CARBON COMPOUND

CARBON

The element carbon is a nonmetal, and its chemical symbol is C. The atomic number of carbon is 6 and its mass number is 12. The electronic configuration of carbon is $1s^2$, $2s^2$ $2p^2$. It is clear that carbon atom has four electron in its outer most shell. It has no tendency to gain or loss electrons to complete its octet. So, a Carbon atom completes its octet by sharing electrons with other atoms. Therefore Carbon always forms covalent bonds.

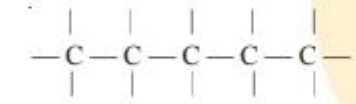
◈ **Tetravalent**

An atom of carbon needs four electrons to complete its octet. Therefore the valency of Carbon is 4. That is Carbon is tetravalent

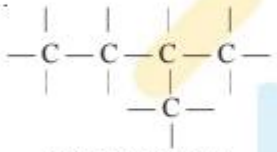
◈ **Catenation**

Catenation is the property of atoms of an element to link with one another through covalent bonds to form a chain of atoms.

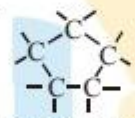
Carbon atom possesses this unique capacity to link with other carbon atoms to form various types of straight chains, branched chains and ring structures. This gives rise to a large variety of compounds. Carbon shows maximum catenation extent due to the strong carbon-carbon sigma bonds.



Straight chain



Branched chains



Ring structure

Occurrence of Carbon

Carbon occurs in nature in 'free state' (as element) as well as in the 'combined state' (in the form of compounds with other elements).

◆ **In free state :** carbon occurs in nature mainly in two forms : diamond and graphite. Another naturally occurring form of carbon called buckminsterfullerence has been discovered recently. Please note that only a small amount of carbon occurs as free element in the earth's crust. Most of carbon occurs in the combined state.

◆ **In the combined state :** carbon occurs in nature in the form of compounds such as

(i) Carbon dioxide gas in air

(ii) Carbonates (like limestone, marble and chalk) (iii) Fossil fuels like coal, petroleum and natural gas

(iv) Organic compounds like carbohydrates, fats and proteins, and

(v) Wood, cotton and wool, etc.

Allotropes of Carbon

The various physical forms in which an element can exist are called allotropes of the element. The carbon element exists in three solid forms called allotropes. The three allotropes of carbon are :

(A) Diamond,

(B) Graphite, and

(C) Buckminsterfullerence

(A) Diamond :

Diamond is colourless transparent substance having extra ordinary brilliance. Diamond is quite heavy. Diamond is extermely hard. There are 'no free electrons' in a diamond crystal it does not conduct electricity. Diamond burns on strong heating to form carbon dioxide.

Uses of Diamond

- Diamonds are used is cutting instruments like glass cutters and in rack drilling equipment.
- Diamond are used for making Jewellery.
- Sharp-edged diamonds are used by eye-surgeons as a tool to remove cataract from eyes with a great precision.

(B) Graphite :

Graphite is a greyish black opaque substance. Graphite is lighter than diamond. Graphite is soft and slippery to touch. Graphite conduct electricity. Graphite burns on strong heating to form carbon dioxide.

Uses of Graphite

- Powdered graphite is used as a Lubricant for the fast moving parts of machinery.
- Graphite is used for making carbon electrodes or graphite electrodes in dry cells and electric ares.
- Graphite is used for making the cores of our pencils called 'Pencil leads' and black paints.

(C) Buckminsterfullerence :

- Buckminsterfullerence is an allotrope of carbon containing clusters of 60 carbons atoms joined together to form spherical molecules. Since there are 60 carbon atoms in a molecule of buckminsterfullerene, so its formula is C_{60} (C-sixty). Buckminsterfullerene is a football-shaped spherical molecule in which 60 carbon atoms are arranged in interlocking hexagonal and pentagonal rings of carbon atoms. There are twenty hexagons and twelve pentagons of carbon atoms in one molecule of buckminsterfullerene.
- Buckminsterfullerene is a dark solid at room temperature. It differs from the other two allotropes of carbon, diamond and graphite, in the fact that diamond and graphite are giant molecules which consist of an unending network of carbon atoms, but buckminsterfullerene is a very small molecule made up of only 60 carbon atoms. Diamond is extremely hard whereas graphite is soft. On the other hand, buckminsterfullerene is neither is soft. On the other hand, buckminsterfullerene is neither very hard nor soft.

Organic Compound

The compound of Carbon are known as organic compounds. Organic compounds occur in all living things like plants and animals.

