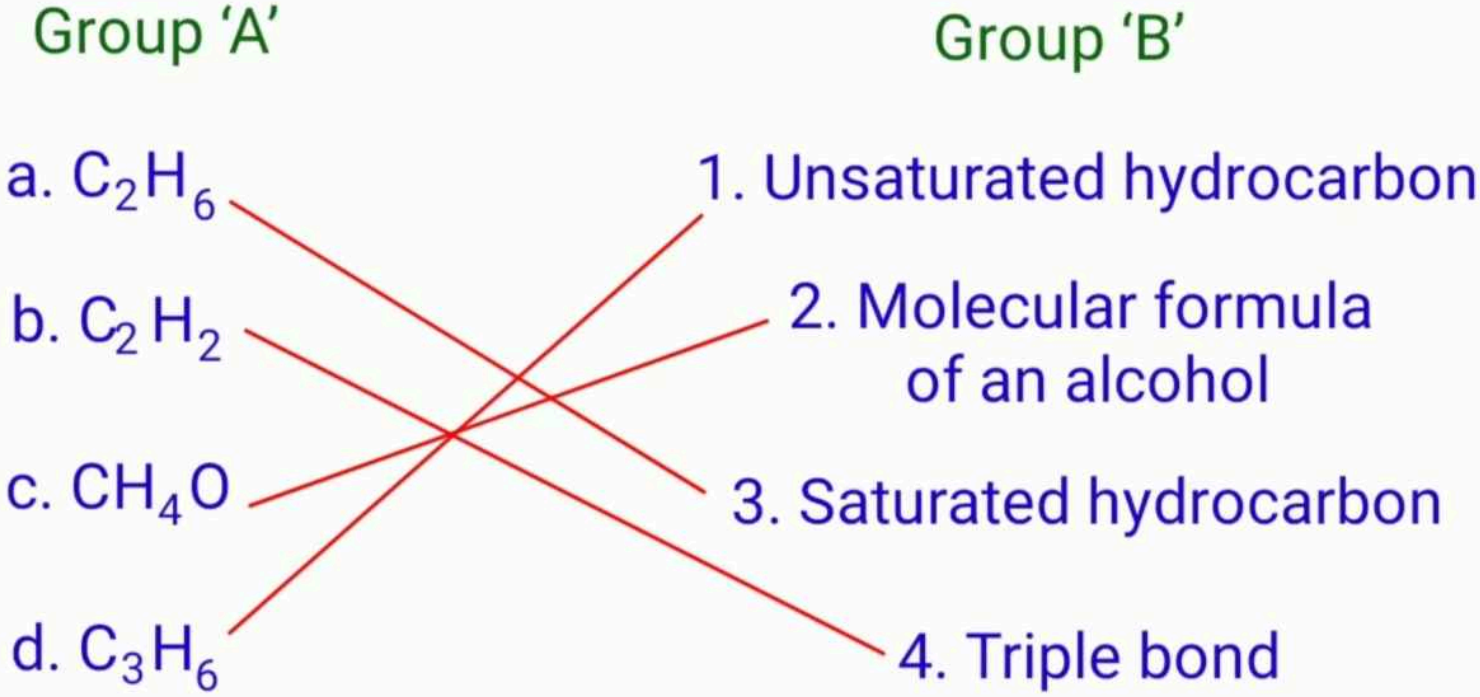
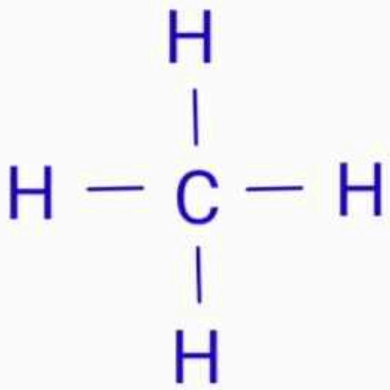
1. Match the pairs.

