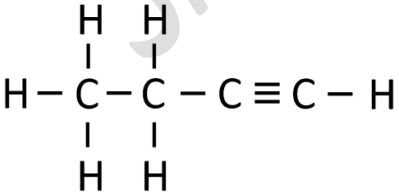


2. But-2-ene

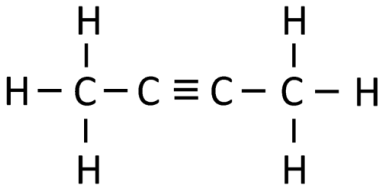


(c) Triple bond compound : C_4H_6 has two position isomers

1. But-1-yne



2. But-2-yne



Question 11

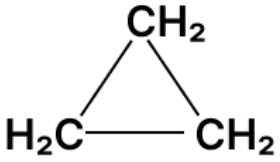
Name a compound of each type and draw the figure,

(a) Cyclic compound with single bond

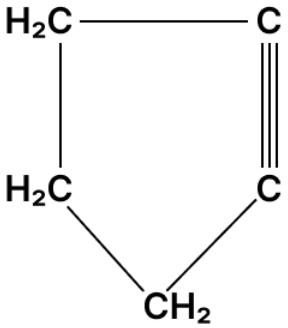
(b) Cyclic compound with triple bond

Answer

(a) Cyclopropane [C_3H_6]



(b) Cyclopentyne [C_5H_6]



Question 12

Give the name of one member of each of the following:

(a) saturated hydrocarbons

(b) unsaturated hydrocarbons

Answer

(a) Methane

(b) Ethene

Question 13

Define substitution and addition reactions. Give an example for each.

Answer

Substitution reactions — A reaction in which one atom of a molecule is replaced by another atom (or group of atoms) is called a substitution reaction.

e.g., $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Addition reactions — A reaction involving addition of atoms or molecules to the double or the triple bond of an unsaturated compound so as to yield a saturated product is known as addition reaction.

e.g., $C_2H_4 + Br_2 \longrightarrow C_2H_4Br_2$

Intext Questions 2

Question 1

Define a functional group and give the structural formula of the following functional groups:

(a) Ketone

(b) Alcohols

(c) Aldehydes

Answer

Functional group is defined as an atom or group of atoms joined in a specific manner which is responsible for the characteristic chemical properties of the organic compounds.
The structural formula of the functional groups are given below:
(a) $-C-O||$
(b) -OH
(c) -CH=O

Question 2

(a) What is a homologous series?
(b) What is the difference in the molecular formula of any two adjacent homologues:
1. in terms of molecular mass.
2. in terms of number and kind of atoms per molecule?

Answer

(a) A homologous series is a group of organic compounds having a similar structure and similar chemical properties in which the successive compounds differ by a CH_2 group.
(b) The difference in the molecular formula of two adjacent homologues:
1. In terms of molecular mass is 14 a.m.u.
2. In terms of number & kind of atoms per molecule is that each member of the series differs from the preceding one by the addition of CH_2 group.

Question 3

Write the name and formula of fourth member of the following homologous series:
(a) Alkyne
(b) Alcohol

Answer

(a) Butyne C_4H_6
(b) Butanol C_4H_9OH

Question 4

Which part of an organic compound determines
(i) Physical properties
(ii) Chemical properties

Answer

(i) Alkyl group
(ii) Functional group

Question 5

(a) What is an alkyl group?
(b) Give the names of any three alkyl radicals. How are they formed?

Answer

(a) An alkyl group of atoms is obtained by removing one atom of hydrogen from an alkane molecule.
(b) Three alkyl radicals are:
1. Methyl
2. Ethyl
3. Propyl

These are formed by losing one hydrogen atom
$CH_4 \longrightarrow CH_3 + H$
$C_2H_6 \longrightarrow C_2H_5 + H$
$C_3H_8 \longrightarrow C_3H_7 + H$

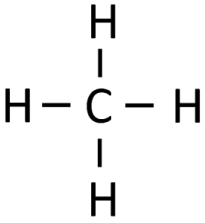
Question 6

Give the names and the structural formula of the first three members of the homologous series of alkanes.

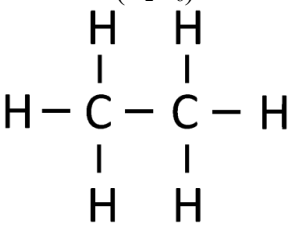
Answer

First three members of the homologous series of alkanes are :

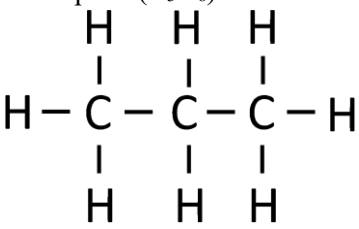
1. Methane (CH_4)



2. Ethane(C_2H_6)



3. Propane (C_3H_8)



Question 7

Name the alkyl radical and the functional group of the following organic compounds:

(a) CH_3OH

(b) C_2H_5OH

(c) C_3H_7CHO

(d) C_4H_9COOH

(e) CH_3COOH

(f) C_2H_5Br

Answer

(a) CH_3OH

Alkyl radical — Methyl ($-CH_3$)

Functional group — Alcohol (-OH)

(b) C_2H_5OH

Alkyl radical — Ethyl ($-C_2H_5$)

Functional group — Alcohol (-OH)

(c) C_3H_7CHO

Alkyl radical — Propyl ($-C_3H_7$)

Functional group — Aldehyde (-CHO)

(d) C_4H_9COOH

Alkyl radical — Butyl ($-C_4H_9$)

Functional group — carboxyl (-COOH)

(e) CH_3COOH

Alkyl radical — Methyl ($-CH_3$)

Functional group — carboxyl (-COOH)

(f) C_2H_5Br

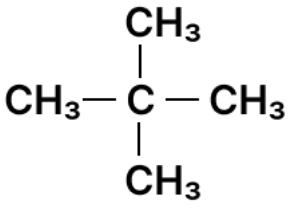
Alkyl radical — Ethyl ($-C_2H_5$)

Functional group — Bromine (-Br)

Exercise 12A

Question 1(a)

Write the IUPAC name of:

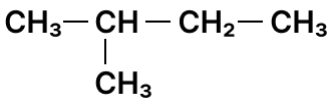


Answer

2,2-Dimethylpropane

Question 1(b)

Write the IUPAC name of:

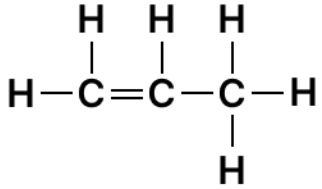


Answer

2-Methylbutane

Question 1(c)

Write the IUPAC name of:

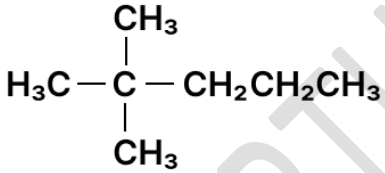


Answer

Prop-1-ene

Question 1(d)

Write the IUPAC name of:



Answer

2,2-Dimethylpentane

Question 1(e)

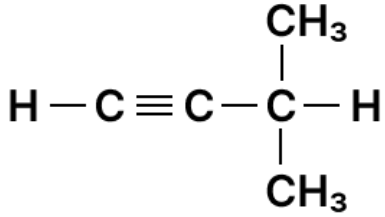
Write the IUPAC name of:

Answer

Pent-2-yne

Question 1(f)

Write the IUPAC name of:

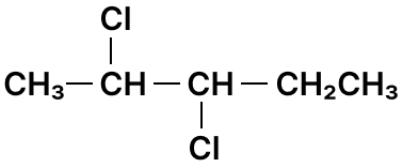


Answer

3-Methylbut-1-yne

Question 1(g)

Write the IUPAC name of:

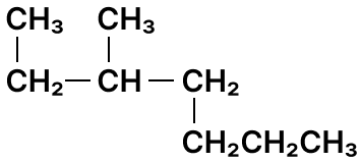


Answer

2,3-Dichloropentane

Question 1(h)

Write the IUPAC name of:

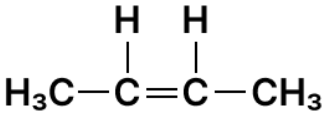


Answer

3-Methylheptane

Question 1(i)

Write the IUPAC name of:



Answer

But-2-ene

Question 1(j)

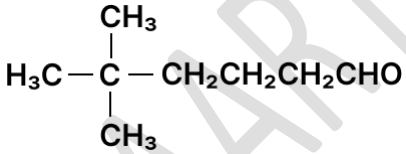
Write the IUPAC name of:

Answer

Hept-2-yne

Question 1(k)

Write the IUPAC name of:

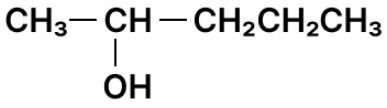


Answer

5,5-Dimethylhexanal

Question 1(l)

Write the IUPAC name of:

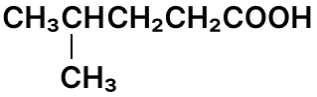


Answer

Pentan-2-ol

Question 1(m)

Write the IUPAC name of:

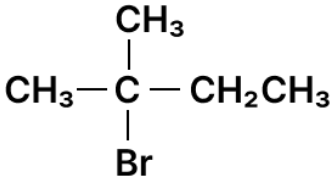


Answer

4-Methylpentanoic acid

Question 1(n)

Write the IUPAC name of:

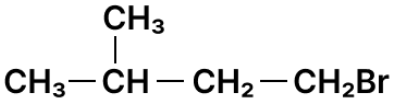


Answer

2-Bromo-2-methylbutane

Question 1(o)

Write the IUPAC name of:

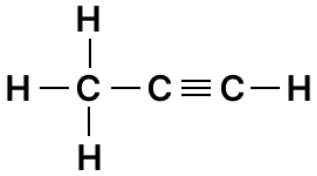


Answer

1-Bromo-3-methylbutane

Question 1(p)

Write the IUPAC name of:

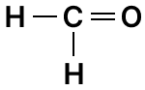


Answer

Prop-1-yne

Question 1(q)

Write the IUPAC name of:

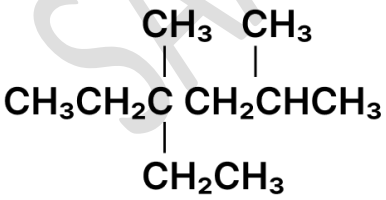


Answer

Methanal

Question 1(r)

Write the IUPAC name of:

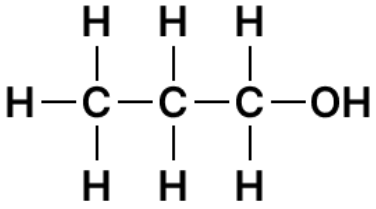


Answer

3-ethyl-3,5-dimethylhexane

Question 1(s)

Write the IUPAC name of:

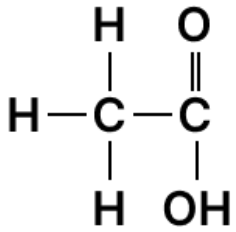


Answer

Propan-1-ol

Question 1(t)

Write the IUPAC name of:

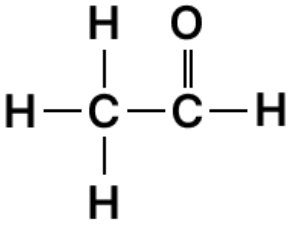


Answer

Ethanoic acid

Question 1(u)

Write the IUPAC name of:

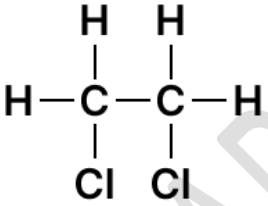


Answer

Ethanal

Question 1(v)

Write the IUPAC name of:



Answer

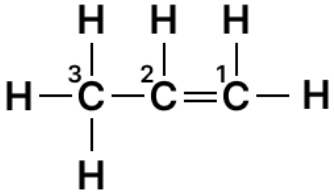
1,2-Dichloroethane

Question 2(a)

Write the structure of Prop-1-ene

Answer

Prop-1-ene

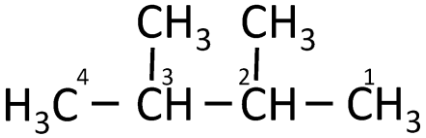


Question 2(b)

Write the structure of 2,3-dimethyl butane

Answer

2,3-dimethylbutane

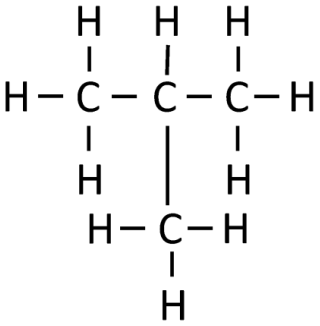


Question 2(c)

Write the structure of 2-methyl propane

Answer

2-methylpropane

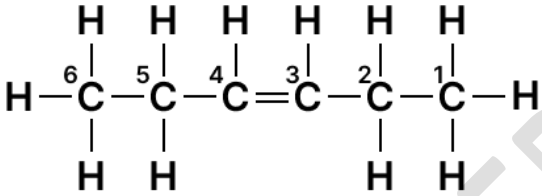


Question 2(d)

Write the structure of 3-hexene

Answer

3-hexene

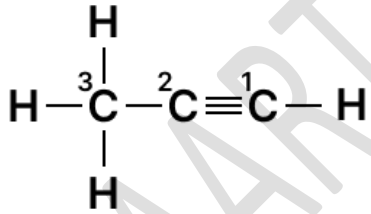


Question 2(e)

Write the structure of Prop-1-yne

Answer

Prop-1-yne

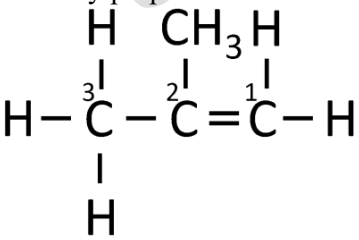


Question 2(f)

Write the structure of 2-methyl prop-1-ene.

Answer

2-methylprop-1-ene

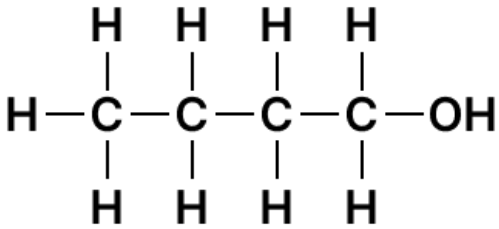


Question 2(g)

Draw the structure of Alcohol with molecular formula $C_4H_{10}O$

Answer

Alcohol with molecular formula $C_4H_{10}O$



Question 3(a)

Choose the correct answer:

C_5H_{11} is an

1. alkane
2. alkene
3. alkyne
4. alkyl group

Answer

(a) Alkyl group

Reason — It follows the formula C_nH_{2n+1}

Question 3(b)

Choose the correct answer:

A hydrocarbon of the general formula C_nH_{2n} is

1. $C_{15}H_{30}$
2. $C_{12}H_{26}$
3. C_8H_{20}
4. C_6H_{14}

Answer

$C_{15}H_{30}$

Reason — According to the formula C_nH_{2n}, hydrogen is double of carbon, hence, $C_{15}H_{30}$ follows the formula C_nH_{2n}

Question 3(c)

The total number of different carbon chains that four carbon atoms form in alkane is :

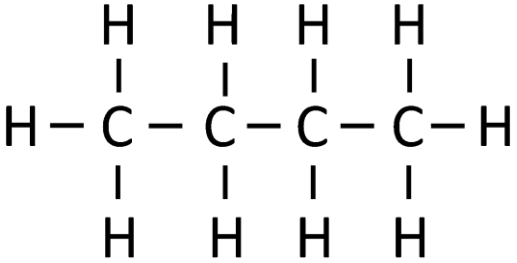
1. 5
2. 4
3. 3
4. 2

Answer

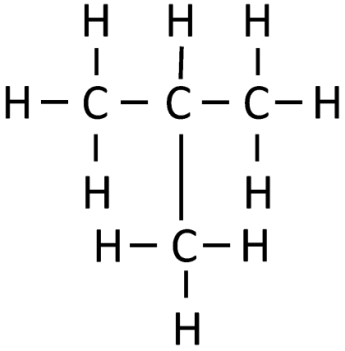
2

Reason — The chain structures are shown below:

n-butane



Isobutane



Question 3(d)

CH_3-CH_2-OH and CH_3-O-CH_3 are :

1. Position isomers
2. Chain isomers
3. Homologous
4. Functional group isomers

Answer

Functional group isomers

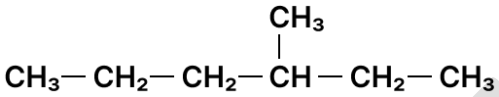
Reason — CH_3-CH_2-OH is ethyl alcohol and contains Hydroxyl (OH) as the functional group.