Hydrocarbons

Organic compounds containing only carbon and hydrogen are known as hydrocarbons.

Ex. 1 Methane (CH_4)

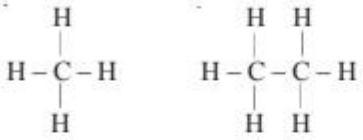
Ethane (C_2H_6)

There are two types of hydrocarbons

◈ **Saturated hydrocarbons :**

Hydrocarbons which contain only single bonds are said to be saturated.

Ex. 2

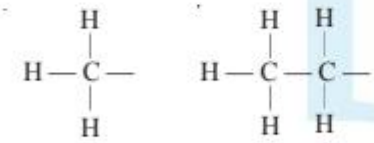


Methane Ethane

Saturated hydrocarbons are also called paraffins or alkanes. They are represented by the general formula C_nH_{2n+2}. Where n = number of carbon atoms in a molecule of the alkane.

Name	Condensed formula	Mol. form.	b.p. (°C)
Methane	CH_4	CH_4	–164
Ethane	CH_3CH_3	C_2H_6	–89
Propane	$CH_3CH_2CH_3$	C_3H_8	–45
Butane	$CH_3CH_2CH_2CH_3$	C_4H_{10}	–0.6
Pentane	$CH_3CH_2CH_2CH_2CH_3$	C_5H_{12}	36
Hexane	$CH_3CH_2CH_2CH_2CH_2CH_3$	C_6H_{14}	69
Heptane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	C_7H_{16}	98
Octane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	C_8H_{18}	126
Nonane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	C_9H_{20}	151
Decane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	$C_{10}H_{22}$	174

Alkyl group : The group formed by the removal of one hydrogen atom from all alkane molecule is called an alkyl group. Example of alkyl group are methyl group (CH_3—) and ethyl group (C_2H_5—). Methyl group (CH_3—) is formed by the removal of one H atom from methane (CH_4); and ethyl group (C_2H_5—) is formed by the removal of one H atom from ethane (C_2H_6).

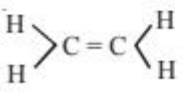


Methyl group Ethyl group

◈ **Unsaturated Hydrocarbons :**

Hydrocarbons in which two carbon atoms in the molecule are joined by a double (=) or triple (≡) bond are said to be unsaturated hydrocarbons.

Ex.3



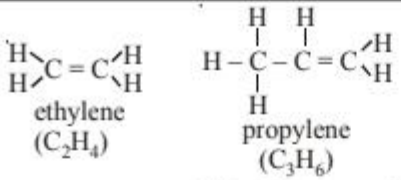
$H - C \equiv C - H$

Ethylene Acetylene

There are two types of unsaturated hydrocarbons

(A) Alkenes - Unsaturated hydrocarbons, in which the molecules contain a double bond between two carbon atoms, are called alkenes.

Ex.4



alkenes are represented by the general formula, C_nH_{2n}, where n = number of carbon atoms in a molecule.

(B) Alkynes - Unsaturated hydrocarbons in which the molecules contain a triple bond between two carbon atoms are called alkynes. For example, ethyne (acetylene) and propyne (methyl acetylene) are alkynes.

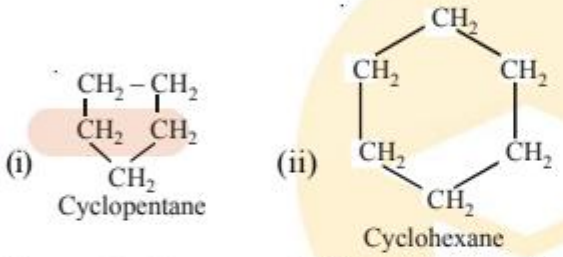
Alkynes are represented by the general formula C_nH_{2n-2} where n = number of carbon atoms in a molecule.

(C) Carbocyclic Compounds - Hydrocarbons containing rings of carbon atoms are called as carbocyclic compounds.

There are two types of carbocyclic compounds.