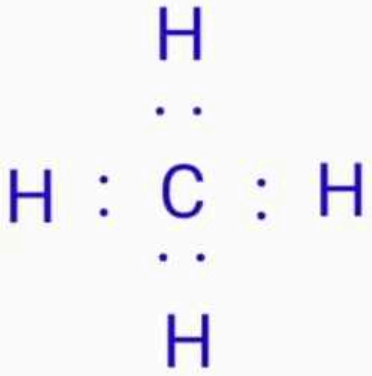

Group 'A'
Group 'B'
a. C_2H_6
b. C_2H_2
c. CH_4O
d. C_3H_6
1. Unsaturated hydrocarbon
2. Molecular formula of an alcohol
3. Saturated hydrocarbon
4. Triple bond

2. Draw an electron dot structure of the following molecules. (Without showing the circles)

a. Methane

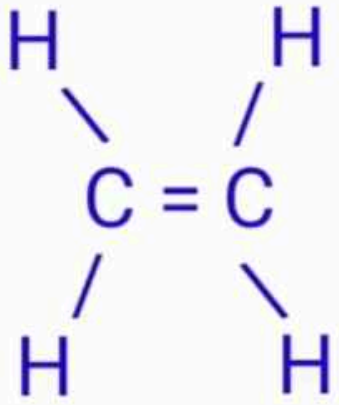
Methane : Molecular formula : CH_4





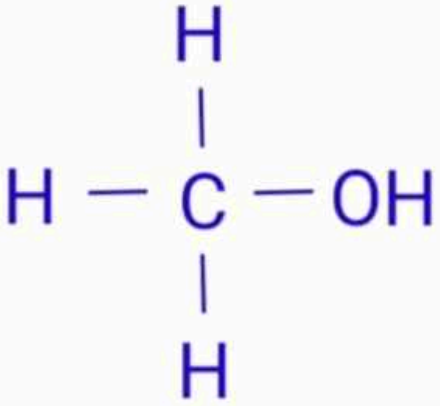
b. Ethene

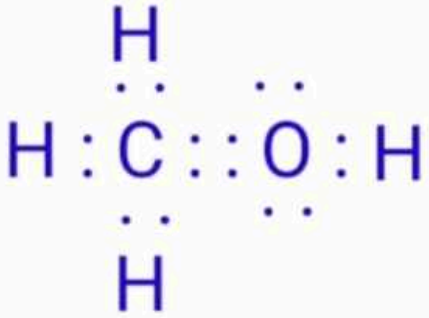
Ethene : Molecular formula : $H_2C = CH_2$