CH_3-O-CH_3 is Dimethyl ether and contains Ether C-O-C as the functional group.

As the two have same molecular formula but different but different functional groups hence, they are called functional isomers.

Question 3(e)

The IUPAC name of the compound is :



1. 3-trimethylhexane
2. 3-methyl hexane
3. 4-methyl hexane

Answer

3-methylhexane

Reason — As one methyl group is attached at the third carbon and the longest chain is of 6 carbon atoms, hence, the name is 3-methylhexane

Question 4

Fill in the blanks.

(a) Propane and ethane are ..... (homologous, isomers)

(b) A saturated hydrocarbon does not participate in a/an ..... reaction (substitution, addition)

(c) Succeeding members of a homologous series differ by ..... (CH, CH_2, CH_3)

(d) As the molecular masses of hydrocarbons increase, their boiling points ..... and melting points ..... (increase, decrease)

(e) $C_{25}H_{52}$ and $C_{50}H_{102}$ belong to ..... homologous series (the same, different)

(f) CO is an ..... compound. (organic, inorganic)

(g) The chemical properties of an organic compound are largely decided by the ..... and the physical properties of an organic compound are largely decided by the ..... (functional group, number of carbon atoms)

(h) CHO is the functional group of an ..... (alcohol, aldehyde)

(i) The root in the IUPAC name of an organic compound depends upon the number of carbon atoms in ..... (any chain, principal chain)

(j) But-1-ene and but-2-ene are examples of ..... isomerism (chain, position, functional)

Answer

(a) Propane and ethane are ***homologous***.

(b) A saturated hydrocarbon does not participate in a/an ***addition*** reaction.

(c) Succeeding members of homologous series differ by $\boldsymbol{CH_2}$.

(d) As the molecular masses of hydrocarbons increase, their boiling points ***increase*** and melting points ***increase***.

(e) $C_{25}H_{52}$ and $C_{50}H_{102}$ belong to ***the same*** homologous series

(f) CO is an ***inorganic*** compound.

(g) The chemical properties of an organic compound are largely decided by the ***functional group*** and the physical properties of an organic compound are largely decided by the ***number of carbon atom***.

(h) CHO is the functional group of an ***aldehyde***.

(i) The root in the IUPAC name of an organic compound depends upon the number of carbon atoms in ***principal chain***.

(j) But-1-ene and but-2-ene are examples of ***position*** isomerism.

Question 5

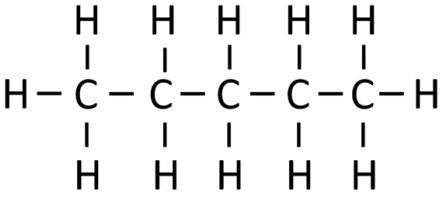
Define or explain chain isomerism and position isomerism with examples in each case.

Answer

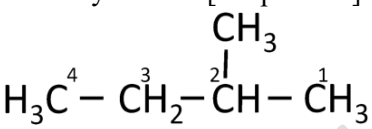
Chain isomerism — When two or more compounds have a similar molecular formula but are different in the arrangement of carbon atoms in straight or branched chains the compounds are referred as chain isomers.

Example: Pentane C_5H_{12}

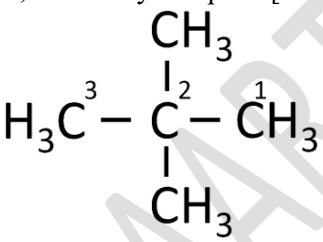
Pentane [n-pentane]



2-Methyl butane [iso-pentane]



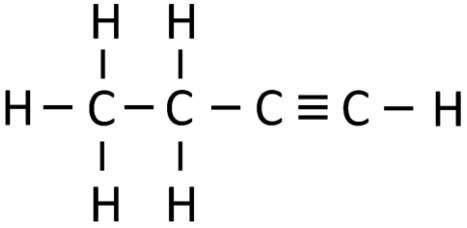
2,2 Dimethyl Propane [neo-pentane]



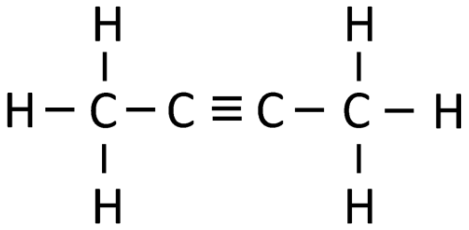
Position isomers — When two or more compounds with the same molecular formula differ in the position of substituent atom or functional group on the carbon atom, they are called position isomers.

Example : But-1-yne and But-2-yne

But-1-yne



But-2-yne



Question 6(a)

Define the term isomerism. State two main causes of isomerism.

Answer

Isomerism is the phenomenon due to which two or more compounds have the same molecular formula but differ in molecular arrangement or in structural formula.

Two main causes of isomerism are:

1. Difference is the mode of linking of atoms.
2. Difference in the arrangement of atoms or groups in space.

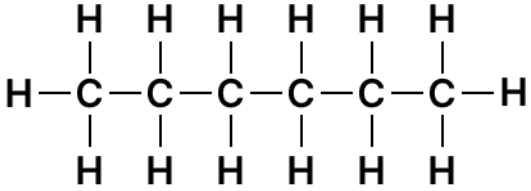
Question 6(b)

Draw the chain isomers of hexane (C_6H_{14}).

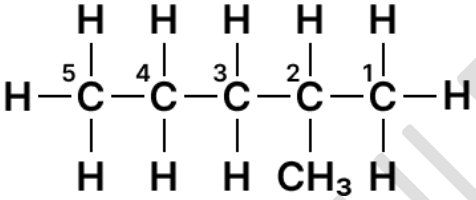
Answer

The chain isomers of hexane are shown below:

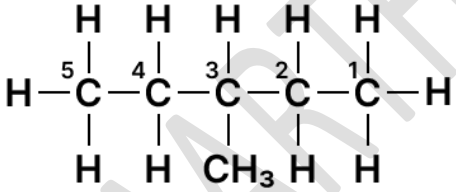
n-hexane



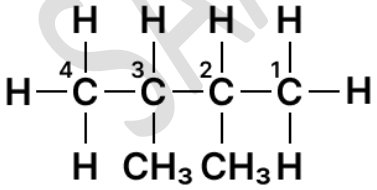
2 Methylpentane



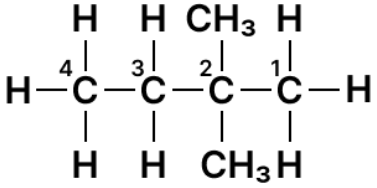
3 Methylpentane



2,3 Dimethylbutane



2,2 Dimethylbutane



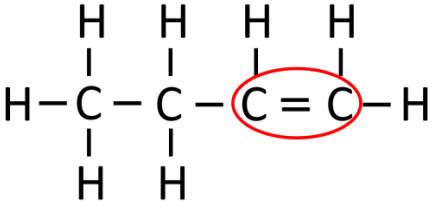
Question 6(c)

Draw position isomers of butene (C_4H_8)

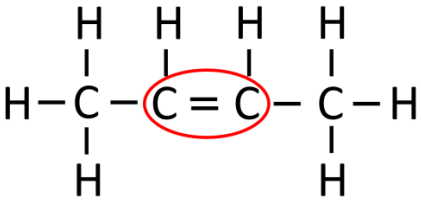
Answer

Position isomers of butene are shown below:

1-butene



2-butene



Question 7

Draw structural formula for each of the following compounds:

(a) isomer of n-butane

(b) Vinegar

(c) 2-Propanol

(d) Ethanal

(e) Acetone

(f) Diethyl ether

(g) propanoic acid

(h) pentan-2-ol

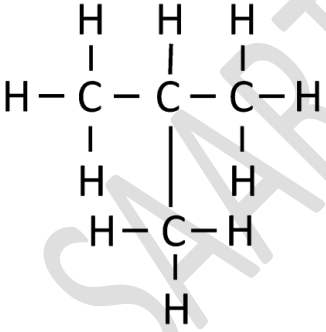
(i) 2,2-dibromobutane

What is used to describe these compounds together?

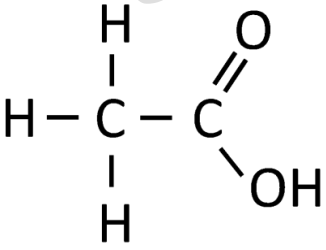
Answer

(a) isomer of n-butane is Isobutane. Its structural formula is shown below:

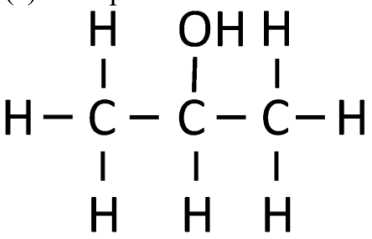
Isobutane



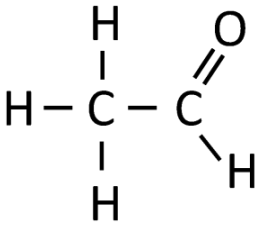
(b) Vinegar (acetic acid)



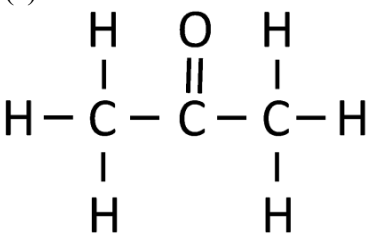
(c) 2-Propanol



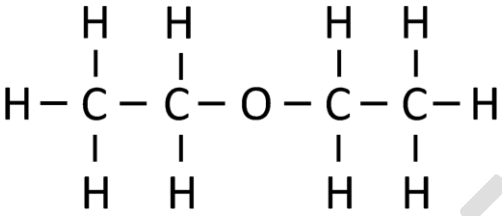
(d) Ethanal



(e) Acetone

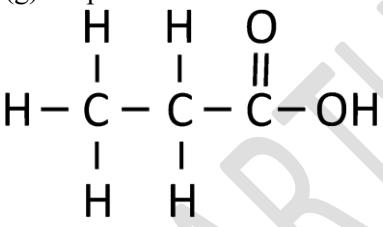


(f) Diethyl ether

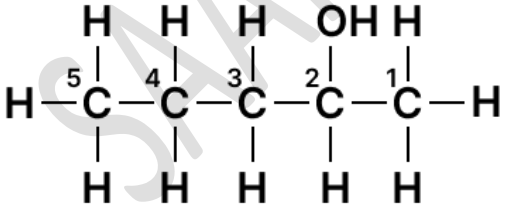


These compounds together can be called **organic compounds**.

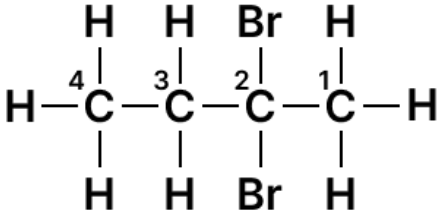
(g) Propanoic acid



(h) Pentan-2-ol



(i) 2,2 dibromo butane



Question 8

(a) What is the special feature of the structure of:

(i) Ethene

(ii) Ethyne

(b) What type of reaction is common to both of the above compounds? Why methane does not undergo this type of reaction.

(c) What is the IUPAC name of dimethyl ether.

Answer

(i) The special feature of the structure of ethene is that the two carbon atoms are linked by double covalent bond formed by sharing two pairs of electrons between the two carbon atoms.

(ii) The special feature of the structure of ethyne is that the two carbon atoms are linked by triple covalent bond formed by sharing three pairs of electrons between the two carbon atoms.

(b) The above compounds undergo addition reactions. Methane does not undergo this type of reaction as its all 4 valencies are satisfied by hydrogen atoms forming single bond and so they are less reactive and undergo substitution reaction only.

(c) Methoxymethane

Question 9 Which type of reaction will (i) ethane and (ii) ethene undergoe?

Answer

(i) Ethane will undergo **Substitution reactions**.

Reason — In case of ethane, all of its 4 valencies are satisfied by hydrogen atoms forming single bond and so they are less reactive and undergo substitution reaction only.

(ii) Ethene will undergo **Addition reactions**.

Reason — In case of ethene, the valencies of atleast 2 carbon atoms are not fully satisfied by hydrogen atoms. The availability of electrons in the double bond makes them more reactive and hence they undergo addition reactions only.

Question 10

Choosing only words from the following list, write down appropriate words to fill in the blanks from (a) to (e) given below.

Addition, carbohydrates, C_nH_{2n-2}, C_nH_{2n}, C_nH_{2n+2}, electrochemical, homologous, hydrocarbon, saturated, substitution, unsaturated.

The alkanes form an (a) ..... series with the general formula (b) ..... The alkanes are (c) ..... (d) ..... which generally undergo (e) ..... reactions.

Answer

The alkanes form a (a) ***homologous*** series with the general formula (b) $\boldsymbol{C_nH_{2n+2}}$. The alkanes are (c) ***saturated*** (d) ***hydrocarbons*** which generally undergo (e) ***substitution*** reactions.

Question 11

Draw the structural formula of a compound with two carbon atoms in each of the following cases.

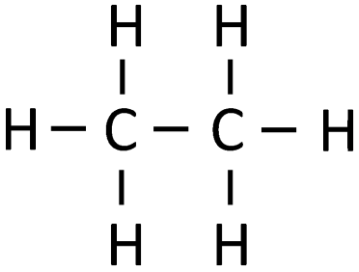
(a) An alkane with a carbon to carbon single bond.

(b) An alcohol containing two carbon atoms.

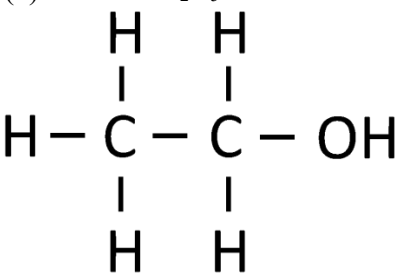
(c) An unsaturated hydrocarbon with a carbon to carbon triple bond.

Answer

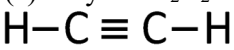
(a) Ethane : CH_3-CH_3



(b) Ethanol : C_2H_5OH



(c) Ethyne : C_2H_2



Question 12

Ethane, Ethene, Ethanoic acid, Ethyne, Ethanol.

From the above, name

(a) The compound with -OH as the part of it's structure.

(b) The compound with -COOH as the part of its structure.

(C) Homologue of homologous series with general formula C_nH_{2n}.