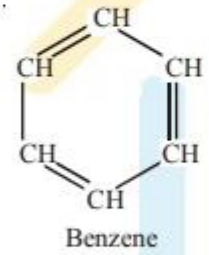
(a) Alicyclic Compound (Saturated cyclic hydrocarbons)

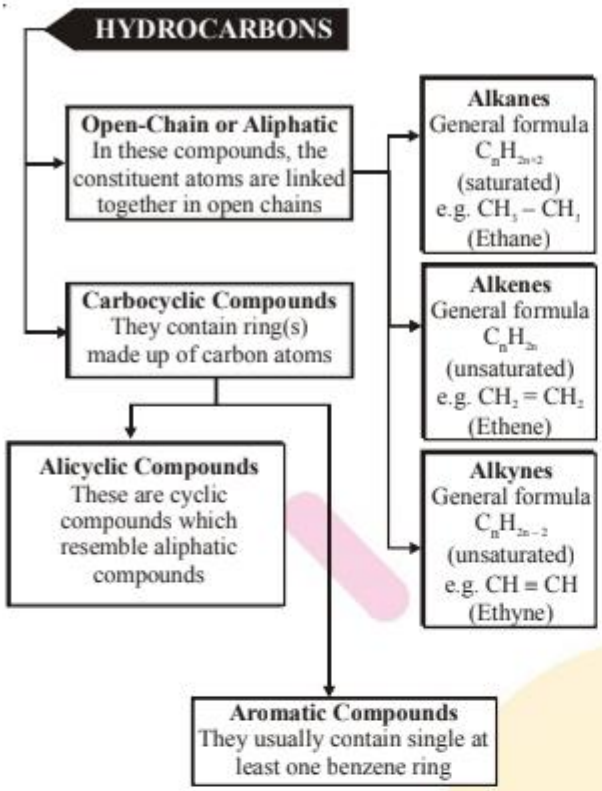
Ex. 5



(b) Aromatic Compounds (Unsaturated cyclic hydrocarbons)

Ex. 6





Nomenclature of Hydrocarbons

◆ The system of naming of compounds is known as nomenclature. Organic compounds have two names.

(i) Common names

(ii) IUPAC names

IUPAC name of organic compounds were given by International Union of pure and applied chemistry in 1958.

◈ Naming of Straight Chain Hydrocarbons

The name of straight chain hydrocarbon may be divided into two parts.

◆ **Word root :** The number of carbon atoms in the chain is represented by the word root.

Word roots for some carbon chains

Chain Length	word Root
C_1	Meth-
C_2	Eth-
C_3	Prop-
C_4	But-
C_5	Pen-
C_6	Hex-
C_7	Hept-
C_8	Oct-
C_9	Non-
C_{10}	Dec-

◆ **Primary Suffixes :** To derive the IUPAC name a suffix is added to the word root to indicate saturation or unsaturation in the molecule. Therefore these suffixes are called as primary suffixes.

Class of Compounds	Primary Suffix	General Name
Saturated	–ane	Alkane
Unsaturated $(>C=C<)$	–ene	Alkene
Unsaturated $(-C\equiv C-)$	–yne	Alkyne

Ex. 7 Name of alkanes

Molecular Formula	Word Root	Primary Suffix	IUPAC Name
1. CH_4	Meth-	-ane	Methane
2. CH_3CH_3	Eth-	-ane	Ethane
3. $CH_3CH_2CH_3$	Prop-	-ane	Propane
4. $CH_3CH_2CH_2CH_3$	But-	-ane	Butane
5. $CH_3CH_2CH_2CH_2CH_3$	Pen-	-ane	Pentane
6. $CH_3CH_2CH_2CH_2CH_2CH_3$	Hex-	-ane	Hexane

◈ **Naming of Branched Chain Hydrocarbons**

Branched chain hydrocarbons are named according to the following rules.

◆ The longest chain of carbon atoms in the structure of the compound (to be named) is found first. The compound is then named as a derivative of the alkane hydrocarbon which corresponds to the longest chain of carbon atoms (This is called parent hydrocarbon)

◆ The alkyl groups present as side chains (branches) are considered as substituents and named separately as methyl (CH_3-) or ethyl $(C_2H_5—)$ groups.

◆ The carbon atoms of the longest carbon chain are numbered in such a way that the alkyl groups (substituents) get the lowest possible number (smallest possible number)

◆ The position of alkyl group is indicated by writing the number of carbon atom to which it is attached

◆ The IUPAC name of the compound is obtained by writing the 'position and name of alkyl group' just before the name of 'parent hydrocarbon'.

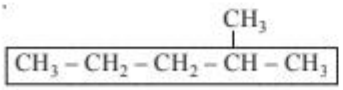
◈ **Longest Chain Rule**

Select the longest continuous chain of carbon atoms as the parent chain.

◆ The number of carbon atoms in the parent chain decides the word root and saturation or unsaturation decides the primary suffix.

◆ The carbon atoms which are not included in the parent chain constitute side chain which are represented by perfixes.