c. Methanol

Methanol : Molecular formula : H_3C -OH





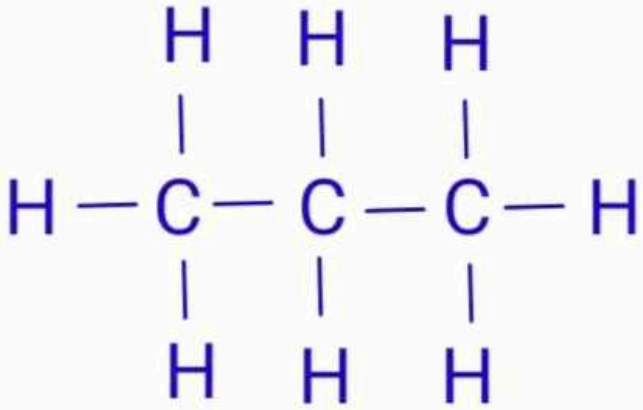
d. Water

Water : Molecular formula : H_2O

3. Draw structural formulae of compounds from their molecular formula given below.

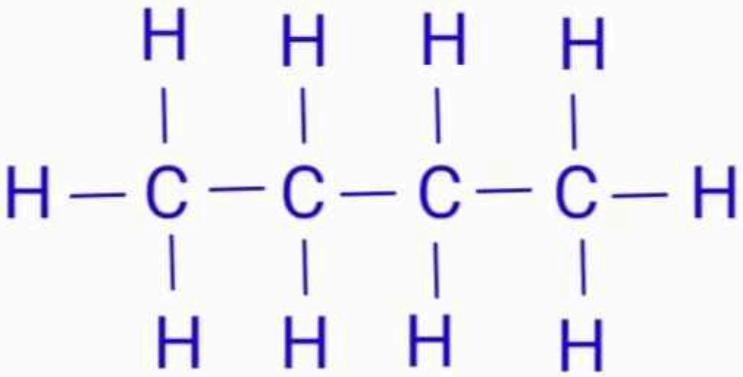
a. C_3H_8

Propane



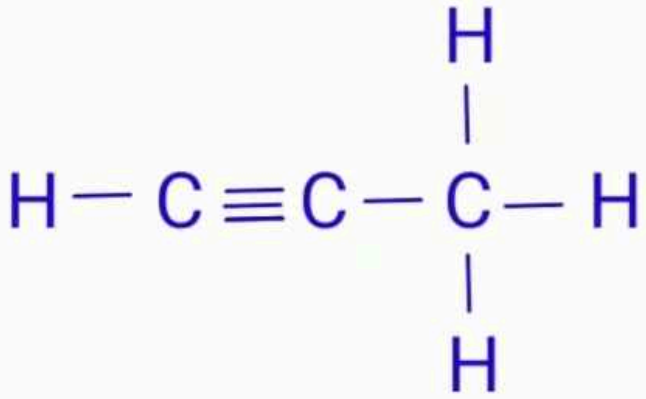
b. C_4H_{10}

Butane



c. C_3H_4

Propyne



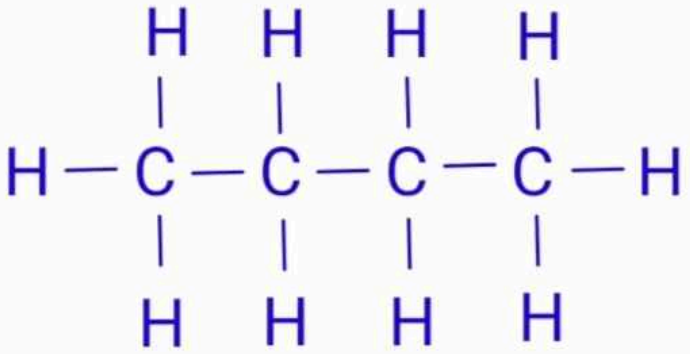
4. Explain the following terms with example.

a. Structural isomerism

The phenomenon in which compounds having different structural formulae have the same molecular formula is called structural isomerism.

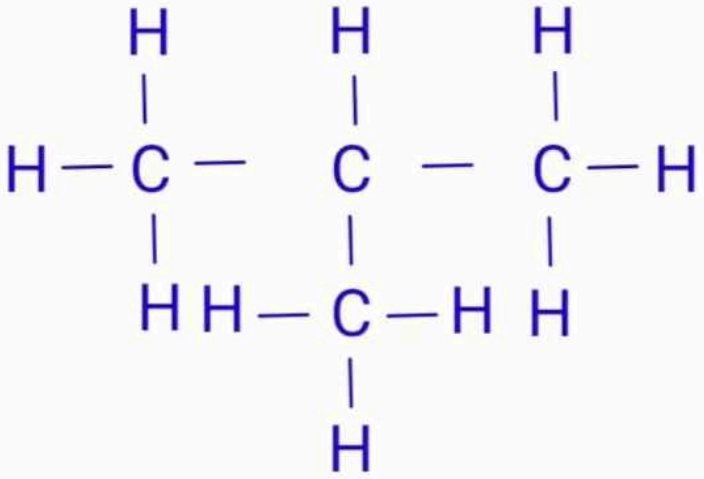
Butane is represented by two different compounds as their structural formulae are different. These two different structural formulae have the same molecular formula i.e.