Answer

(a) Ethanol

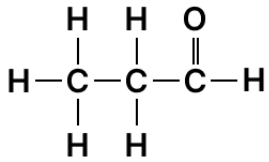
(b) Ethanoic acid

(c) Ethene

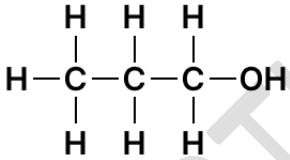
Question 13

Give the correct IUPAC name and the functional group for each of the compounds whose structural formulae are given below:

(a)



(b)



Answer

(a) IUPAC name: Propanoic acid

Functional group: -COOH

(b) IUPAC name: Propanol

Functional group: -OH

Question 14

Copy and complete the following table which relates to three homologous series of hydrocarbons:

General Formula	**C_nH_{2n}**	**C_nH_{2n-2}**	**C_nH_{2n+2}**
IUPAC name of the homologous series			
Characteristic bond type			Single bonds
IUPAC name of the first member of the series			
Type of reaction with chlorine		Addition	

Answer

General Formula	**C_nH_{2n}**	**C_nH_{2n-2}**	**C_nH_{2n+2}**
IUPAC name of the homologous series	***Alkene***	***Alkyne***	***Alkane***
Characteristic bond type	***Double bonds***	***Triple bonds***	Single bonds
IUPAC name of the first member of the series	***Ethene***	***Ethyne***	***Methane***
Type of reaction with chlorine	***Addition***	Addition	***Substitution***

Question 15

Fill in the blanks with the correct words from the brackets:

(a) Alkenes are the (i) ..... (analogous/homologous) series of (ii) ..... (saturated/unsaturated) hydrocarbons. They differ from alkanes due to the presence of (iii) ..... (double/single) bonds. Alkenes mainly undergo (iv) ..... (addition/substitution) reactions.

(b) The organic compound which undergoes substitution reaction is (v) ..... (C_2H_2, C_2H_4, $C_{10}H_{18}$, C_2H_6)

(c) Draw the structural formulae of the two isomers of Butane. Give the correct IUPAC name of each isomer.

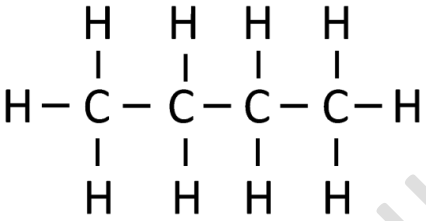
Answer

(a) Alkenes are the (i) ***homologous*** series of (ii) ***unsaturated*** hydrocarbons. They differ from alkanes due to the presence of (iii) ***double*** bonds. Alkenes mainly undergo (iv) ***addition*** reactions.

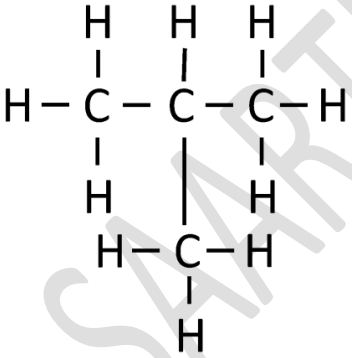
(b) The organic compound which undergoes substitution reaction is (v) ***C_2H_6***.

(c) The correct IUPAC names of isomers of Butane are Butane and 2-Methyl propane. Their structural formulae are given below:

1. Butane [n-butane]



2. 2-Methyl propane [iso-butane]



Question 16

Name:

(a) The saturated hydrocarbon containing two carbon atoms.

(b) An alcohol with three carbon atom.

(c) A triple bond hydrocarbon with two carbon atoms.

Answer

(a) Ethane [C_2H_6]

(b) Propan-1-ol [C_3H_7OH]

(c) Ethyne [C_2H_4]

Exercise 12B

Question 1

State the sources of alkanes.

Answer

Natural gas and petroleum are the principal sources of alkanes. Natural gas contains mainly methane with smaller amounts of ethane, propane and butane.

Question 2

Methane is a greenhouse gas. Comment

Answer

Methane is a primary constituent of natural gas. It absorbs outgoing heat radiations from the earth and thus contributes to the green house effect and so is considered as a green house gas. Methane remains in the atmosphere for approximately 10 years. It is twenty times more effective in trapping heat in comparison to carbon dioxide.

Question 3

Give the general formula of the alkanes.

Answer

The general formula for alkanes is C_nH_{2n+2}, where n is the number of carbon atoms.

Question 4

Draw the structures of isomers of:

(a) butane

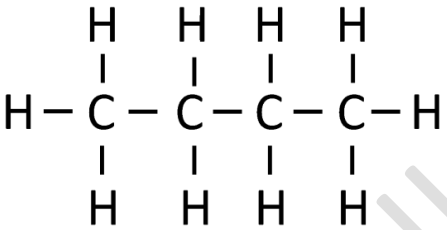
(b) pentane

Write the IUPAC and comman names of these isomers.

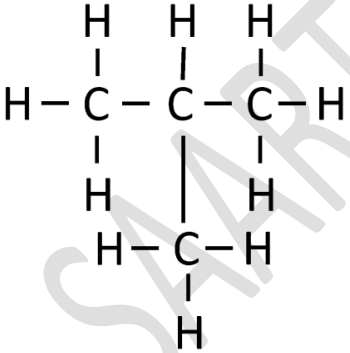
Answer

(a) Isomers of butane [C_4H_{10}]:

1. n-butane

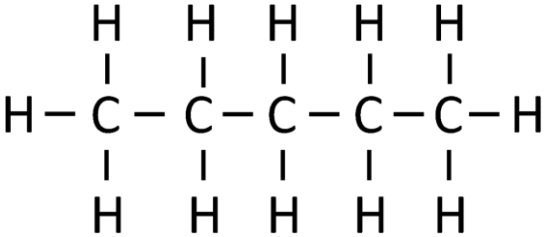


2. Isobutane

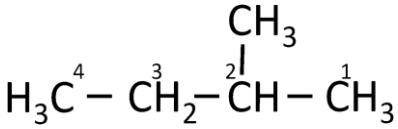


(b) Isomers of pentane [C_5H_{12}]:

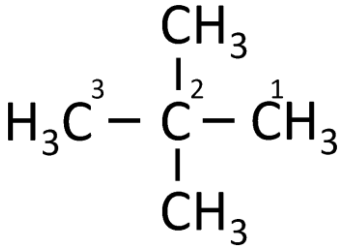
Pentane [n-pentane]



2-Methyl butane [iso-pentane]



2,2 Dimethyl Propane [neo-pentane]



Question 5

Write the :

(a) molecular formula.

(b) electron dot formula and

(c) structural formula of methane and ethane.

Answer

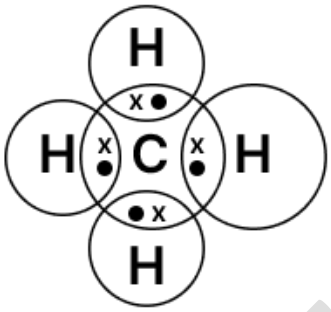
(a) Molecular formula

Methane - CH_4

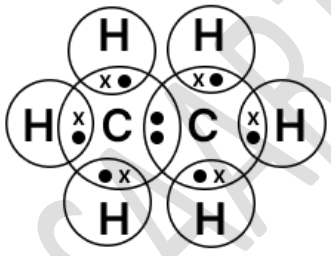
Ethane - C_2H_6

(b) Electron dot formula

Methane

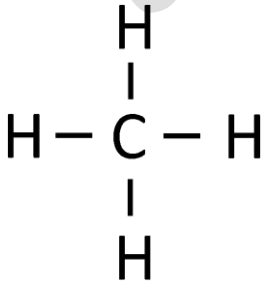


Ethane

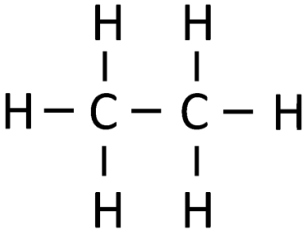


(c) Structural formula

Methane (CH_4)



Ethane(C_2H_6)



Question 6

How is:

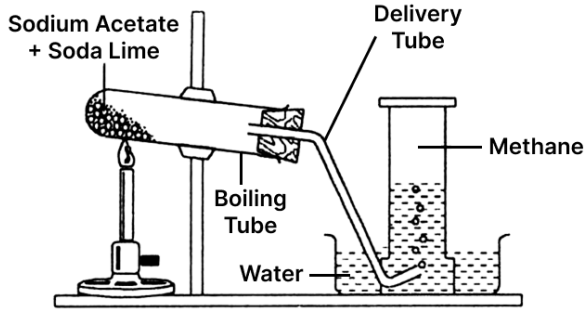
(a) methane and

(b) ethane prepared in the laboratory?

Answer

(a) **Laboratory preparation of methane**

A mixture of sodium ethanoate (sodium acetate) and soda lime is taken in a hard glass test tube and heated over a bunsen flame.

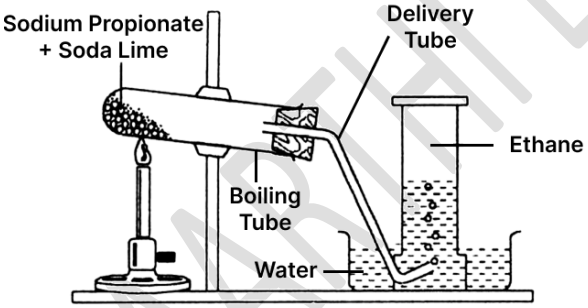


$CH_3COONa + NaOH \xrightarrow[300°C]{CaO} CH_4\uparrow + Na_2CO_3$

The gas evolved is collected by downward displacement of water since it is slightly soluble in water and is lighter than air.

(b) **Laboratory preparation of ethane**

A mixture of sodium propionate and soda lime is taken in a boiling tube and heated over a bunsen flame.



$C_2H_5COONa + NaOH \xrightarrow[300°C]{CaO} C_2H_6\uparrow + Na_2CO_3$

The gas evolved is collected by downward displacement of water.

Question 7

How are methane and ethane prepared from methyl iodide and ethyl bromide?

Answer

Iodomethane (Methyl iodide) and bromoethane (ethyl bromide) are reduced by nascent hydrogen at ordinary room temperature.

$CH_3I + 2[H] \longrightarrow CH_4 + HI$

$C_2H_5Br + 2[H] \longrightarrow C_2H_6 + HBr$

Nascent hydrogen is produced by the action of Zn powder and dil. HCl or Zn/Cu couple in alcohol.

Question 8

What is a substitution reaction? Give the reaction of chlorine with ethane and name the product formed.

Answer

A reaction in which one atom of a molecule is replaced by another atom (or group of atoms) is called a substitution reaction.

e.g., $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Reaction of chlorine with ethane is given below:

$C_2H_6 + Cl_2 \longrightarrow C_2H_5Cl + HCl$

The product formed is **Monochloroetahne [C_2H_5Cl]**

Question 9

Name the compounds formed when methane burns in:

(a) sufficient air

(b) insufficient air

Give a balanced equation.

Answer

(a) The compounds formed are **carbon dioxide and water**

$CH_4 + 2O_2[\text{excess}] \longrightarrow CO_2 + 2H_2O$

(b) The compounds formed are **carbon monoxide and water**

$2CH_4 + 3O_2[\text{insufficient}] \longrightarrow 2CO + 4H_2O$

Question 10

Write the names and the formula of the products formed when:

(a) methane (b) ethane

reacts with (i) chlorine (ii) bromine

Write the chemical equations.

Answer

(a) Methane

(i) Reaction with chlorine: Chloromethane [CH_3Cl] and Hydrochloric acid [HCl] are formed when methane reacts with chlorine.

$$CH_4 + Cl_2 \xrightarrow[\text{or } 600K]{\text{diffused sunlight}} CH_3Cl + HCl$$

(ii) Reaction with Bromine : Bromomethane [CH_3Br] and Hydrogen bromide [HBr] are formed when methane reacts with bromine.

$CH_4 + Br_2 \longrightarrow CH_3Br + HBr$

(b) Ethane

(i) Reaction with chlorine: Chloroethane [C_2H_5Cl] and Hydrochloric acid [HCl] are formed when ethane reacts with chlorine.

$C_2H_6 + Cl_2 \longrightarrow C_2H_5Cl + HCl$

(ii) Reaction with Bromine : Bromoethane [C_2H_5Br] and Hydrogen bromide [HBr] are formed when ethane reacts with bromine.

$C_2H_6 + Br_2 \longrightarrow C_2H_5Br + HBr$

Question 11

Name the compound prepared from:

(a) Sodium propionate

(b) Methyl iodide and

(c) Ethyl bromide.

Write a balanced equation for the same.

Answer

(a) Sodium propionate : compound prepared are **ethane and sodium carbonate**

$$C2H5COONa\text{sodium propionate} + NaOH\text{sodalime} \xrightarrow[\Delta]{CaO} C2H6\text{ethane} \uparrow + Na_2CO_3$$

(b) Methyl iodide : compound prepared are **methane and hydrogen iodide**

$$CH3I\text{methyl iodide} + 2[H]\text{nascent hydrogen} \xrightarrow[\text{alcohol}]{\text{Zn/Cu couple}} CH4\text{methane} \uparrow + HI$$

(c) Ethyl bromide : compound prepared are **ethane and hydrogen bromide**

$$C2H5Br\text{ethylbromide} + 2[H]\text{nascent hydrogen} \xrightarrow[\text{alcohol}]{\text{Zn/Cu couple}} C2H6\text{ethane} \uparrow + HBr$$

Question 12

Write the equation for the complete combustion of

(i) Methane

(ii) Ethane

Answer

(i) Methane:

$CH_4 + 2O_2[\text{excess}] \longrightarrow CO_2 + 2H_2O$

(ii) Ethane

$2C_2H_6 + 7O_2[\text{excess}] \longrightarrow 4CO_2 + 6H_2O$

Question 13

Convert:

(a) Methane into chloroform.

(b) Sodium acetate into methane

(c) Methyl iodide into ethane.

(d) Methane to methyl alcohol

Answer

(a) Methane into chloroform

$$CH4\text{ methane} + Cl_2 \rightarrow \text{diffused sunlight}\Delta CH3Cl\text{monochloromethane} + HCl$$

$$CH3Cl\text{monochloromethane} + Cl2[\text{excess}] \longrightarrow CH2Cl2\text{dichloromethane} + HCl$$

$$CH2Cl2\text{dichloromethane} + Cl_2 \longrightarrow CHCl3\text{trichloromethane or chloroform} + HCl$$

(b) Sodium acetate into methane

$$CH3COONa\text{sodium acetate} + NaOH\text{sodalime} \rightarrow CaO\Delta CH4\text{methane} + Na_2CO_3$$

(c) Methyl iodide into ethane

$$2CH3I\text{methyl iodide} + 2Na \xrightarrow{\text{dry ether}} C2H6\text{ethane} \uparrow + 2NaI$$

(d) Methane to methyl alcohol

$$2CH4\text{ methane} + O_2 \xrightarrow[120\text{ atm.}]{475\text{ K Cu tube}} 2CH3OH\text{methyl alcohol}$$

Question 14

Give three uses of:

(a) Methane

(b) Ethane

Answer

(a) Methane

1. Methane is a source of carbon monoxide and hydrogen.
2. It is used in the preparation of useful compounds like ethyne, methanal, methanol, chloro-methane, and tetrachloro-methane.
3. It is employed as a domestic fuel.

(b) Ethane

1. It is used in the preparation of ethene, ethanol, ethanal and ethanoic acid.
2. It forms ethyl chloride, which is used to make tetraethyllead.
3. Ethane is also a good fuel.