Ex. 8



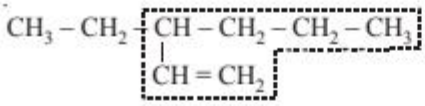
Primary chain containing 5 carbon atoms.

word root → Pent

Primary suffix → ane

Prefix → Methyl

IUPAC Name - 2-methyl pentane

Ex. 9 

Word root → Hex

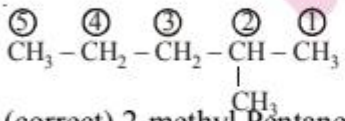
Primary Suffix → ene

Prefix → Ethyl

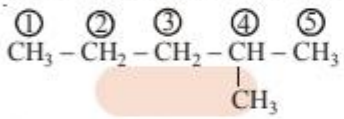
IUPAC Name - 3-ethyl hexene

◈ **Lowest Number Rule :**

In applying the numbering of the parent chain is done such that the carbon atom to which the substitutent is attached gets the lowest possible numbers.

Ex.10 

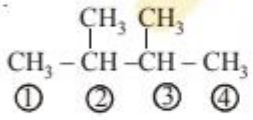
(correct) 2-methyl Pentane



(Incorrect) 4-methyl Pentane

◈ **Uses of Prefixes Di, Tri, etc.**

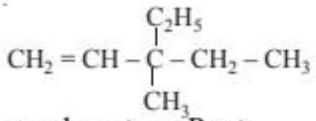
If the compound contains more than one similar alkyl group, their positions are indicated separately and prefix di, tri etc. is attached to the name of the substituent.

Ex. 11 

2, 3 – Dimethyl butane

◈ **Alphabetical Arrangment of Prefixes**

In case there are different alkyl groups present in the compound, their names are mentioned in the alphabetical order.

Ex. 12 

word root → Pent

Primary suffix → ene

Substituents - One ethyl group and one methyl group at position 3

IUPAC Name - 3-ethyl, 3-methyl pent

◈ Naming Unsaturated Hydrocarbons Containing a Double Bond

An unsaturated hydrocarbons containing a double bond between two adjacent carbon atoms is named by taking the prefix of the name of the corresponding saturated hydrocarbon and by replacing the suffix ane by ene.

Ex.13 $H_2C = CH_2$

The saturated hydrocarbon corresponding to two carbon atoms is ethane C_2H_4 contains a double bond. Hence the IUPAC name of this hydrocarbon will be ethene

◈ Naming Unsaturated Hydrocarbons Containing a Triple Bond

An unsaturated hydrocarbons containing a triple bond between two adjacent carbon atoms is named by taking the prefix of the name of the corresponding saturated hydrocarbons and by replacing the suffix ane by yne

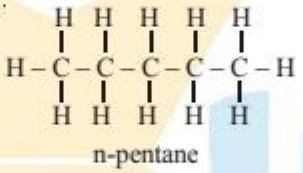
Ex.14 $CH \equiv CH$

The saturated hydrocarbon corresponding to two carbon atom is ethane C_2H_2 contains a triple bond, the suffix ane of ethane is replaced by yne. Thus, the IUPAC name of the C_2H_2 is ethyne.

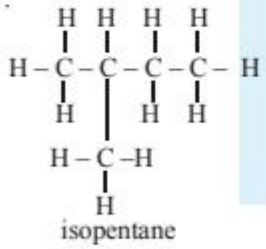
Isomers

The organic compounds having the same molecular formula but different structures are known as isomers.

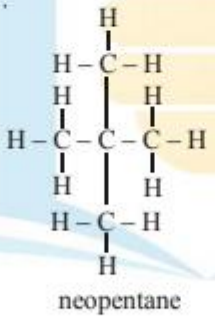
Ex.15 **Isomers of pentane:** The molecular formula of pentane is C_5H_{12}. Three isomers corresponding to this formula are possible.



n-pentane



isopentane



neopentane

◈ Characteristics of Isomers

- ◆ All the isomers of a compound have the same molecular formula
- ◆ The isomers of a compound have different structures.
- ◆ The physical and chemical properties of all the isomers of a compound differ from one another.

◈ Isomerism

The phenomenon of two or more compounds having the same molecular formula but different structural formulae is called isomerism.