a. Structural isomerism



Straight chain

a. Structural isomerism

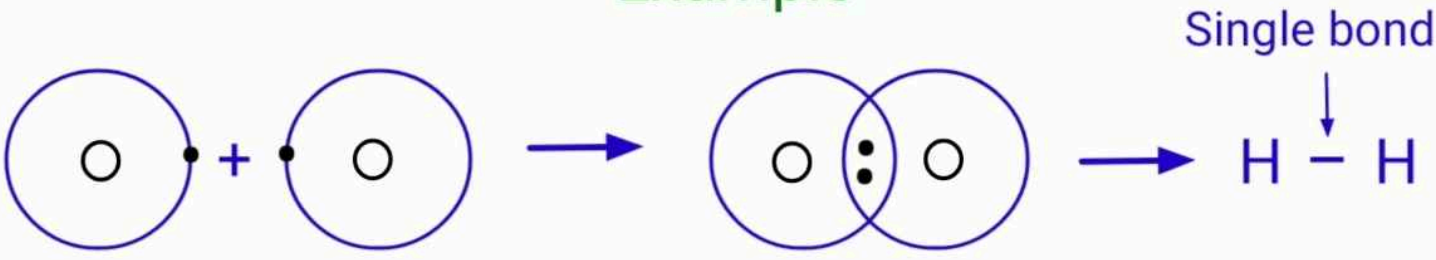


Branched chain

b. Covalent bond

The chemical bond formed by sharing of two valence electrons between the two atoms is called covalent bond.

Example



c. Hetero atom in a carbon compound.

Carbon compounds are formed by formation of bonds of carbon with other elements such as halogens, oxygen, nitrogen, sulphur. The atoms of these elements substitute one or more hydrogen atoms in the hydrocarbon chain and thereby the tetravalency of carbon is satisfied. The atom of the element which is substitute for hydrogen is referred to as a hetero atom. Sometimes hetero atoms are not alone but exist in the form of certain group of atoms.

c. Hetero atom in a carbon compound.

Examples :

Structural formula	Hetero atom
– O –	Oxygen
$-NH_2$	Nitrogen

d. Functional group

The compound acquire specific chemical properties due to these hetero atoms or the groups of atoms that contain hetero atoms, irrespective of the length and nature of the carbon chain in that compound. Therefore these hetero atoms or groups of atoms containing hetero atoms are called the functional groups.

All organic compounds are derivatives of hydrocarbons. The derivatives are formed by replacing one or more H-atom/atoms of hydrocarbon by some other hetero atom or groups of atoms containing hetero atoms. After replacement, a new compound is formed which has properties different from the parent hydrocarbon.

Examples :

For methane, if one hydrogen atom is replaced by an -OH group, then a compound is methyl alcohol (CH_3OH). The -OH group is known as the alcoholic functional group.

Functional group is organic compound :

1. Alcohol : - OH (hydroxy group)
2. Carboxylic acid : - COOH

e. Alkane

In hydrocarbon, the four valencies of carbon atom are satisfied only by the single bonds, such compounds are called alkane.

In methane, four hydrogen atoms are bonded to carbon atom by four single covalent bonds.

Examples : Methane (CH_4), Ethane (C_2H_6).

f. Unsaturated hydrocarbon

The carbon compounds having a double bond or triple bond between two carbon atoms are called unsaturated hydrocarbons.

The unsaturated hydrocarbons containing a carbon-carbon double bond are called alkenes.

e.g. Ethene ($CH_2 = CH_2$), Propene ($CH_3 - CH = CH_2$).

g. Homopolymer

The polymers formed by repetition of single monomer are called homopolymer.
e.g. polyethylene.

$$(-CH_2-CH_2-)_n$$

h. Monomer

The small unit that repeats regularly to form a polymer is called monomer.