Question 15

Under what conditions does ethane get converted to:

(a) ethyl alcohol

(b) acetaldehyde

(c) acetic acid

Answer

(a) Ethyl alcohol — is produced when ethane and oxygen react at 120 atm pressure, 475 K temperature and pushed through copper tubes.

$$2C2H6\ \text{ethane} + O_2 \xrightarrow[120\ \text{atm.}]{\text{Cu tube 475 K}} 2C2H5OH\text{ethyl alcohol}$$

(b) Acetaldehyde — is produced when ethane and oxygen react by using catalyst MoO

$$C2H6\ \text{ethane} + O_2 \xrightarrow{MoO} CH3CHO\text{acetaldehyde} + H_2O$$

(c) Acetic acid

$$2C2H6\ \text{ethane} + O_2 \xrightarrow[120\ \text{atm.}]{\text{Cu tube 475 K}} 2C2H5OH\text{ethyl alcohol}$$

$$C2H5OH\text{ethyl alcohol} + O_2 \xrightarrow{\text{Pt. 300°C}} CH3COOH + H2O\text{acetic acid}$$

Question 16

Using appropriate catalysts, ethane can be oxidised to an alcohol, an aldehyde and an acid. Name the alcohol, aldehyde and acid formed when ethane is oxidised.

Answer

Alcohol ⟶ **Ethyl alcohol [C_2H_5OH]**

Aldehyde ⟶ **Acetaldehyde [CH_3CHO]**

Acid ⟶ **Acetic acid [CH_3COOH]**

Ethane to an alcohol :

$$2C2H6\ \text{ethane} + O_2 \xrightarrow[120\ \text{atm.}]{\text{Cu tube 475 K}} 2C2H5OH\text{ethyl alcohol}$$

Ethane to an aldehyde :

$$C2H6\ \text{ethane} + O_2 \xrightarrow{MoO} CH3CHO\text{acetaldehyde} + H_2O$$

Ethane to an acid :

$$2C2H6\ \text{ethane} + O_2 \xrightarrow[120\ \text{atm.}]{\text{Cu tube 475 K}} 2C2H5OH\text{ethyl alcohol}$$

$$C2H5OH\text{ethyl alcohol} + O_2 \xrightarrow{\text{Pt. 300°C}} CH3COOH + H2O\text{acetic acid}$$

Excercise 12C

Question 1

Write:

(a) molecular formula

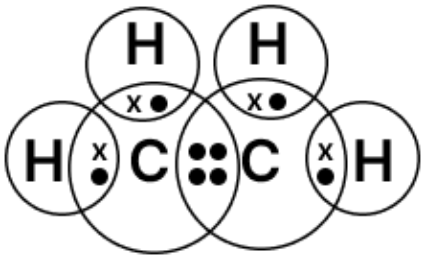
(b) electron dot formula and

(c) structural formula of ethene (ethylene).

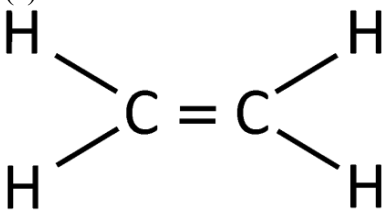
Answer

(a) C_2H_4

(b) Electron dot formula of ethene:



(c) Structural formula of ethene:



Question 2

The molecules of alkene family are represented by a general formula C_nH_{2n}.

Answer the following:

(a) What do n and 2n signify?

(b) What is the name of alkene when n=4?

(c) What is the molecular formula of alkene when n=4?

(d) What is the molecular formula of the alkene if there are ten H atoms in it?

(e) What is the structural formula of the third member of the alkene family?

(f) Write the molecular formula of lower and higher homologous of an alkene which contains four carbon atoms.

Answer

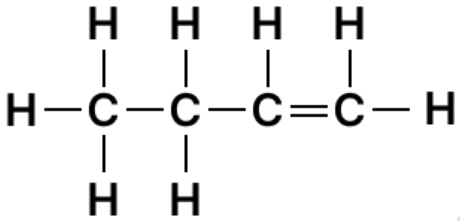
(a) n is the number of carbon atoms in the molecule and 2n is the number of hydrogen atoms.

(b) Butene

(c) When n=4 then no. of carbon atoms is n=4 and hydrogen atoms is 2n=8, hence alkene is **C_4H_8**

(d) When 2n=10 then no. of carbon atoms is n=5 and hydrogen atoms is 2n=10, hence alkene is **C_5H_{10}**

(e) Third member of the alkene family is Butene. Its structural formula is shown below:



(f) Lower homologous: **C_3H_6**

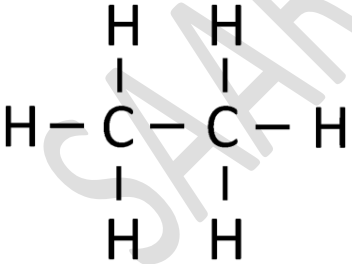
Higher homologues : **C_5H_{10}**

Question 3(a)

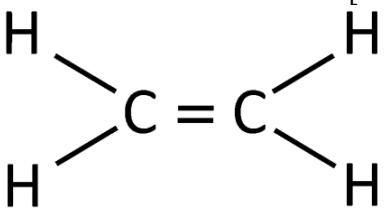
Distinguish between the saturated hydrocarbon ethane and the unsaturated hydrocarbon ethene by drawing their structural formulae.

Answer

Structural formula of Ethane [saturated]:



Structural formula of Ethene [unsaturated]:



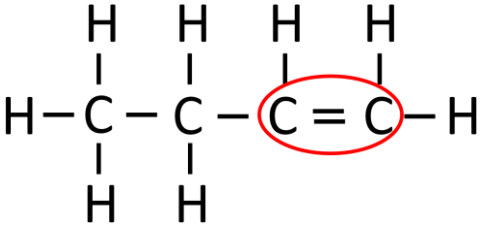
Question 3(b)

Draw the structures of isomers of butene and write their IUPAC names.

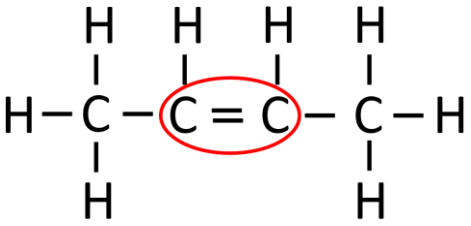
Answer

Butene has three isomers:

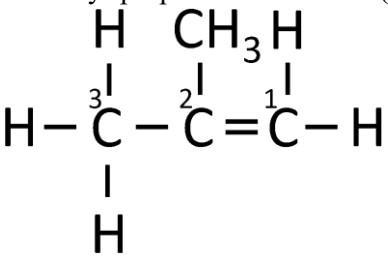
But−1−ene — CH_3-CH_2-CH=CH_2



But−2−ene — CH_3-CH=CH-CH_3



2-methyl-prop-1-ene — CH_2=C(CH_3)-CH_3



Question 4

Give a balanced equation for the lab. preparation of ethylene. How is the gas collected?

Answer

$$C2H5OH \text{ ethyl alcohol} \xrightarrow[170°C]{\text{Conc. } H_2SO_4[\text{excess}]} C2H4\text{ethylene} + H_2O$$

The gas is collected by **downward displacement of water.**

Question 5

How is ethene prepared by:

(a) dehydrohalogenation reaction?

(b) dehydration reaction?

Give equations and name the products formed.

Answer

(a) Dehydrohalogenation involves elimination of hydrogen halide.

$$C2H5Br \text{ Bromo ethane [ethyl bromide]} + KOH\text{alcoholic, hot and conc.} \longrightarrow C2H4\text{ethene [ethylene]} + KBr \text{ Potassium bromide} + H_2O$$

The products formed are **ethene, potassium bromide and water**.

(b) Dehydration involves elimination of elements of water from alcohol. Conc. sulphuric acid act as dehydrating agent.

$$C2H5OH \text{ ethyl alcohol} \xrightarrow[170°C]{\text{Conc. } H_2SO_4[\text{excess}]} C2H4\text{ethene} + H_2O$$

The products formed are **ethene and water**.

Question 6

(a) Ethene when reacts with halogens (chlorine and bromine) form saturated products. Name them and write balanced equations.

(b) Give the conditions and the main product formed by hydrogenation of ethene.

Answer

(a)

$$C2H4 \text{ ethene} + Cl_2 \xrightarrow[\text{[inert solvent]}]{CCl_4} C2H4Cl21,2, \text{dichloroethane [ethylene chloride]}$$

Product formed is **1,2, dichloroethane [ethylene chloride]**

$$C2H4 \text{ ethene} + Br_2 \xrightarrow[\text{[inert solvent]}]{CCl_4} C2H4Br21,2, \text{dibromooethane [ethylene bromide]}$$

Product formed is **1,2, dibromooethane [ethylene bromide]**

(b) Conditions for hydrogenation of ethene : **finely divided catalyst, such as platinum or palladium** at ordinary temperature or **nickel at 200°C**. Main product formed is **ethane**.

$$C2H4 \text{ ethene} + H_2 \xrightarrow[200°C]{\text{Nickle}} C2H6\text{ethane}$$

Question 7

Convert ethanol into ethene using:

(a) solid dehydrating agent

(b) hot conc. H_2SO_4?

Give only balanced equations.

Answer

(a) Using Al_2O_3 as dehydrating agent.

$$C2H5OH \text{ ethyl alcohol} \xrightarrow[350°C]{Al_2O_3} C2H4\text{ethene} + H_2O$$

(b) Using hot conc. H_2SO_4

$$C2H5OH \text{ ethyl alcohol} \xrightarrow[170°C]{\text{Conc. } H_2SO_4\text{[excess]}} C2H4\text{ethene} + H_2O$$

Question 8

Write the following properties of ethene:

(a) Physical state

(b) Odour

(c) Density as compared to air

(d) Solubility

Answer

(a) Colourless and inflammable gas.

(b) Faint sweetish odour.

(c) Slightly less dense than air.

(d) Sparingly soluble in water but highly soluble in organic solvents like alcohol, ether and chloroform.

Question 9

How would you convert:

(a) ethyl bromide into ethene

(b) ethene into 1,2-dibromoethane

(c) ethene into ethane

Answer

(a) ethyl bromide into ethene : **Dehydrohalogenation**

$$C2H5Br \text{ Bromo ethane [ethyl bromide]} + KOH\text{alcoholic, hot and conc.} \longrightarrow C2H4\text{ethene [ethylene]} + KBr + H_2O$$

(b) ethene into 1,2-dibromoethane : **Halogenation**

$$C2H4 \text{ ethene} + Br_2 \xrightarrow[\text{[inert solvent]}]{CCl_4} C2H4Br21,2, \text{dibromooethane [ethylene bromide]}$$

(c) ethene into ethane : **Hydrogenation**

$$H2C = CH2 \text{ ethene [ethylene]} + H_2 \xrightarrow[200°C]{\text{Nickle}} C2H6\text{ethane}$$

Question 10

Give balanced equations when:
(a) ethene is burnt in excess of oxygen.
(b) ethene reacts with chlorine gas.
(c) ethene combines with hydrogen chloride.
(d) a mixture of ethene and hydrogen is passed over nickel at 200°C.

Answer

(a) ethene is burnt in excess of oxygen.

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$ + heat

(b) ethene reacts with chlorine gas.

$$\text{C2H4 ethene} + Cl_2 \xrightarrow[\text{[inert solvent]}]{CCl_4} \text{C2H4Cl21,2, dichloroethane [ethylene chloride]}$$

(c) ethene combines with hydrogen chloride.

$$\text{H2C} = \text{CH2 ethene [ethylene]} + \text{HCl (aq.)} \longrightarrow \text{CH3CH2Clchloroethane}$$

(d) a mixture of ethene and hydrogen is passed over nickel at 200°C.

$$\text{H2C} = \text{CH2 ethene [ethylene]} + H_2 \xrightarrow[200°C]{\text{Nickle}} \text{C2H6ethane}$$

Question 11

Give the formula and names of A, B, C and D in the following equations:

(a) $CH_4 \xrightarrow[-HCl]{Cl_2} A \xrightarrow[-HCl]{Cl_2} B \xrightarrow[-HCl]{Cl_2} C \xrightarrow[-HCl]{Cl_2} D$

(b) $C_2H_2 \xrightarrow{H_2} A \xrightarrow{H_2} B \xrightarrow[-HBr]{Br_2} C \xrightarrow[-HBr]{Br_2} D$

(c) $C_2H_4 + B \xrightarrow[Nickle]{200°C} C_2H_6$

Answer

(a) A — CH_3Cl (Chloro methane)
B — CH_2Cl_2 (Di-chloromethane)
C — $CHCl_3$ (Tri-chloro methane)
D — CCl_4 (Carbon tetrachloride)

$CH_4 \xrightarrow[-HCl]{Cl_2} CH_3Cl \xrightarrow[-HCl]{Cl_2} CH_3Cl_2 \xrightarrow[-HCl]{Cl_2} CHCl_3 \xrightarrow[-HCl]{Cl_2} CCl_4$

(b) A — C_2H_4 (ethene)
B — C_2H_6 (ethane)
C — C_2H_5Br (bromo-ethane)
D — $C_2H_4Br_2$ (1,2-Di-bromoethane)

$C_2H_2 \xrightarrow{H_2} C_2H_4 \xrightarrow{H_2} C_2H_6 \xrightarrow[-HBr]{Br_2} C_2H_5Br \xrightarrow[-HBr]{Br_2} C_2H_5Br_2$

(c) B — H_2 (Hydrogen)

$C_2H_4 + H_2 \xrightarrow[Nickle]{200°C} C_2H_6$

Question 12

Write the name and formula of the product formed in each case below:

(a) $C_2H_4 + Cl_2 \longrightarrow$ .....

(b) $C_2H_5I + KOH$ (alc.) $\xrightarrow{\Delta}$ .....

(c) $H_2C{=}CH_2 \xrightarrow{\text{alc. } KMnO_4}$ .....

(d) $H_2C{=}CH_2 + HBr \longrightarrow$.....

Answer

(a) $C_2H_4 + Cl_2 \longrightarrow$ ***Cl-CH₂-CH₂-Cl***

Product formed is **1,2-dichloroethane[Cl-CH_2-CH_2-Cl]**

(b) $C_2H_5I + KOH\ (alc.) \xrightarrow{\Delta} C_2H_4 + KI + H_2O$

Product formed is **ethene [C_2H_4], KI and water**

(c) $H_2C{=}CH_2 \xrightarrow{alk.\ KMnO_4} CH_2(OH)\text{-}CH_2(OH)$

Product formed is **1,2-Ethane-diol [$CH_2(OH)\text{-}CH_2(OH)$]**

(d) $H_2C{=}CH_2 + HBr \longrightarrow C_2H_5Br$

Product formed is **Bromoethane [C_2H_5Br]**

Question 13

What do you observe when ethene is passed through alkaline $KMnO_4$ solution?

Answer

Ethene is oxidised with alkaline $KMnO_4$ at room temperature, the purple colour of $KMnO_4$ decolourises.

$$H2C = CH2 \text{ ethene [ethylene]} + H - O - H + [O] \text{ cold alkaline} \longrightarrow OH - CH2 - CH2OH1,2 - Ethane - diol$$

Question 14

Name three compounds formed by ethene and give one use of each compound.

Answer

1. Polythene — carry bags are made.
2. Ethanol — cosmetics and toiletries preparation.
3. Oxy-ethylene torch — used for cutting and welding of metals.

Exercise 12D

Question 1

What are the sources for alkynes? Give the general formula of alkynes.

Answer

Natural gas and petroleum are the sources of alkynes. The general formula of alkynes is : C_nH_{2n-2}

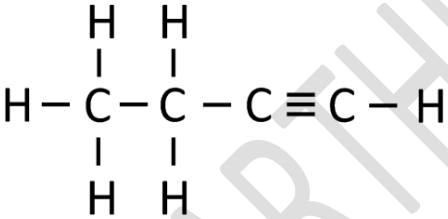
Question 2

Give an example of isomers shown by triple bond hydrocarbons (alkynes) and write their IUPAC names.