Homologous Series

A homologous series is a group of organic compounds having similar structures and similar chemical properties in which the successive compounds differ by CH_2 group. The various organic compounds of a homologous series are called homolgous. It is clear that the two adjacent homolgous differ by 1 carbon atom and 2 hydrogen atoms (or CH_2 group)

Homologous series of Alkanes

Alkane	Molecular formula
1. Methane	CH_4
2. Ethane	C_2H_6
3. Propane	C_3H_8
4. Butane	C_4H_{10}
5. Pentane	C_5H_{12}

Homologous series of Alkenes

Alkene	Molecular formula
1. Methene	C_2H_4
2. Propene	C_3H_6
3. Butene	C_4H_8
4. Pentene	C_5H_{10}
5. Hexene	C_6H_{12}

◈ Characteristics of Homologous Series

- ◆ All the members of a homologous series can be represented by the same general formula.
- ◆ Any two adjacent homologues differ by 1 carbon atom and 2 hydrogen atoms in their molecular formulae.
- ◆ The difference in the molecular masses of any two adjacent homologoues is 14 u. for example, the molecular mass of methane (CH_4) is 16 u, and that of its next higher homologue ethane (C_2H_6) is 30 u. so, the difference in the molecular masses of ethane and methane is 30 – 16 = 14 u.
- ◆ all the compounds of homologous series show similar chemical properties. For example, all the compounds of alkane series like methane, ethane, propane, etc., undergo substitution reactions with chlorine.
- ◆ The members of a homologous series show a gradual change in their physical properties with increase in molecular mass. For example, in the alkane series as the number of carbon atoms per molecule increases, the melting points, boiling points and densities of its members increase gradually.

Alkanes

As you know, alkanes form a homologous series of hydrocarbons having the general formula C_nH_{2n+2}. Since they are relatively inert towards chemical reagents, they are also called paraffins (Latin: parum = little, affinis = affinity) or saturated hydrocarbons.

The principal sources of alkanes are petroleum and natural gas. All alkanes can be commercially obtained by the fractional distillation of crude oil (petroleum)

◈ Properties

(A) Physical (B) Chemical

(A) Physical

- ◆ The first four members of alkane series (methane to butane) are gases. The next thirteen (pentane to heptadecane) are liquids. Those that contain 18 carbon atoms or more are solids.
- ◆ The melting point and the boiling point of alkanes increase with increase in molecular mass.

Name	Molecular formula	m.p. (°C)	b.p. (°C)
Methane	CH_4	−183	−164
Ethane	C_2H_6	−172	−89
Propane	C_3H_8	−188	−45
n-butane	C_4H_{10}	−135	−0.6
n-pentane	C_5H_{12}	−130	36

- They are practically nonpolar molecules.
- Alkanes are lighter than water.
- They are soluble in nonpolar solvents (benzene, carbon tetrachloride, etc,) but insoluble in polar solvents (water, alcohol, etc.)

(B) Chemical

- **Combustion :** When alkanes are burnt in air or oxygen, they are completely oxidized to carbon dioxide and water with the evolution of large amounts of heat.

$$C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \longrightarrow nCO_2 + (n+1)\,H_2O + \text{heat}$$

(a) $\underset{\text{methane}}{CH_4} + 2O_2 \longrightarrow CO_2 + 2H_2O + 212.8\text{kcal}$

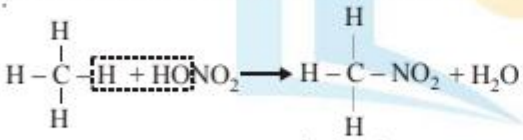
(b) $\underset{\text{butane}}{2C_4H_{10}} + 13O_2 \longrightarrow 8CO_2 + 10H_2O + \text{heat}$

Butane is the principal constituent of liquefied petroleum gas (LPG). When it burns, a lot of heat energy is liberated. So, it is also used as a fuel.

$$\underset{\text{n-pentane}}{C_5H_{12}} + 8O_2 \longrightarrow 5CO_2 + 6H_2O + 845\text{kcal}$$

- **Substitution Reaction :** In these reactions, one or more hydrogen atoms of an alkane are replaced by a more reactive atom or group of atoms.

(a) Nitration : alkanes undergo nitration when treated with fuming nitric acid at 475°C



nitromethane

(b) Halogenation : alkanes react with halogens in the presence of sunlight. For example, when, a mixture of methane and chlorine is exposed to sunlight, a hydrogen atom of methane is replaced by a chlorine atom.

$$\underset{\text{methane}}{CH_4} + Cl_2 \longrightarrow \underset{\substack{\text{methyl}\\\text{chloride}}}{CH_3Cl} + HCl$$

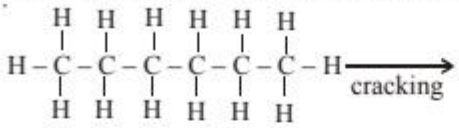
In an excess of chlorine, more hydrogen atoms from methane may be replaced by chlorine atoms.