E.g. Tetrafluro ethylene ($CF_2 = CF_2$) is monomer in the teflon polymer. Monomers may be of same type or of different types. Polymers acquire various properties depending on the nature of the monomers in them and the type of their structure.

i. Reduction

A chemical reaction in which substance gains hydrogen or loses oxygen is called a reduction reaction. E.g. Ethylene is reduced to ethane. An unsaturated hydrocarbon can undergo reduction by addition of hydrogen to form a saturated hydrocarbon in the presence of Ni or Pt catalyst. Hydrogenation of vegetable oil in the presence of Ni or Pt catalyst toreaction form saturated fats is also a reduction reaction.

j. Oxidant

The substances which can give oxygen to other compounds substances are called oxidant or oxidizing agents. compounds e.g. Potassium permanganate and potassium dichromate in acidic or alkaline medium are commonly used oxidants. Oxidants affect certain functional groups present in carbon compounds.

5. Write the IUPAC names of the following structural formulae.

a. CH_3-CH_2-CH_2-CH_3

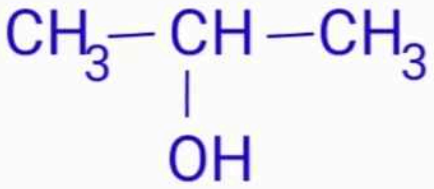
The number of carbon atoms in the largest chain : 4

Parent alkane : Butane

IUPAC name : n-Butane

b. CH_3-CHOH-CH_3

The number of carbon atoms in the longest chain : 3



Parent alkane : Propane

Functional group : -OH (ol)

Assign the number : 2

The carbon atom to which the -OH group is attached is numbered as C_2. If the carbon chain of the compound contains a -OH group then change the ending of the parent name, i.e. 'e' of propane is replaced by 'ol' (ol stands for alcohol)

Parent suffix : Propan-2-ol

IUPAC name : Propan-2-ol

c. CH_3-CH_2-COOH

The number of carbon atoms in the longest chain : 3

Parent alkane : Propane

Functional group : -COOH (-oic acid)

If the carbon chain of the compound contains a -COOH group then change the ending of the parent name, i.e. 'e' of propane is replaced by 'oic acid'.

c. CH_3-CH_2-COOH

Parent suffix : Propanoic acid

IUPAC name : Propanoic acid

d. CH_3-CH_2-NH_2

Number of carbon atoms : 2

Parent alkane : Ethane

Functional group : -NH_2 (amine)

d. CH_3-CH_2-NH_2

If the carbon chain of the compound contains a -NH_2 group, then change the ending of the parent name, i.e. 'e' of ethane is replaced by 'amine'.

Parent suffix : Ethanamine

IUPAC name : Ethanamine

e. CH_3-CHO

Number of carbon atoms : 2

Parent alkane : Ethane

Functional group : -CHO (al)

e. CH_3-CHO

If the cabon chain of the compound contains a -CHO group, then change the ending of the parent name, i.e. 'e' of ethane is replaced by 'al'.

Parent suffix : Ethanal

IUPAC name : Ethanal

f. CH_3-CO-CH_2-CH_3

Number of carbon atoms in the longest chain : 4

Parent alkane : Butane

Functional group : -CO- (-one)

f. CH_3-CO-CH_2-CH_3

Assign the number : 2 $(\overset{1}{C}H_3\text{-}\overset{2}{C}O\text{-}\overset{3}{C}H_2\text{-}\overset{4}{C}H_3)$

In the longest chain, the numbering of carbon atom starts from the carbon atom nearest to the functional group.

f. CH_3-CO-CH_2-CH_3

If the carbon chain of the compound contains a (-CO-) group, then change the ending of the parent name, i.e. 'e' of butane it replaced by 'one'.