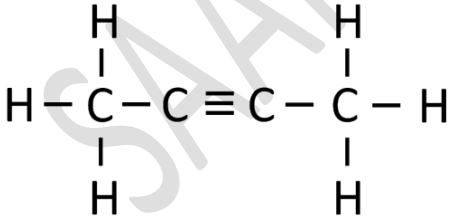
Answer

Isomers of Butyne exhibit position isomerism:

IUPAC name : but-1-yne



IUPAC name : but-2-yne



Question 3

How is ethyne prepared in the laboratory?

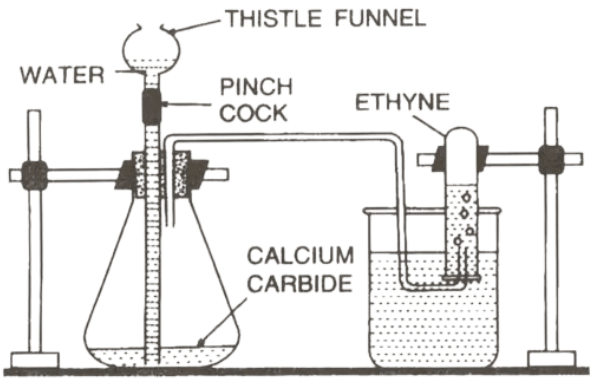
(a) Draw a diagram

(b) Give an equation

(c) How is pure dry gas collected?

Answer

(a) Below diagram shows the setup for laboratory preparation of ethyne:



(b) Ethyne [C_2H_2] from Calcium Carbide :

$$\mathrm{CaC2calcium\ carbide} + \mathrm{2H2Owater} \longrightarrow \mathrm{C2H2ethyne} + \mathrm{Ca(OH)2calcium\ hydroxide}$$

(b) As the pure dry gas is insoluble in water, it is collected by downward displacement of water.

Question 4

Give the method of preparation of ethyne by: 1,2-dibromoethane.

Answer

When 1,2-dibromoethane [ethylene dibromide] is boiled with alcoholic potassium hydroxide, ethyne is formed.

$$\mathrm{C2H4Br2\ ethylene\ dibromide} + \mathrm{2KOHalcoholic} \xrightarrow[\text{boiling}]{200°C} \mathrm{C2H2ethyne} + \mathrm{2KBr} + 2H_2O$$

Question 5

Name the organic compound which:

(a) is a tetrahedral molecule.

(b) is a planar molecule.

(c) is a linear molecule.

(d) forms a red precipitate with ammoniacal solution of copper (I) chloride.

(e) is known as paraffin.

(f) is known as olefin.

(g) will give ethyne (acetylene) gas when treated with water.

Answer

(a) Methane

(b) Ethene

(c) Ethyne

(d) Ethyne

(e) Alkanes

(f) Alkenes

(g) Calcium carbide

Question 6

Classify the following compounds as alkanes, alkenes and alkynes: C_3H_4, C_3H_8, C_5H_8, C_3H_6

Answer

- Alkanes — C_3H_8
- Alkenes — C_3H_6
- Alkynes — C_3H_4, C_5H_8

Question 7

Give a chemical test to distinguish between

(a) saturated and unsaturated compounds

(b) ethane and ethene

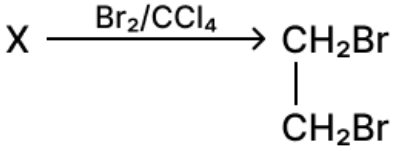
(c) ethene (ethylene) and ethyne (acetylene)

Answer

(a) On adding few drops of alkaline potassium permanganate (purple colour) to the hydrocarbons, no change is seen in saturated hydrocarbons whereas the purple colour fades in case of unsaturated hydrocarbons.
(b) When bromine is passed through solutions of ethane and ethene in an inert solvent [CCl_4] at room temperature, incase of ethene gas, brown colour of bromine is discharged whereas in case of ethane gas no change in the colour is observed.
(c) On adding ammoniacal silver nitrate, no change is seen in ethene whereas white ppt. of silver acetylide is formed in case of ethyne.

Question 8

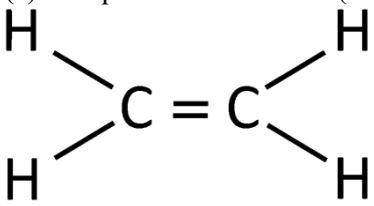
Compound X is bubbled through bromine dissolved in carbon tetrachloride (CCl_4);



(a) Draw the structure of X.
(b) State your observation during the reaction.

Answer

(a) Compound 'X' is Ethene ($H_2C=CH_2$). Its structural formula is shown below:



(b) Brown colour of bromine is discharged.

Question 9

Give balanced equations for the following conversions:
(a) An alkene to an alkane
(b) An alkene to an alcohol
(c) An alkyne to an alkene.

Answer

(a) An alkene to an alkane

$$\mathrm{C2H4ethene} + \mathrm{H_2} \xrightarrow[300°\mathrm{C}]{\text{Nickle}} \mathrm{C2H6ethane}$$

(b) An alkene to an alcohol

$$\mathrm{C2H4\ ethene} + \mathrm{H_2O} \xrightarrow[300°\mathrm{C,\ 60\ atm.}]{\mathrm{H_3PO_4}} \mathrm{C2H5OHethene}$$

(c) An alkyne to an alkene.

$$\mathrm{H2C2\ ethyne\ [acetylene]} + \mathrm{H_2} \xrightarrow[300°\mathrm{C}]{\text{Nickle}} \mathrm{C2H4ethene}$$

Question 10

Name the products formed and write an equation when ethyne is added to the following in an inert solvent:
(a) chlorine
(b) bromine
(c) iodine
(d) hydrogen
(e) excess of hydrochloric acid.

Answer

1,2-dichloro ethene and 1,1,2,2 -tetrachloro ethane will be formed.
$C_2H_2 + Cl_2 \longrightarrow C_2H_2Cl_2 + Cl_2 \longrightarrow C_2H_2Cl_4$
(b) Bromine

1,2-dibromo ethene and 1,1,2,2 -tetrabromo ethane will be formed.

$C_2H_2 + Br_2 \longrightarrow C_2H_2Br_2 + Br_2 \longrightarrow C_2H_2Br_4$

(c) Iodine

1,2-di-iodoethene will be formed.

$C_2H_2 + I_2 \longrightarrow ICH{=}CHI$

(d) Hydrogen

Ethene and then ethane will be formed.

$$\mathrm{C2H2\ Ethyne} + H_2 \xrightarrow{\text{Nickle}} \mathrm{C2H4ethene} + H_2 \xrightarrow{\text{Nickle}} \mathrm{C2H6ethane}$$

(e) Excess of hydrochloric acid.

Chloro ethene and then 1,1-dichloro ethane will be formed.

$$\mathrm{C2H2\ Ethyne} \xrightarrow{+\mathrm{HCl}} \mathrm{C2H3Clchloro\ ethene} \xrightarrow{+\mathrm{HCl}} \mathrm{C2H4Cl21,1-dichloro\ ethane}$$

Question 11

Substitution reactions are characteristic reactions of ..... (alkynes/alkenes/alkanes).

Answer

Substitution reactions are characteristic reactions of ***alkanes***.

Question 12

(a) Write an equation for the laboratory preparation of

(i) An unsaturated hydrocarbon from calcium carbide.

(ii) An alcohol from ethyl bromide.

(b) What would you see, when ethyne is bubbled through a solution of bromine in carbon tetrachloride?

(c) Name the addition product formed between ethene and water.

Answer

(a) (i) Ethyne [C_2H_2] from Calcium Carbide :

$$\mathrm{CaC2calcium\ carbide} + \mathrm{2H2Owater} \longrightarrow \mathrm{C2H2ethyne} \uparrow + \mathrm{Ca(OH)2calcium\ hydroxide}$$

(ii) An alcohol from ethyl bromide.

$$\mathrm{C2H5-Br\ Bromoethane\ [ethyl\ bromide]} + \mathrm{KOH\ [aq.]} \xrightarrow{\text{boil}} \mathrm{C2H5OH\ ethyl\ alcohol} + \mathrm{KBr}$$

(b) Brown colour of bromine disappears when ethyne is bubbled through a solution of bromine in carbon tetrachloride.

$C_2H_2 + Br_2 \longrightarrow C_2H_2Br_2 + Br_2 \longrightarrow C_2H_2Br_4$

(c) Ethanol (C_2H_5OH)

$C_2H_4 + H_2O \longrightarrow C_2H_5OH$

Question 13

Give reasons:

(a) Ethyne is more reactive than ethene.

(b) Ethene is more reactive than ethane.

(c) Hydrocarbons are excellent fuels.

Answer

(a) The two carbon atoms of ethyne form a triple covalent bond whereas that of ethene form a double covalent bond. Hence, there are more electrons available in case of ethyne making it more reactive than ethene.

(b) Ethene is an unsaturated hydrocarbon having two carbon atoms forming a double covalent bond as their valencies are not fully satisfied by hydrogen atoms whereas ethane is a saturated hydrocarbon as all the four valencies of its two carbon atoms are satisfied by the hydrogen atoms. The availability of electrons in the double bond in case of ethene makes it more reactive than ethane which has does not have electrons available in the single covalent bond.

(c) Hydrocarbons have high calorific value. They are easily combustible and the reaction is exothermic releasing heat energy. Hence, they are excellent fuels.

Question 14

(a) Write balanced equations:

(i) when butane is burnt in oxygen

(ii) for preparation of ethylene from ethyl alcohol.
(b) (i) Convert ethane to tetrabromoethane
(ii) Convert ethyne to ethane.

Answer

(i) $C_4H_{10} + 6O_2 \longrightarrow 4CO_2 + 5H_2O$

(ii)

$$C2H5OH \text{ ethyl alcohol} \xrightarrow[170°C]{\text{Conc. } H_2SO_4[\text{excess}]} C2H4\text{ethylene} + H_2O$$

(b) (i) Convert ethane to tetrabromoethane

$$C2H2 \text{ Ethyne} \xrightarrow[(\text{from } CBr_4)]{+Br_2} C2H2Br2\text{dibromoethene} \xrightarrow[(\text{from } CBr_4)]{+Br_2} C2H2Br4\text{tetrabromo ethane}$$

(ii) Convert ethyne to ethane.

$$C2H2 \text{ Ethyne} + H_2 \xrightarrow{\text{Nickle}} C2H4\text{ethene} + H_2 \xrightarrow{\text{Nickle}} C2H6\text{ethane}$$

Question 15

(a) Write the equation for the preparation of carbon tetrachloride from methane.
(b) Draw the structural formula of ethyne.
(c) How is the structure of alkynes different from that of alkenes?

Answer

(a) Carbon tetrachloride from methane

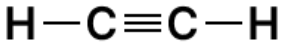
$$CH4 \text{ methane} + Cl_2 \xrightarrow[\text{or } 600K]{\text{diffused sunlight}} CH_3Cl + HCl$$

$$CH3Cl \text{ chloromethane} + Cl_2 \longrightarrow CH2Cl2\text{dichloromethane} + HCl$$

$$CH2Cl2\text{dichloromethane} + Cl_2 \longrightarrow CHCl3\text{trichloromethane} + HCl$$

$$CHCl3\text{trichloromethane} + Cl_2 \longrightarrow CCl4\text{tetrachloromethane} + HCl$$

(b) Structural formula of ethyne is shown below:



(c) Alkynes contain triple bonds while alkenes contain double bonds.

Exercise 12E

Question 1

(a) What are alcohols? State their sources.
(b) Give general formulae of monohydric alcohol.

Answer

(a) Alcohols are the hydroxyl derivatives of alkane. They are formed by replacing one or more hydrogen atoms of the alkane with an OH group.

Alcohols are not found naturally in the earth's atmosphere, they are obtained by artificial synthesis in the laboratory. For example, Methanol (wood spirit) is obtained from destructive distillation of wood, while ethanol is obtained from fermentation of sugar.

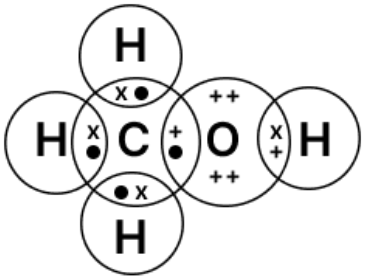
(b) $C_nH_{2n+1}OH$

Question 2

Give the:
(a) dot diagram of first member of alcohol.
(b) abbreviated formula of third member of alcohol.
(c) structure of second member of the alcohol group.
(d) structure of alcohol with 4 carbon atoms.

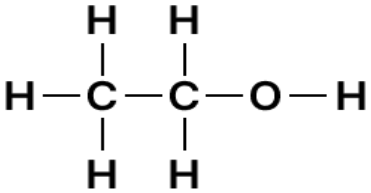
Answer

(a) Methyl alcohol (CH_3OH) is the first member of alcohol. Its electron dot structure is shown below:

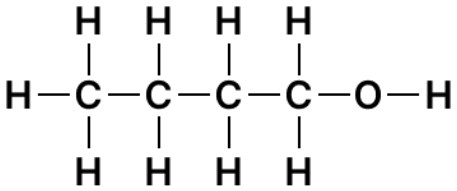


(b) Propyl alcohol : CH_3-CH_2-CH_2-OH

(c) Ethyl alcohol : CH_3-CH_2-OH



(d) Butyl alcohol : CH_3-CH_2-CH_2-CH_2-OH



Question 3

State the method of preparation of ethanol:

(a) by hydrolysis of ethene.

(b) by hydrolysis of ethyl bromide.

Answer

(a) **Hydrolysis of ethene** — Ethanol is produced when ethene is heated with water at 300°C and 60 atmosphere pressure in presence of phosphoric acid (catalyst).

$$C2H4 \text{ ethene} + H_2O \xrightarrow[300°C,\ 60 \text{ atm.}]{H_3PO_4} C2H5OH \text{ethanol}$$

(b) **Hydrolysis of ethyl bromide** — Ethanol can be prepared by boiling aq. NaOH with ethyl bromide.

$$C2H5 - Br \text{ Bromoethane [ethyl bromide]} + NaOH \text{ aqueous} \xrightarrow{\text{boil}} C2H5OH \text{ethanol} + NaBr$$

Question 4

Halo alkanes reacts with alkalies to produce alcohol. Give the equation for the preparation of second member of homologous series of alcohol. State under what condition the reaction occur.

Answer

Ethyl alcohol can be prepared by hydrolysis of haloalkane on reaction with hot and dilute alkali or when an alkyl halide is boiled with aqueous alkalis.

$$C2H5 - Br \text{ Bromoethane [ethyl bromide]} + NaOH \text{aqueous} \xrightarrow{\text{boil}} C2H5OH \text{ ethyl alcohol} + NaBr$$

Question 5

(a) How do the boiling point and melting point change in the homologous series of alcohols?

(b) Name the product formed when ethanol reacts with acetic acid. Give an equation.

(c) What is the name given to this type of reaction?

Answer

(a) The boiling point and melting point increase with increasing molecular weight in the homologous series of alcohols.

(b) Ethyl acetate is generated when ethanol combines with acetic acid.

$$C2H5OHethanol + CH3COOHacetic\ acid \xrightarrow[\Delta]{Conc.\ H_2SO_4} CH3 - COO - C2H5ethyl\ acetate + H_2O$$

(c) Esterification.

Question 6

Complete and balance the following equations. State the conditions wherever necessary.

(a) H-C≡C-H + H_2 ⟶ ..... + H_2 ⟶ .....

(b) $C_2H_4 + Br_2$ ⟶ .....

(c) C_2H_4 + HCl ⟶ .....

(d) CaC_2+ H_2O ⟶ .....

(e) $C_2H_2 + Br_2$ ⟶ .....

(f) $C_2H_5OH \xrightarrow[K_2Cr_2O_7]{[O]}$ .....