- **Cracking or Pyrolysis :** When heated to a sufficiently high temperature in the absence of oxygen alkanes decompose. The reaction is known as cracking or pyrolysis. For example, ethane undergoes decomposition at 600°C in the absence of oxygen to produce a new hydrocarbon and hydrogen.

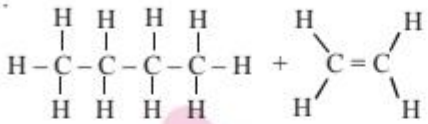
$$\underset{\text{ethane}}{C_2H_6} \longrightarrow \underset{\text{ethylene}}{C_2H_4} + H_2$$

The new hydrocarbon is unsaturated

Cracking is used to convert some of the less volatile fractions of petroleum into compounds of lower molecular mass which are more suitable for use in gasoline. Typical reactions are-



hexane



butane ethane

$$\underset{}{C_{16}H_{34}} \longrightarrow \underset{\text{n-octane}}{C_8H_{18}} + \underset{\text{unsaturated hydrocarbon}}{C_8H_{16}}$$

In cracking, large amounts of unsaturated hydrocarbons are produced. They contribute to the yield of gasoline, and many of them are starting materials for the manufacture of plastics and other chemicals.

◈ **Uses :**

Alkanes are excellent fuels. Methane and butane (liquefied petroleum gas, LPG) are used as domestic fuels. Fuels such as kerosene, petrol and diesel also contain alkanes.

Functional Groups

An 'atom' or 'a group of atoms' which makes a carbon compound (or organic compound) reactive and decides its properties (or functions) is called a functional group.

Ex.16 The alcohol group, —OH, present in ethanol, C_2H_5OH, is an example of a functional group. Some of the important functional groups present in organic compounds are : Halo group (or Halogen group), Alcohol group, Aldehyde group, Ketone group, Carboxylic acid group, alkene group and Alkyne group.

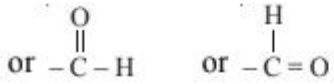
1. Halo Group : – X (X can be Cl, Br or I)

Element chlorine, bromine and iodine are collectively known as halogens, so the chloro group, bromo group and iodo group are called halo groups and represented by the general symbol —X. So, we can say that the halo group is present in chloromethane (CH_3— Cl), bromomethane (CH_3 – Br) and iodomethane (CH_3 — I). Please note that halo group is also known as halogeno group. In fact, halo group is the short form of halogeo group. The haloalkanes can be written as R — X (where R is an alkyl group and X is the halogen atom).

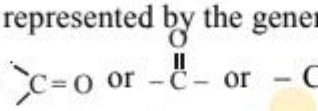
2. Alcohol Group : – OH

The alcohol group is made up of one oxygen atom and one hydrogen atom joined together. The alcohol group is also known as alcoholic group or hydroxyl group. The compounds containing alcohol group are known as alcohols. The examples of compounds containing alcohol group are : methanol, CH_3OH, and ethanol, C_2H_5OH. The general formula of an alcohol can be written as R–OH (where R is an alkyl group like CH_3, C_2H_5, etc., and OH is the alcohol group)

3. Aldehyde Group : –CHO

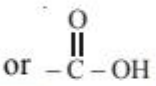


The aldehyde group consists of one carbon atom, one hydrogen atom and one oxygen atom joined together. The aldehyde group is written as – CHO The aldehyde group is sometimes called aldehydic group. The compounds containing aldehyde group are known as aldehydes. The examples of compounds containing an aldehyde group are : methanal, HCHO, and ethanal, CH_3CHO. The aldehydes can be represented by the general formula R —CHO (where R is an alkyl group.)

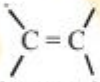
4. Ketone Group : 

The ketone group consists of one carbon atom and one oxygen atom. The oxygen atom of the ketone group is joined to the carbon atom by a double bond. The carbon atom of the ketone group is attached to two alkyl groups (which may be same or different). The ketone group is sometimes called a ketonic group. The compounds containing ketone group are known as ketones. The examples of compounds containing ketone group are : propanone CH_3COCH_3, and butanone, $CH_3COCH_2CH_3$.

5. Carboxylic Acid Group :



Carboxylic acid group is present in methanoic acid, H—COOH and ethanoic acid CH_3 – COOH. The carboxylic acid group is also called just carboxylic group or carboxyl group. The organic compounds containing carboxylic acid group (–COOH group) are called carboxylic acids or organic acids.