Parent suffix : Butane-2-one

IUPAC name : Butane-2-one

6. Identify the type of the following reaction of carbon compounds.

a. $CH_3\text{-}CH_2\text{-}CH_2\text{-}OH \xrightarrow[\text{alk } KMnO_4]{(O)} CH_3\text{-}CH_2\text{-}COOH$

Chemical reaction : Oxidation reaction

b. $CH_3\text{-}CH_2\text{-}CH_3 + O_2 \longrightarrow 3CO_2 + 4H_2O$

Chemical reaction : Combustion

c. $CH_3-CH=CH-CH_3 + Br_2 \longrightarrow CH_3-CHBr-CHBr-CH_3$

Chemical reaction : Addition reaction

d. $CH_3-CH_3 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3-CH_2Cl + HCl$

Chemical reaction : Substitution reaction

e. $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}OH \xrightarrow[\Delta]{Conc.H_2SO_4} CH_3\text{-}CH_2\text{-}CH{=}CH_2 + H_2O$

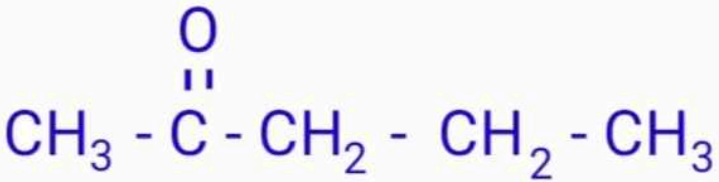
Chemical reaction : Dehydration reaction

f. $CH_3\text{-}CH_2\text{-}COOH + NaOH \longrightarrow CH_3\text{-}CH_2\text{-}COO^-Na^+ + H_2O$

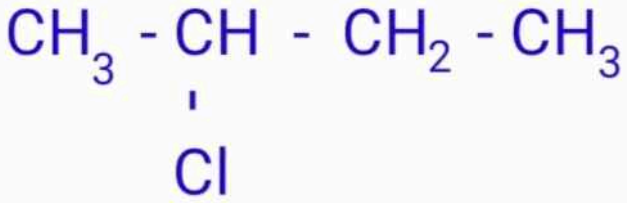
Chemical reaction : Neutrilization

7. Write structural formulae for the following IUPAC names.

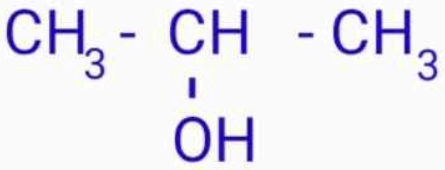
a. pentan -2-one



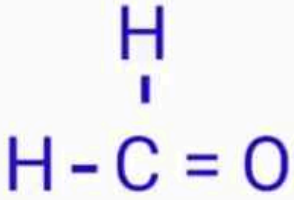
b. 2- chlorobutane



c. propan - 2- ol



d. methanal



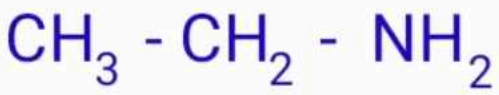
e. butanoic acid

$CH_3 - CH_2 - CH_2 - COOH$

f. 1- bromopropane

$CH_3 - CH_2 - CH_2 - Br$

g. ethanamine



h. butanone

8. Write answers as directed.

a. What causes the existance of very large number of carbon compound ?

(1) Carbon has a unique ability to form strong covalent bonds with other carbon atoms ; this results in formation of big molecules. This property of carbon is called catenation power. The carbon compounds contain open chains or closed chains of carbon atoms.

An open chain can be a straight chain or a branched chain. A closed chain is a ring structure. The covalent bond between two carbon atoms is strong and therefore stable. Carbon is bestowed with catenation power due to the strong and stable covalent bonds.

(2) One, two or three covalent bonds can bond together two carbon atoms. These bonds are called single covalent bond, double covalent bond and triple covalent bond respectively. Due to the ability of carbon atoms to form multiple bonds as well as single bonds, the number of carbon compounds increases. For example, there are three compounds, namely, ethane (CH_3 - CH_3), ethene ($CH_2 = CH_2$), and ethyne ($CH \equiv CH$) which contain two carbon atoms.