Answer

(a) H-C≡C-H + H_2 ⟶ ***H_2C=CH_2*** + H_2 ⟶ ***H_3C-CH_3***

(b) $C_2H_4 + Br_2$ ⟶ ***Br-CH_2-CH_2-Br***

(c) C_2H_4 + HCl ⟶ ***CH_3CH_2Cl***

(d) $CaC_2 + 2H_2O$ ⟶ ***C_2H_2*** ↑ + ***$Ca(OH)_2$***

(e) $C_2H_2 + Br_2$ ⟶ $C_2H_2Br_2$

(f) $C_2H_5OH \xrightarrow[K_2Cr_2O_7]{[O]}$ ***CH_3CHO***

Question 7

What is the effect of ethanol on human body?

Answer

Ethanol affects the part of the brain which controls our muscular movements. It gives temporary relief from tiredness, but it damages the liver and kidney too in excess quantities.

Question 8

How are the following obtained:

(a) absolute alcohol

(b) spurious alcohol

(c) methylated spirit ?

Answer

(a) **Absolute alcohol** — By distilling wet alcohol with benzene, absolute alcohol can be obtained. The mixture of water and benzene distils off, leaving behind anhydrous alcohol.

(b) **Spurious alcohol** — It is illicit liquor made by improper distillation. It contains large proportions of methanol in a mixture of alcohols.

It's a blend of alcohol with a lot of methanol in it. It is fatal for human consumption.

(c) **Methylated spirit** — Ethyl alcohol is mixed 5% methyl alcohol, a coloured dye, and some pyridine to obtain methylated spirit.

Question 9

Name the products formed and give appropriate chemical equations for the following:

(a) Sodium reacting with ethyl alcohol.

(b) Ethanol oxidised by acidified potassium dichromate.

Answer

(a) When sodium reacts with ethyl alcohol, hydrogen is produced, and sodium ethoxide is formed.

$C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2 \uparrow$

(b) Ethanol is oxidised and transformed to ethanal, which is then turned to acetic acid.

$$C2H5OHethanol \xrightarrow[K_2Cr_2O_7]{[O]} CH3CHOethanal \xrightarrow[K_2Cr_2O_7]{[O]} CH3COOHethanoic\ acid$$

Question 10

Give the trivial (common) names and the IUPAC names of the following:
(a) C_3H_6
(b) C_2H_4
(c) C_2H_2
(d) CH_3OH
(e) C_2H_5OH

Answer

S. No.	Formula	Common name	IUPAC name
a)	C_3H_6	Propylene	Propene
b)	C_2H_4	Ethylene	Ethene
c)	C_2H_2	Acetylene	Ethyne
d)	CH_3OH	Methyl alcohol	Methanol
e)	C_2H_5OH	Ethyl alcohol	Ethanol

Question 11

Ethanol can be oxidised to ethanoic acid. Write the equation and name the oxidising agent.

Answer

Ethanol under high pressure and low temperature when treated with oxidising agent like acidified potassium dichromate produces ethanoic acid

$$C2H5OH \text{ ethanol[ethyl alcohol]} \xrightarrow[K_2Cr_2O_7]{[O]} CH3CHO\text{ethanal [acetaldehyde]} \xrightarrow[K_2Cr_2O_7]{[O]} CH3COOH\text{ethanoic acid[acetic acid]}$$

Question 12

Name an organic compound which is:
(a) used for illuminating country houses.
(b) used for making a household plastic material.
(c) called 'wood spirit'.
(d) poisonous and contain OH group.
(e) consumed as a drink.
(f) used in thermometer.
(g) solvent for gums and resins.
(h) dehydrated to produced ethene.

Answer

(a) Ethyne
(b) Ethyne
(c) Methanol
(d) Methanol
(e) Ethanol
(f) Ethanol
(g) Ethanol
(h) Ethanol

Question 13

Ethanol can be converted into ethene which can be changed into ethane. Choose the correct word or phrase from the brackets to complete the following sentences.
(a) The conversion of ethanol into ethene is an example of ..... (dehydration, dehydrogenation).
(b) Converting ethanol into ethene requires the use of ..... (conc. HCl, conc. HNO_3, conc. H_2SO_4).

(c) The conversion of ethene into ethane is an example of ..... (hydration, hydrogenation).
(d) The catalyst used in the conversion of ethene into ethane is commonly ..... (iron, nickel, cobalt).

Answer

(a) The conversion of ethanol into ethene is an example of ***dehydration***
(b) Converting ethanol into ethene requires the use of ***conc. H_2SO_4***
(c) The conversion of ethene into ethane is an example of ***hydrogenation***
(d) The catalyst used in the conversion of ethene into ethane is commonly ***nickel***

Question 14

Write the equations for the following lab. preparations:
(a) Ethane from sodium propionate.
(b) Ethene from iodoethane.
(c) Ethyne from calcium carbide.
(d) Methanol from iodomethane.

Answer

(a) Ethane [C_2H_6] from sodium propionate:

$$C2H5COONasodium\ propionate + NaOHsodalime \xrightarrow[300°C]{CaO} C2H6ethane + Na_2CO_3$$

(b) Ethene from iodoethane:

$$C2H5I\ iodoethane + KOHalcoholic \xrightarrow{boil} H2C = CH2ethene\ [ethylene] + KI + H_2O$$

(c) Ethyne from calcium carbide:

$$CaC2calcium\ carbide + 2H2Owater \longrightarrow C2H2ethyne\ [acetylene] + Ca(OH)_2$$

(d) Methanol from idomethane.

$$CH_3I + NaOH \longrightarrow CH_3OH + NaI$$

Question 15

Name the compound prepared by each of the following reactions:
(i) $C_2H_5COONa + NaOH \longrightarrow$
(ii) $CH_3I + 2H \longrightarrow$
(iii) $C_2H_5Br + KOH$ (alcoholic solution)$\longrightarrow$
(iv) $CO + 2H_2$ (Zinc oxide catalyst) $\longrightarrow$
(v) $CaC_2 + 2H_2O \longrightarrow$

Answer

(i) Ethane

$$C2H5COONasodium\ propionate + NaOHsodalime \xrightarrow[300°C]{CaO} C2H6ethane + Na_2CO_3$$

(ii) Methane

$$CH3Imethyl\ iodide + 2[H]nascent\ hydrogen \xrightarrow[alcohol]{Zn/Cu\ couple} CH4methane + HI$$

(iii) Ethene [ethylene]

$$C2H5Br\ Bromo\ ethane\ [ethyl\ bromide] + KOHalcoholic \xrightarrow{boil} H2C = CH2ethene\ [ethylene] + KBr + H_2O$$

(iv) Methanol

$$CO + 2H_2 \xrightarrow[catalyst]{Zinc\ oxide} CH_3OH$$

(v) Ethyne [Acetylene]

$$CaC2calcium\ carbide + 2H2Owater \longrightarrow C2H2ethyne\ [acetylene] + Ca(OH)2calcium\ hydroxide$$

Question 16

Write the equations for the following reactions:
(a) Calcium carbide and water.
(b) Ethene and water (steam).

(c) Bromoethane and an aqueous solution of sodium hydroxide.

Answer

(a) Water is added to calcium carbide:

$$\mathrm{CaC2calcium\ carbide} + \mathrm{2H2Owater} \longrightarrow \mathrm{C2H2ethyne\ [acetylene]} + \mathrm{Ca(OH)2calcium\ hydroxide}$$

(b) Ethene and water (steam).

$$\mathrm{C2H4\ ethene} + \mathrm{H_2O} \xrightarrow[300°C,\ 60\ atm.]{\mathrm{H_3PO_4}} \mathrm{C2H5OHethene}$$

(c) Bromoethane and an aqueous solution of sodium hydroxide.

$$\mathrm{C2H5 - Br\ Bromoethane\ [ethyl\ bromide]} + \mathrm{NaOH\ aqueous} \xrightarrow{\mathrm{boil}} \mathrm{C2H5OHethanol} + \mathrm{NaBr}$$

Exercise 12F

Question 1

What are carboxylic acids? Give their general formula

Answer

An organic compound containing the carboxyl group (-COOH) is known as carboxylic acid. These compounds possess acidic properties.

General formula : $C_nH_{2n+1}COOH$ (or RCOOH)

Question 2

Write the names of:

(a) first three members of carboxylic acid series.

(b) three compounds which can be oxidised directly, or in stages to produce acetic acid.

Answer

(a) First three members of carboxylic acid series are:

1. Methanoic acid (formic acid)
2. Ethanoic acid (acetic acid)
3. propanoic acid (propionic acid)

(b) Three compounds which can be oxidised directly, or in stages to produce acetic acid are:

1. Ethanol
2. Acetylene
3. Ethanal

Question 3

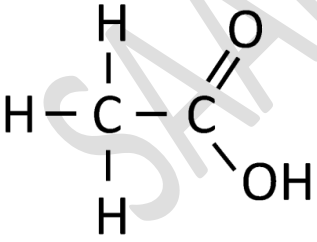
(a) Give the structural formulae of acetic acid.

(b) IUPAC name of acetic acid.

(c) What is glacial acetic acid?

Answer

(a) Structural formula of acetic acid is shown below:



(b) Ethanoic acid

(c) Acetic acid that contains a very low amount of water (less than 1%) is called anhydrous (water-free) acetic acid or glacial acetic acid. Its melting point is around 17°C. On cooling it forms a crystalline mass resembling ice and for this reason it is called glacial acetic acid.

Question 4

Vinegar is greyish in colour with a particular taste. Explain.

Answer

Dilute (4-5 percent) solution of ethanoic acid is also called vinegar. The presence of a colouring matter gives vinegar a greyish colour while the presence of other organic compounds imparts it the usual taste and flavour.

Question 5

Complete:

(a) Vinegar is prepared by the bacterial oxidation of .....

(b) The organic acid present in vinegar is .....

(c) The next higher homologue of ethanoic acid is .....

Answer

(a) Vinegar is prepared by the bacterial oxidation of ***ethanol***

(b) The organic acid present in vinegar is ***acetic acid***

(c) The next higher homologue of ethanoic acid is ***propanoic acid***

Question 6

How is acetic acid prepared from

(a) Ethanol

(b) Acetylene

Answer

(a) Ethanol under high pressure and low temperature when treated with oxidising agent like acidified potassium dichromate produces ethanoic acid (acetic acid).

$$\mathrm{C2H5OH\ ethanol[ethyl\ alcohol]} \xrightarrow[K_2Cr_2O_7]{[O]} \mathrm{CH3CHOethanal\ [acetaldehyde]} \xrightarrow[K_2Cr_2O_7]{[O]} \mathrm{CH3COOHethanoic\ acid[acetic\ acid]}$$

(b) Acetylene is first converted to acetaldehyde by passing it through a 40 percent H_2SO_4 solution at 60°C in the presence of 1% Mercury(II) Sulphate [$HgSO_4$].

$$\mathrm{C2H2acetylene} + H_2O \xrightarrow{H_2SO_4(dil)\ ,\ HgSO_4} \mathrm{CH3CHOethanal\ [acetaldehyde]}$$

The acetaldehyde is oxidised to acetic acid by passsing a mixture of acetaldehyde vapous and air over manganese acetate at 70°C

$$\mathrm{2CH3CHOethanal\ [acetaldehyde]} + O_2 \xrightarrow[\text{Catalyst}]{\Delta} \mathrm{2CH3COOHethanoic\ acid[acetic\ acid]}$$

Question 7

What do you notice when acetic acid reacts with

(a) litmus

(b) metals

(c) alkalies

(d) alcohol ?

Answer

(a) Acetic acid turns moist blue litmus red.

(b) Hydrogen gas with a pop sound is evolved.

$2CH_3COOH + Zn \longrightarrow (CH_3COO)_2Zn + H_2 \uparrow$

(c) Reacts with alkalis to form salt and water.

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

(d) Forms an ester (pleasant fruity smelling compound) on reacting with alcohol in the presence of dehydrating agents like concentrated sulphuric acid.

$$\mathrm{C2H5OHethyl\ alcohol} + CH_3COOH \xrightarrow{\text{conc. } H_2SO_4} \mathrm{CH3COOC2H5ethyl\ acetate} + H_2O$$

Question 8

Acetic acid is a typical acid. Write one equation in each case for its reaction with

(a) a metal

(b) a base/alkali

(c) a carbonate

(d) a bicarbonate

Answer

(a) a metal

$2CH_3COOH + Zn \longrightarrow (CH_3COO)_2Zn + H_2 \uparrow$

(b) a base/alkali

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

(c) a carbonate

$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2 \uparrow$

(d) a bicarbonate

$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2 \uparrow$

Question 9

What do you observe when acetic acid is added to

(a) sodium bicarbonate

(b) ethyl alcohol in the presence of sulphuric acid.

(c) neutral $FeCl_3$ solution?

Answer

(a) **Carbon dioxide** is produced when acetic acid is added to sodium bicarbonate.

(b) When warmed with ethyl alcohol in the presence of sulphuric acid, a pleasant fruity smell of ethyl acetate is produced.

(c) On adding acetic acid to neutral $FeCl_3$ solution, wine red colour is produced.

Question 10

Name:

(a) compound formed when acetic acid and ethanol react together.

(b) substance used to change acetic acid to acetic anhydride.

Answer

(a) Ethyl acetate

(b) Phosphorus pentoxide (P_2O_5)

Miscellaneous — Multiple Choice Type

Question 1

Which of the following statements is wrong about alkanes?

1. They are all saturated hydrocarbon.
2. They can undergo addition as well as substitution reaction.
3. They are almost non polar in nature.
4. On complete combustion give out carbon dioxide and water.

Answer

They can undergo addition as well as substitution reaction.

Reason — The non-availability of electrons in the single covalent bond makes them less reactive and therefore undergo characteristic substitution reaction only.

Question 2

The organic compound obtained as the end product of the fermentation of sugar solution is :

1. Methanol
2. Ethanol
3. Ethane
4. Methanoic acid

Answer

Ethanol

Reason —

$$C12H22O11\text{cane sugar [molasses]} + H_2O \xrightarrow[\text{[yeast]}]{\text{invertase}} C6H12O6\text{glucose} + C6H12O6\text{fructose}$$

$$C6H12O6\text{glucose} \xrightarrow[\text{fermentation}]{\text{zymase [yeast]}} 2C2H5OH\text{ethanol} + 2CO_2$$

Question 3

An organic compound undergoes addition reactions and gives a red colour precipitate with ammoniacal cuprous chloride. Therefore, the organic compound could be :

1. Ethane
2. Ethene
3. Ethyne
4. Ethanol

Answer

Ethyne

Reason — When few drops of ammonical cuprous chloride is added to ethyne, red precipitate of copper acetylide is foemed.

Question 4

An organic weak acid is :

1. Formic acid
2. Sulphuric acid
3. Nitric acid
4. Hydrochloric acid

Answer

Formic acid

Reason — Formic acid is the organic weak acid.

Question 5

The organic compound mixed with ethanol to make it spurious is:

1. Methanol
2. Methanoic acid
3. Methanal
4. Ethanoic acid

Answer

Methanol

Reason — Methanol is mixed with ethanol by improper distillation.This illicit liquour is refered as spurious alcohol. This contains large proportion of methanol and it is fatal for human consumption.

Question 6

The functional group present in acetic acid is:

1. Ketonic >C=O
2. Hydroxyl -OH
3. Aldehydic -CHO
4. Carboxyl -COOH

Answer

Carboxyl -COOH

Reason — Formula of acetic acid is CH_3-COOH. Hence, we can see that Carboxyl -COOH is present.

Question 7

The unsaturated hydrocarbons undergo:

1. a substitution reaction
2. an oxidation reaction
3. an addition reaction
4. none of the above

Answer

Addition reaction

Reason — The availability of electrons in the double or triple bond makes them more reactive and therefore they undergo characteristic addition reactions only.