6. Alkene Group : 

The alkene group is a carbon-carbon double bond. The alkene group is present in ethene ($CH_2 = CH_2$), and propene ($CH_3 – CH = CH_2$). The compounds containing alkene group are known as alkenes.

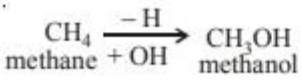
7. Alkyne Group : – C ≡ C–

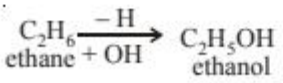
The alkyne group is a carbon-carbon triple bond. The alkyne group is present in ethyne (CH ≡ CH) and propyne ($CH_3 – C \equiv CH$) The compounds containing alkyne group are known as alkynes.

All the organic compounds having same functional group show similar chemical properties.

Alcohols

Alcohols are a class of compounds which contain carbon, hydrogen and oxygen. Alcohol is derived by the replacement of one hydrogen atom in an alkane by a hydroxyl group. For example, replacement of one hydrogen atom in methane by a hydroxyl group produces a new compound called methanol. Similarly, if one hydrogen atom in ethane is replaced by a hydroxyl group, we obtain ethanol.





Thus, alcohols are organic compounds which contain hydroxyl (–OH) group bonded to a carbon atom. The hydroxyl group, characterizing alcohols, is the functional group. The general formula for

alcohols is R–OH where R is an alkyl group and –OH is the functional group.

◈ Name of Alcohols

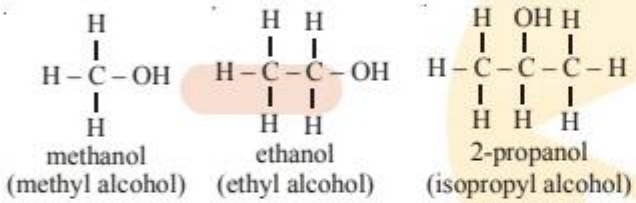
There are two methods for naming alcohols.

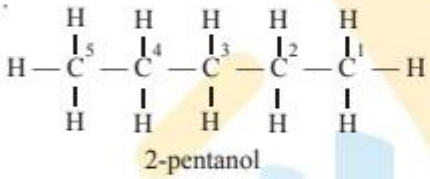
◆ **The common method :** In the common method, the name of the parent alkyl group is combined with the word alcohol.

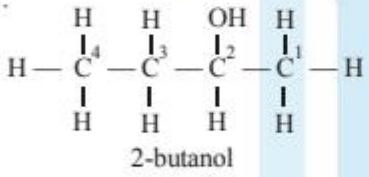
◆ **The IUPAC method :** According to this system, the last e in the name of the parent hydrocarbon of the alcohol is replaced by ol.

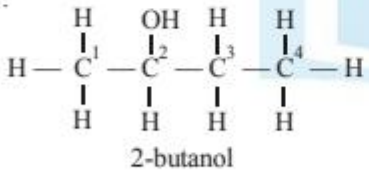
Parent hydrocarbon		Alcohol	
Name	**Formula**	**Name**	**Formula**
Methane	CH_4	Methanol	CH_3OH
Ethane	C_2H_6	Ethanol	C_2H_5OH
Propane	C_3H_8	Propanol	C_3H_7OH

The carbon atom with the –OH group is carbon atom number 1 if it is the end carbon in the chain. If the hydroxyl group is not attached to the end carbon atom in the chain, the numbering starts from the end carbon atom in such a way that the carbon atom carrying the hydroxyl group has the smallest possible number.





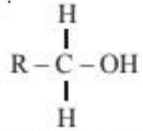




◈ Classification of Alcohols

(A) Alcohols are classified as primary, secondary or tertiary. This depends upon the number of alkyl groups attached to the carbon atom carrying the hydroxyl group.

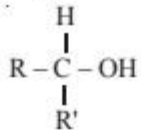
◆ A primary alcohol has the general formula $R - CH_2OH$



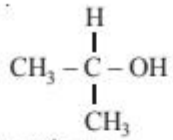
where R = alkyl group. For methanol, R = H and for ethanol, $R = CH_3$

◆ A secondary alcohol has the general formula

R–CHOH – R′

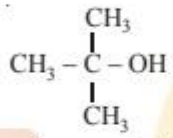


R and R′ may or may not be same. For 2-propanol (isopropyl alcohol), R = R′ = CH_3



◆ A tertiary alcohol has the general formula R R′R″ C – OH

R, R′ and R″ may be the same or different. For 2-methyl propan-2-ol, R = R′ = R″ = CH_3. This is also called tertiary butyl alcohol or t-butyl alcohol.