(3) Carbon being tetravalent, one carbon atom can form bonds with four other atoms (carbon or any other). This results in formation of many compounds. These compounds posses different properties as per the atoms to which carbon is bonded.

For example, five different compounds are formed using one carbon atom and two monovalent elements hydrogen and chlorine : CH_4, CH_3Cl, CH_2Cl_2, $CHCl_3$, CCl_4. Similarly carbon atoms form covalent bonds with atoms of elements like O, N, S, halogen and P to form different types of carbon compounds in large number.

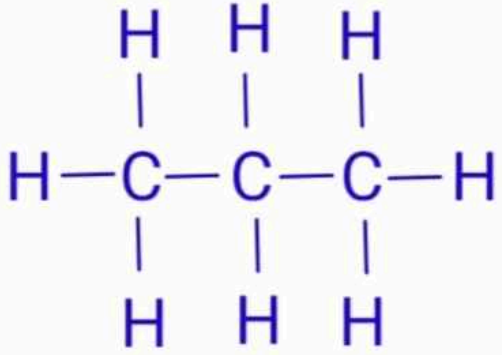
(4) Isomerism is one more characteristic of carbon compound which is responsible for large number of carbon compounds.

b. Saturated hydrocarbons are classified into three types. Write these names giving one example each.

Saturated hydrocarbons are classified into three types. Their names and examples are as ;