Question 8

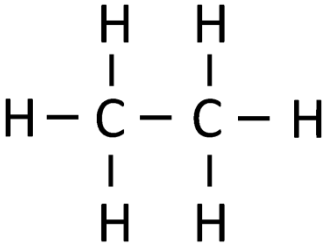
The number of C-H bonds in ethane molecule are:

1. Four
2. Six
3. Eight
4. Ten

Answer

Six

Reason — Below is the structural formula of Ethane:



Question 9

Hydrocarbon which is a greenhouse gas is:

1. Butane
2. Ethylene
3. Ethane
4. Methane

Answer

Methane

Reason — Methane absorbs outgoing heat radiation from the earth. It is twenty times more effective in trapping heat in comparison to carbon dioxide. Hence, it contributes to green house effect.

Question 10

The IUPAC name of acetylene is:

1. Propane
2. Propyne
3. ethene
4. ethyne

Answer

Ethyne

Reason — The IUPAC name of acetylene is ethyne (C_2H_2).

Question 11

The organic compound having a double carbon-carbon bond is :

1. C_4H_{10}
2. C_5H_{10}
3. C_3H_4
4. C_3H_8

Answer

C_5H_{10}

Reason — Carbon-carbon double bond is present in alkenes. Their general formula is C_nH_{2n}. Out of the given options only C_5H_{10} follows this formula. Hence, it contains a carbon-carbon double bond.

Question 12

An example of a cyclic organic compound is:

1. Pentene
2. Butene
3. Benzene
4. Propene

Answer

Benzene

Reason — In benzene, six carbon atoms form a ring structure and there are three single and three double bonds between the carbon atoms. Hence, benzene is a cyclic compound.

Question 13

The IUPAC name of methyl acetylene is:

1. Propyne
2. Ethene
3. Propane
4. Ethyne

Answer

Propyne

Reason — Methyl acetylene is a common name for a compound that has three carbon atoms and a triple bond between two of them.

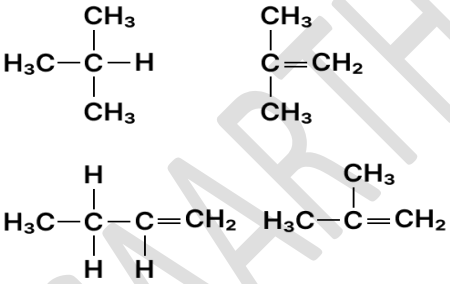
- The compound has 3 carbon atoms, so the root name is "prop-".
- It contains a triple bond, which is indicated by the suffix "-yne".
- So the IUPAC name becomes Propyne.

Let's analyze the given options:

1. Propyne — Correct IUPAC name of methyl acetylene.
2. Ethene — Has 2 carbon atoms and a double bond → Incorrect.
3. Propane — Has 3 carbon atoms but only single bonds → Incorrect.
4. Ethyne — Has 2 carbon atoms and a triple bond → Incorrect.

Question 14

The structures of four hydrocarbons are shown below:



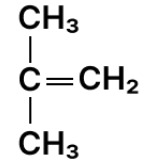
How many isomers of butene are there?

1. 1
2. 2
3. 3
4. 4

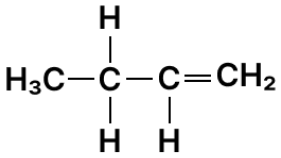
Answer

2

Reason — 2-methyl propene and But-1-ene are two isomers of butene present in the four hydrocarbons shown above.



2-methyl propene



But-1-ene

Question 15

Which of the following is the best reagent to distinguish between ethylene and acetylene ?

P — Bromine water

Q — Ammoniacal silver nitrate solution

R — Acidified potassium dichromate solution

1. Only P
2. Only Q
3. Both P and Q
4. Both Q and R

Answer

Only Q

Reason — Acetylene reacts with ammoniacal silver nitrate solution to give white precipitate of silver acetylide. Whereas, ethylene gives no reaction with ammoniacal silver nitrate solution.

Question 16

Which of the following molecule contains C=C bond between adjacent carbon atoms ?

P — C_4H_8

Q — C_3H_4

R — C_3H_6

1. Only P
2. Only R
3. Both P and R
4. Both P and Q

Answer

Both P and R

Reason — Carbon-carbon double bond is present in alkenes. Their general formula is C_nH_{2n}. Out of the given options both C_4H_8 and C_3H_6 follow this formula. Hence, they contain C=C bond between adjacent carbon atoms.

Question 17

Assertion (A): Carbon shows catenation.

Reason (R): Catenation is the property of self linking by covalent bonds.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation — Carbon has a strong tendency to form bonds with other carbon atoms, resulting in long chains, branched chains, and rings. This is called catenation. Hence, the assertion (A) is true.
Catenation means the ability of atoms to link with themselves via covalent bonds. Hence, the reason (R) is true.
However, the reason explains what is catenation, but it doesn't explain why carbon shows catenation property. The actual reason why carbon shows strong catenation is due to its small atomic size and the strength of the C–C bond, which makes these chains stable. Hence, reason (R) is not the correct explanation of assertion (A).

Question 18

Assertion (A): Alkynes show addition reactions.
Reason (R): Alkanes show substitution reactions.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true but R is not the correct explanation of A.

Explanation— Alkynes contain a carbon–carbon triple bond, making them highly unsaturated; therefore they readily take part in addition reactions with hydrogen, halogens, etc. Hence, the assertion (A) is true.
Alkanes, being saturated hydrocarbons, usually react by substitution, for example, the replacement of a hydrogen atom by chlorine in the presence of ultraviolet light. Hence, the reason (R) is true.
While both statements are correct, the fact that alkanes undergo substitution does not explain why alkynes undergo addition, hence, reason (R) is not the correct explanation of assertion (A).

Question 19

Assertion (A): The members of a homologous series can be prepared by using the same general method.
Reason (R): The members of a homologous series have the same physical properties.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation— All the members of a homologous series can be prepared by using the same general method of preparation. For example: Alcohols are prepared by alkyl halides. Hence, the assertion (A) is true.
However, the physical properties of the members are not identical; they change progressively with increasing molecular mass. For instance, melting points and boiling points rise steadily as the number of carbon atoms increases. Hence, the reason (R) is false.

Question 20

Assertion (A): The brown colour of bromine fades when it is added to ethylene.
Reason (R): Ethylene shows substitution reactions.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation— When a few drops of a bromine solution in carbon tetrachloride are added to ethylene (ethene), the reddish-brown colour of bromine disappears because bromine adds across the carbon–carbon double bond. Hence, the assertion (A) is true.

Ethylene is an alkene and characteristically undergoes addition reactions, not substitution reactions. Hence, the reason (R) is false.

Question 21

Assertion (A): Acetylene burns with a sooty flame.

Reason (R): Acetylene contains a greater carbon content.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true and R is the correct explanation of A.

Explanation— Acetylene (ethyne, C_2H_2) contains a higher proportion of carbon relative to hydrogen than compounds such as ethane (C_2H_6) or ethene (C_2H_4). During ordinary combustion, this excess carbon is not completely oxidised, so glowing carbon particles are produced, giving a luminous, sooty flame. Therefore both statements are correct, and the higher carbon content (Reason) directly explains why acetylene burns with a sooty flame (Assertion).

Question 22

Assertion (A): On adding ammoniacal silver nitrate to ethyne, it gives a white precipitate.

Reason (R): The above reaction forms silver acetylide.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

Both A and R are true and R is the correct explanation of A.

Explanation— Ethyne (HC≡CH) reacts with ammoniacal silver nitrate to give a white precipitate of silver acetylide (AgC≡CAg). Thus Assertion (A) is correct. The precipitate's identity—silver acetylide—explains why the white solid appears, so Reason (R) is also true and provides the correct explanation for the assertion.

Question 23

Assertion (A): Carboxylic acids react with alcohol in presence of concentrated H_2SO_4 to produce a fruity smell.

Reason (R): It is due to the formation of an aldehyde.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the correct explanation of A.
3. A is true but R is false.
4. A is false but R is true.

Answer

A is true but R is false.

Explanation— Carboxylic acids like ethanoic acid react with alcohol in presence of dehydrating agent, concentrated H_2SO_4 to produce a ester with pleasant fruity smell. This reaction is know as reaction of esterification. Hence, the assertion (A) is true.

$$\mathrm{C2H5OH\,ethyl\ alcohol} + \mathrm{CH3COOH\,acetic\ acid} \xrightarrow{\text{Conc. } H_2SO_4} \mathrm{CH3-COO-C2H5\,ethyl\ acetate} + H_2O$$

The pleasant fruity smell is due to the formation of ester not aldehyde. Hence, the reason (R) is false.

Miscellaneous — Very Short Answer Type

Question 1

Choose the correct word/phrase from within the brackets to complete the following sentences:

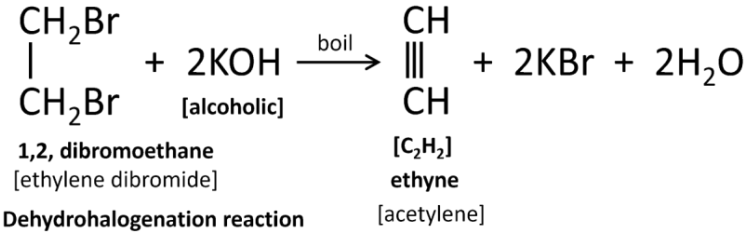
(a) The catalyst used for conversion of ethene to ethane is commonly ..... (nickel/iron/cobalt)

(b) When acetaldehyde is oxidized with acidified potassium dichromate, it forms ..... (ester / ethanol / acetic acid)

(c) Ethanoic acid reacts with ethanol in the presence of concentrated H_2SO_4, so as to form a compound and water. The chemical reaction which takes place is called ..... (dehydration/hydrogenation/esterification)
(d) Write the equation for the reaction taking place between 1,2-dibromoethane and alcoholic potassium hydroxide.
(e) The product formed when ethene gas reacts with water in the presence of sulphuric acid ..... (ethanol / ethanal / ethanoic acid)

Answer

(a) The catalyst used for conversion of ethene to ethane is commonly ***nickel***.
(b) When acetaldehyde is oxidized with acidified potassium dichromate, it forms ***acetic acid***.
(c) Ethanoic acid reacts with ethanol in the presence of concentrated H_2SO_4, so as to form a compound and water. The chemical reaction which takes place is called ***esterification***
(d) Reaction between 1, 2 – dibromoethane and alcoholic potassium hydroxide:



(e) The product formed when ethene gas reacts with water in the presence of sulphuric acid is ***ethanol***.

Question 2

From the following organic compounds given below, choose one compound in each case which relates to the description [i] to [iv]:
[Ethyne, ethanol, acetic acid, ethene, methane].
(a) An unsaturated hydrocarbon used for welding purposes.
(b) An organic compound whose functional group is carboxyl.
(c) A hydrocarbon which on catalytic hydrogenation gives a saturated hydrocarbon.
(d) An organic compound used as a thermometric liquid.

Answer

(a) Ethyne
(b) Acetic acid
(c) Ethene
(d) Ethanol

Question 3

Name :
(a) Process by which ethane is obtained from ethene.
(b) A hydrocarbon which contributes towards the greenhouse effect.
(c) The distinctive reaction that takes place when ethanol is treated with acetic acid.
(d) The property of elements by virtue of which atoms of the element can link to each other in the form of a long chain or ring structure.
(e) The reaction when an alkyl halide is treated with alcoholic potassium hydroxide.
(f) The hydrocarbons containing $-C-O||$ functional group.

Answer

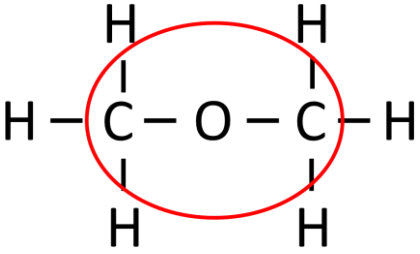
(a) Catalytic hydrogenation (addition)
(b) Methane
(c) Esterification
(d) Catenation
(e) Dehydrohalogenation
(f) ketones

Question 4

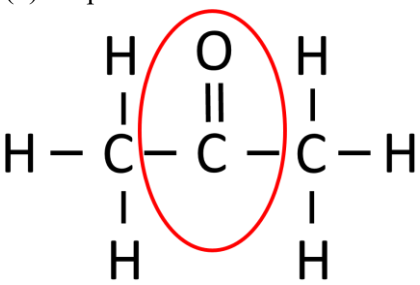
Identify the functional group in :
(a) Dimethyl ether
(b) Propanone

Answer

(a) Dimethyl ether contains the functional group Alkoxy (ether). It is circled in its structural formula below:



(b) Propanone contains the functional group Keto. It is circled in its structural formula below:



Miscellaneous — Short Answer Type

Question 1

(a) Why is pure acetic acid known as glacial acetic acid ?
(b) Give a chemical equation for the reaction between ethyl alcohol and acetic acid.

Answer

(a) Acetic acid that contains a very low amount of water (less than 1%) is called anhydrous (water-free) acetic acid or glacial acetic acid. Its melting point is around 17°C. On cooling it forms a crystalline mass resembling ice and for this reason it is called glacial acetic acid.

(b) Reaction between ethyl alcohol and acetic acid:

$$\mathrm{C2H5OHethyl\ alcohol} + \mathrm{CH3COOHacetic\ acid} \xrightarrow{\text{Conc. } H_2SO_4} \mathrm{CH3-COO-C2H5ethyl\ acetate} + H_2O$$

Question 2

Find the odd one out and explain:
C_3H_8, C_5H_{10}, C_2H_6, CH_4

Answer

C_5H_{10}

Reason — As it is not following the general alkane formula (C_nH_{2n+2}). It is an alkene with general formula C_nH_{2n}

Question 3

(a) Define isomerism
(b) Give the IUPAC name of the isomer C_4H_{10} which has a branched chain.

Answer

(a) Isomerism is the phenomenon due to which two or more compounds have the same molecular formula but differ in molecular arrangement or in structural formula.
Example : Isomers of pentane are (i) n pentane, (ii) isopentane and (iii) neo-pentane

(b) IUPAC name of C_4H_{10} is Butane.

Question 4

Write equation of ethyl bromide with :
(a) aqueous NaOH
(b) alcoholic NaOH

Answer

(a) $C_2H_5Br + NaOH aqueous \xrightarrow{boil} C2H5OH$ Ethanol [ethyl alcohol] $+ NaBr$

(b)

$$C_2H_5Br + NaOH \text{ alcoholic } NaOH \xrightarrow{boil} C2H4 \text{ Ethene [ethylene]} + NaBr + H_2O$$

Question 5

Write balanced chemical equations for the following:

(a) Monochloro ethane is hydrolysed with aqueous KOH.

(b) A mixture of sodalime and sodium acetate is heated.

(c) Ethanol under high pressure and low temperature is treated with acidified potassium dichromate.

(d) Water is added to calcium carbide.

(e) Ethanol reacts with sodium at room temperature.