(1) Straight chain hydrocarbons

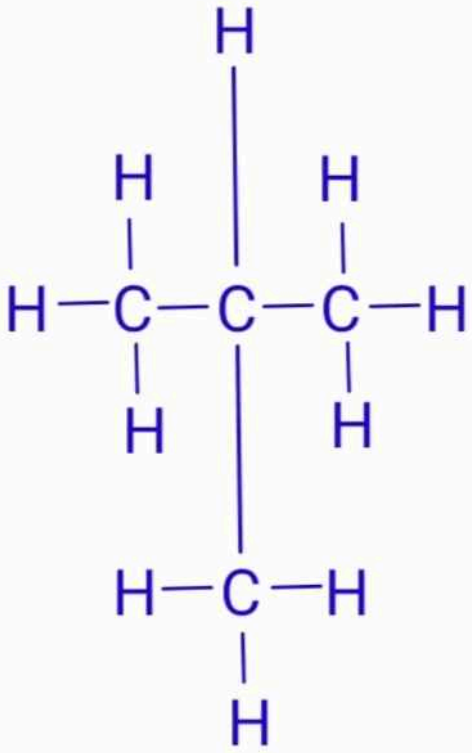
Propane
C_3H_8



(2) Branched chain hydrocarbons

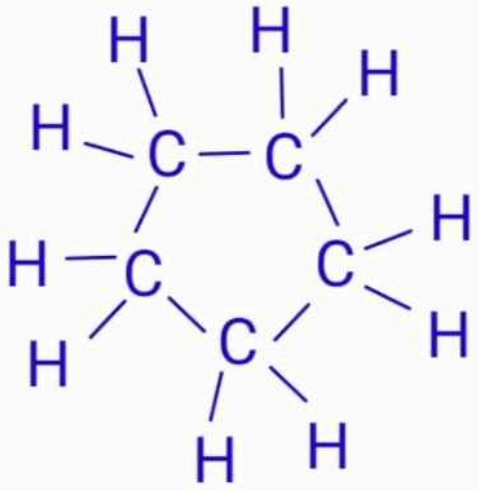
Isobutane

C_4H_{10}

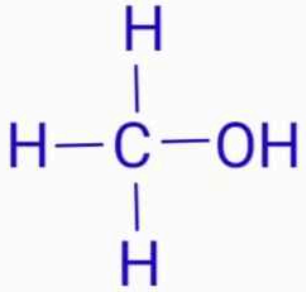


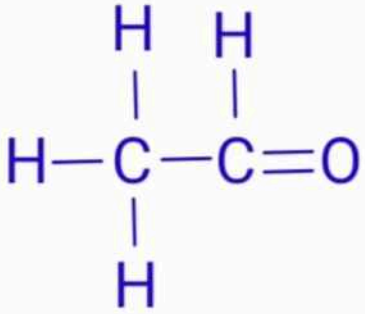
(3) Cyclic hydrocarbons

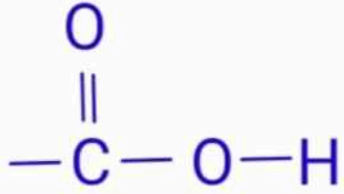
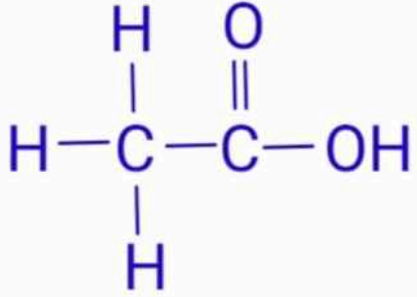
Cyclopentane C_5H_{10}

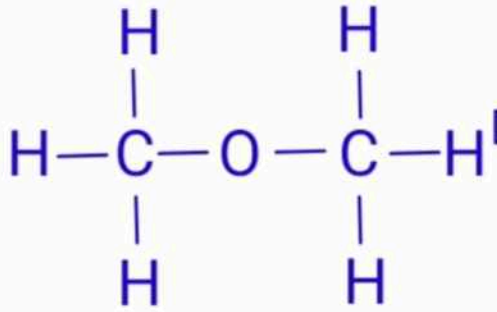


c. Give any four functional groups containing oxygen as the heteroatom in it. Write name and structural formula of one example each

Name	Strucural formula	Condensed Structural Formula	Example	Name
Alcohol	—O—H	—OH		Methanol

Name	Strucural formula	Condensed Structural Formula	Example	Name
Aldehyde		—CHO		Acetal-dehyde

Name	Strucural formula	Condensed Structural Formula	Example	Name
Carboxylic acid		— COOH		Acetic acid

Name	Strucural formula	Condensed Structural Formula	Example	Name
Ether	— O —	— O —		Dimethyl ether

d. Give names of three functional groups containing three different hetero atoms. Write name and structural formula of one example each.

Hetero atom	Name	Structural formula	Condensed Structural formula	Example
Halogen	Halo	- X (- Cl, - Br, - I)	- X (- Cl, - Br, - I)	CH_3Cl Chloromethane
Oxygen	Alcohol	- O - H	- OH	CH_3 - OH Methanol
Nitrogen	Amine	- N - H | H	- NH_2	CH_3 - NH_2 Methyl amine

e. Give names of three natural polymers. Write the place of their occurrance and names of monomers from which they are formed.

(1) Polysaccharide is a a natural polymer. It occurs in starch/carbohydrates. It is formed from monomer glucose.

(2) Protein is a natural polymer. It occurs in muscles, hair, enzymes, skin, egg. It is formed from alpha amino acids.

(3) Rubber is a natural polymer. It occurs in latex of rubber tree. It is formed from monomer isoprene.

f. What is meant by vinegar and gasohol ? What are their uses ?

(1) Vinegar is a 5 - 8 % aqueous solution of acetic acid. It is used as a preservative in pickles. It is used to cook meat. It is used as a salad dressing.

(2) To increase the efficiency of petrol, it is mixed with 10 % anhydrous ethanol, such a fuel is called gasohol. It is used as a fuel in cars and other vehicles.

g. What is a catalyst ? Write any one reaction which is brought about by use of catalyst ?

Catalyst is substance, which changes the rate of reaction, without causing any disturbance to it.

Vegetable oil (unsaturated compound) undergoes addition reaction with hydrogen in the presence of nickel catalyst to form vanaspati ghee (saturated compound)

g. What is a catalyst ? Write any one reaction which is brought about by use of catalyst ?