Answer

(a) Monochloro ethane is hydrolysed with aqueous KOH:

$$C2H5 - Cl \text{ Chloroethane [ethyl chloride]} + KOH \text{ [aq.]} \xrightarrow{boil} C2H5 - OH \text{ Ethanol [ethyl alcohol]} + KCl$$

(b) A mixture of sodalime and sodium acetate is heated:

$$CH3COONa \text{sodium acetate} + NaOH \text{sodalime} \rightarrow CaO\Delta CH4 \text{methane} + Na_2CO_3$$

(c) Ethanol under high pressure and low temperature is treated with acidified potassium dichromate:

$$C2H5OH \text{ ethanol[ethyl alcohol]} \xrightarrow[K_2Cr_2O_7]{[O]} CH3CHO \text{ethanal [acetaldehyde]} \xrightarrow[K_2Cr_2O_7]{[O]} CH3COOH \text{ethanoic acid[acetic acid]}$$

(d) Water is added to calcium carbide:

$$CaC2 \text{calcium carbide} + 2H2O \text{water} \longrightarrow C2H2 \text{ethyne [acetylene]} + Ca(OH)_2$$

(e) Ethanol reacts with sodium at room temperature:

$$2C2H5OH \text{ ethanol} + 2Na \longrightarrow 2C2H5ONa \text{ sodium ethoxide} + H_2$$

Question 6

Give chemical equation for:

(a) The laboratory preparation of methane from sodium acetate.

(b) The reaction of one mole of ethene with one mole of chlorine gas.

(c) The preparation of ethyne from 1,2-dibromoethane.

(d) Preparation of ethane from sodium propionate.

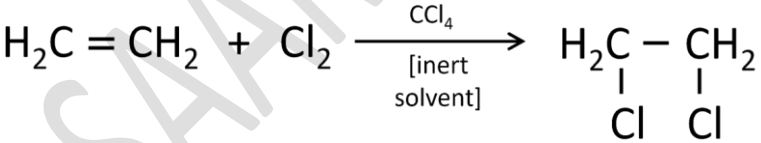
(e) preparation of ethanol from monochloroethane and aq. sodium hydroxide.

Answer

(a) Methane from sodium acetate :

$$CH3COONa \text{sodium acetate} + NaOH \text{sodalime} \rightarrow CaO\Delta CH4 \text{methane} + Na_2CO_3$$

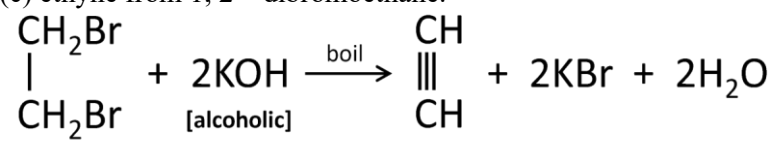
(b) one mole of ethene with one mole of chlorine gas:



Ethene [ethylene]

1,2, dichloroethane
[ethylene dichloride]

(c) ethyne from 1, 2 – dibromoethane.



1,2, dibromoethane
[ethylene dibromide]

Dehydrohalogenation reaction

[C_2H_2]
ethyne
[acetylene]

(d) Preparation of ethane from sodium propionate.

$$CH3-CH2.COONa\text{sodium propionate} + NaOH\text{sodalime} \xrightarrow[\Delta]{CaO} C2H6\text{ethane} + Na_2CO_3$$

(e) Preparation of ethanol from monochloroethane and aq. sodium hydroxide.

$$C2H5-Cl\ \text{monochloroethane} + NaOH[aq]\ \text{aq. sodium hydroxide} \xrightarrow{\text{boil}} C2H5-OH\ \text{Ethanol [ethyl alcohol]} + NaCl$$

Question 7

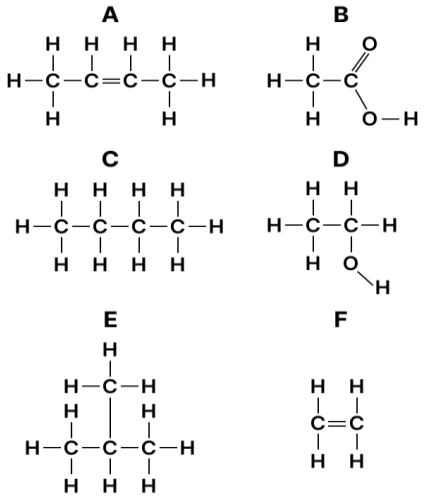
Distinguish ethane and ethene (using alkaline potassium permanganate solution).

Answer

When ethene is passed through alkaline potassium permanganate solution (cold dil. $KMnO_4$), it decolourizes the purple coloured solution whereas on passing Ethane, alkaline potassium permanganate solution remains purple.

Question 8

The structures of six organic compounds are shown:



(a) Identify two of the compounds that are members of the same homologous series but are **not** isomers.

(b) Which two compounds are isomers of each other?

(c) F can be prepared from D. Give a chemical equation for the reaction.

Answer

(a) A and F

(b) C and E

(c) $C_2H_5OH \xrightarrow[170°C]{\text{Conc. } H_2SO_4} C_2H_4 \uparrow + H_2O$

Reason

(a) Butene (C_4H_8) and Ethene (C_2H_4) are members of homologous series of alkenes and are not isomers.

(b) Both C and E have the same molecular formula (C_4H_{10}) but different structure. C is n-butane and E is iso-butane.

(c) Ethene (C_2H_4) can be prepared by the dehydration of ethyl alcohol (C_2H_5OH).

Miscellaneous— Long Answer Type

Question 1

A compound X when treated with an organic acid Y (having vinegar like smell) in the presence of the acid Z, forms a compound P which has a fruity smell.

(a) Identify X, Y and Z.

(b) Write structural formula of X and Y.

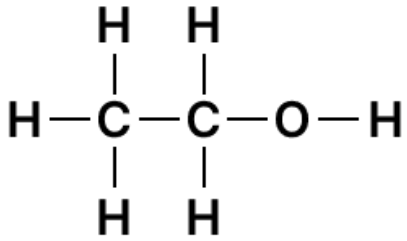
(c) What type of compound is P?

(d) Name the above reaction.

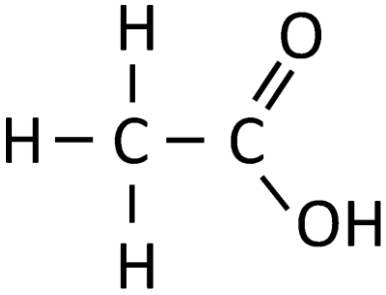
(e) If compound X and Y both have 2 carbon atoms. Write the reaction.

Answer

(a) X, Y and Z are:
X → Ethyl alcohol
Y → Acetic acid
Z → Conc. Sulphuric acid
(b) The structural formulae are shown below:
Ethyl alcohol (X)



Acetic acid (Y)



(c) Ester
(d) Esterification
(e) The reaction is given below:

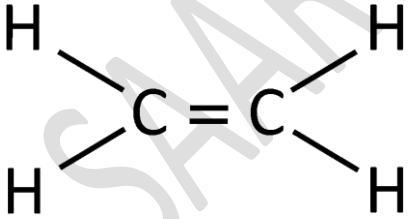
$$C2H5OH\text{ethyl alcohol} + CH3COOH\text{acetic acid} \xrightarrow{\text{Conc. } H_2SO_4} CH3 - COO - C2H5\text{ethyl ethanoate} + H_2O$$

Question 2

Compound A is bubbled through bromine dissolved in carbon tetrachloride and the product formed is $CH_2Br–CH_2Br$.
(a) Draw the structural formula of A.
(b) What type of reaction has A undergone.
(c) What is your observation.
(d) Name (not formula) the compound formed when steam reacts with A in the presence of phosphoric acid.
(e) What is the procedure for converting the product of (e) (iv) back to A ?

Answer

(a) Compound A is Ethene ($H_2C=CH_2$). It's structural formula is shown below:



(b) Ethene [$CH_2=CH_2$] has undergone addition reaction.
(c) Brown colour of bromine is discharged.
(d) Ethanol

$$C2H4\text{Ethene} + H2O\text{ water} \rightarrow H + \text{acid}C2H5OH\text{ ethanol}$$

(e) Ethanol can be converted into ethene, by dehydrating it with concentrated H_2SO_4 at 170°C.

$$C2H5OH\text{ ethyl alcohol} \xrightarrow[170°C]{\text{Conc. } H_2SO_4[\text{excess}]} C2H4\text{ethene} + H_2O$$

Question 3

Draw the structural formula for each of the following—

(a) Ethanoic acid

(b) But-2-yne

(c) Methanoic acid

(d) Ethanal

(e) Ethyne

(f) Acetone

(g) 2-methyl propane

(h) An isomer of n-butane

(i) 2-propanol

(j) ethanol

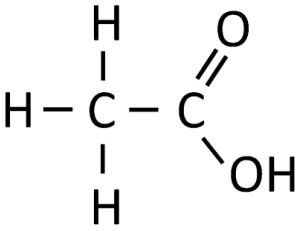
(k) 1-propanal

(l) ethanoic acid

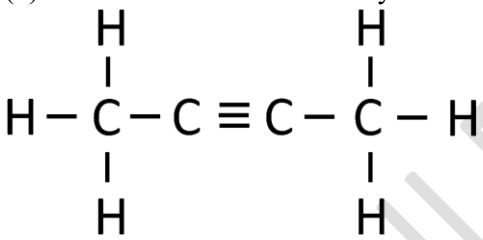
(m) 1,2, dichloroethane

Answer

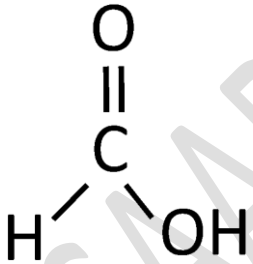
(a) Structural formula of Ethanoic acid is shown below:



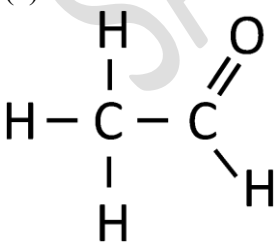
(b) Structural formula of But-2-yne is shown below:



(c) Methanoic acid:

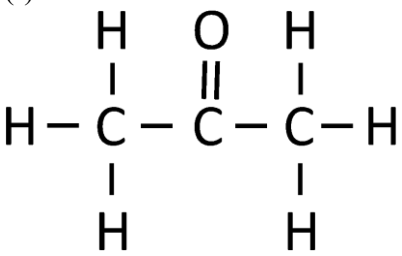


(d) Ethanal:

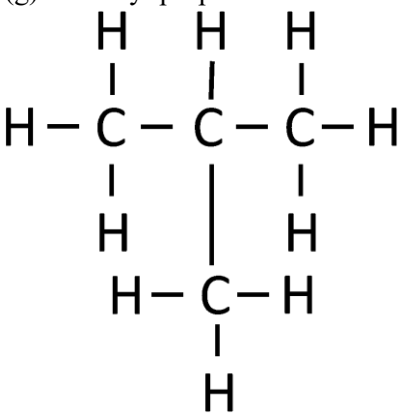


(e) Ethyne:

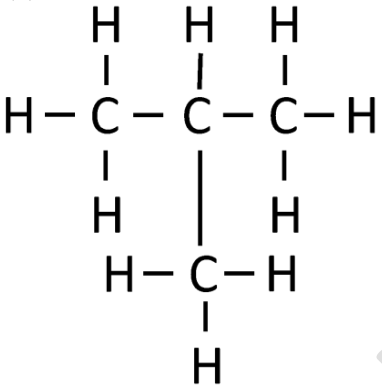
(f) Acetone:



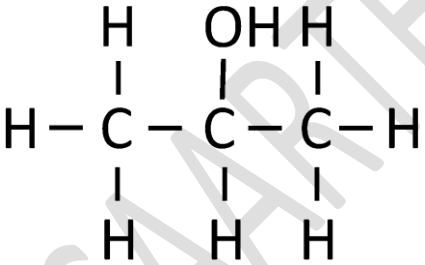
(g) 2-methyl propane:



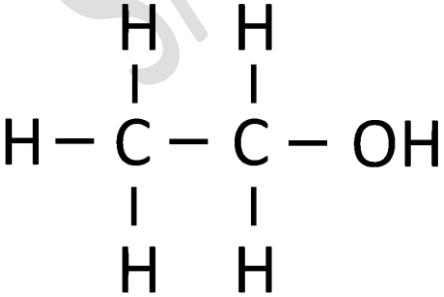
(h) Iso-butane is an isomer of n-butane. Its structure is shown below:



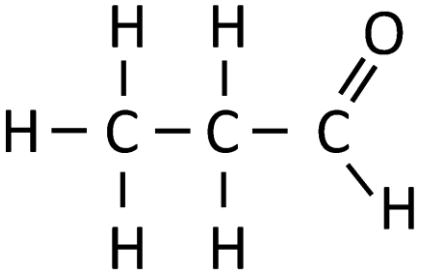
(i) 2-propanol:



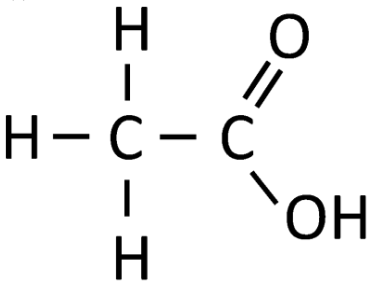
(j) ethanol



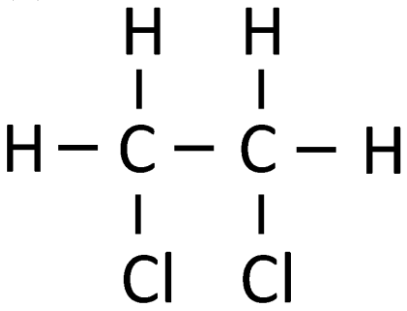
(k) 1-propanal



(l) ethanoic acid



(m) 1, 2, dichloroethane



Question 4

Give balanced chemical equation for the following conversions :

(a) Ethanoic acid to ethyl ethanoate.

(b) Calcium carbide to ethyne

(c) Sodium ethanoate to methane.

(d) Ethyl chloride to ethyl alcohol

(e) Ethyl chloride to ethene

(f) Ethene to ethyl alcohol

(g) Ethyl alcohol to ethene

Answer

(a) Ethanoic acid to ethyl ethanoate. :

$$C2H5OHethyl\ alcohol + CH3COOHacetic\ acid \xrightarrow{Conc.\ H_2SO_4} CH3 - COO - C2H5ethyl\ ethanoate + H_2O$$

(b) Ethyne is formed

$$CaC2calcium\ carbide + 2H2Owater \longrightarrow C2H2ethyne\ [acetylene] + Ca(OH)_2$$

(c) Sodium ethanoate to methane

$$CH3COONasodium\ acetate + NaOHsodalime \xrightarrow[\Delta]{CaO} CH4methane + Na_2CO_3$$

(d) By boiling ethyl chloride with aqueous NaOH.

$$C2H5 - Cl\ Chloroethane\ [ethyl\ chloride] + NaOH\ [aq.] \xrightarrow{boil} C2H5OH\ Ethanol\ [ethyl\ alcohol] + NaCl$$

(e) By boiling ethyl chloride with alcoholic KOH.

$$C2H5 - Cl\ Chloroethane\ [ethyl\ chloride] + KOH\ [aq.]\ alcoholic\ KOH \xrightarrow{boil} C2H4\ Ethene\ [ethylene] + KCl + H_2O$$

(f) Ethene is absorbed in conc. sulphuric acid at 80 °C under 30 atmos. to give ethyl hydrogen sulphate, which on hydrolysis with steam gives ethanol.

$$C2H4\ \text{Ethene} + H2SO4\text{conc.} \rightarrow 80°C30\ \text{atmos.}\ C2H5 - HSO4\ \text{Ethyl hydrogen sulphate}$$

$$C2H5 - HSO4\ \text{Ethyl hydrogen sulphate} + H2O\text{steam} \longrightarrow C2H5 - OH\ \text{Ethanol [ethyl alcohol]} + H_2SO_4$$

(g) By heating ethyl alcohol with concentrated H_2SO_4 at 170°C.

$$C2H5OH\ \text{ethyl alcohol} \xrightarrow[170°C]{\text{Conc. } H_2SO_4\text{[excess]}} C2H4\text{ethene} + H_2O$$