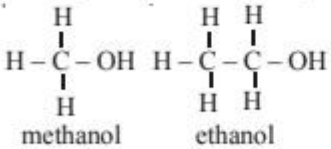


These three classes of alcohols have many similar, chemical properties due to the presence of the same functional group, –OH. But there are differences too, because of the presence of different number of H atoms attached to the carbon atom carrying the hydroxyl group.

Name	Formula	Structural formula	Class
Methanol	CH_3OH	H– CH_2OH	Primary
Ethanol	C_2H_5OH	CH_3–CH_2OH	Primary
Propan-1-ol	C_3H_7OH	CH_3– CH_2–CH_2OH	Primary
Propan-2-ol	C_3H_7OH	CH_3–CHOH– CH_3	Secondary
Butan-1-ol	C_4H_9OH	CH_3–CH_2CH_2–CH_2OH	Primary
Butan-2-ol	C_4H_9OH	CH_3–CH_2 – CHOH – CH_3	Secondary
2-methyl propan-1-ol	C_4H_9OH	$CH_3 - CH(CH_3) - CH_2OH$	Primary
2-methyl propan-2-ol	C_4H_9OH	$CH_3 - C(CH_3)_2 - OH$	Tertiary

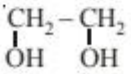
(B) Alcohols are also classified as monohydric, dihydric trihydric, etc.

A monohydric alcohol has just one hydroxyl group, e.g., methanol, ethanol, etc.

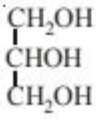


methanol ethanol

A dihydric alcohol has two hydroxyl groups, e.g., ethylene glycol or ethane-1, 2-diol.



A trihydric alcohol has three hydroxyl groups, e.g., glycerol or propane-1, 2, 3-triol.



propane-1, 2, 3-triol.

◈ General Properties of Alcohols

(A) Physical Properties

◆ The first two members of the alcohols series, i.e., methanol and ethanol, are volatile liquids. The alcohols containing 1 to 10 carbon atoms are oily liquid, while those containing more than 10 carbon atoms are solids.

◆ All alcohols are neutral to indicators

◆ (i) The boiling points of alcohols increase as their molecular mass increase

Name	Formula	Molecular mass	b.p (K)
Methanol	CH_3OH	32	337
Ethanol	CH_3CH_2OH	46	351.1
1-propanol	$CH_3CH_2CH_2OH$	60	370.4
2-propanol	$CH_3CHOHCH_3$	60	355.4
1-butanol	$CH_3CH_2CH_2CH_2OH$	74	390.4

(ii) Straight-chain alcohols boil at higher temperature than their branched chain isomers.

In such cases boiling points are in the order.

Primary > secondary > tertiary

◆ In general, alcohols with low molecular mass tend to be soluble in water and are good solvents for organic substances, but they are not good solvents for ionic substances. This shows that there is low polarity in alcohols.

◆ Hydrogen in the hydroxyl group (–OH) does not ionize. Hence, alcohols are poor conductors of electricity.

(B) Chemical Properties

◆ **With Acids :** Alcohols react with acids to form an esters.

$$\underset{}{R-OH} + \underset{\text{nitric acid}}{HONO_2} \longrightarrow R-ONO_2 + H_2O$$

$$\underset{}{R-OH} + \underset{\text{ethanoic acid}}{CH_3COOH} \longrightarrow \underset{\text{alkyl ethanoate}}{CH_3COOR} + H_2O$$

◆ **With Sodium :** Alcohols react with metallic sodium to liberate hydrogen.

$$2R-OH + 2Na \longrightarrow 2RO^-Na^+ + H_2$$

◆ **Oxidation of Alcohols :**

$$CH_3CH_2OH \xrightarrow[\text{Or Acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

The Substances capable of adding oxygen to other, are known as oxidising agent.

Alkaline potassium Permangnate or acidified potassium dichromate are oxidising alcohols to acid.

◆ **Combustion :** Alcohols burn readily in air, forming carbon dioxide and water vapour. A lot of heat is also produced.

$$\underset{\text{methanol}}{2CH_3OH} + 3O_2 \longrightarrow 2CO_2 + 4H_2O$$

◈ Tests for Alcohols or Alcoholic Group

◆ **Sodium Test :** About 5 mL of the organic liquid is taken in a dry test tube. A small piece of sodium is added to it. It effervescence due to the evolution of hydrogen gas occurs, presence of alcoholic group in the organic liquid is indicated.

$2R - CH_2OH + 2Na \longrightarrow 2R- CONa + 3H_2 \uparrow$

◆ **Ester Formation Test :** The organic compound is warmed with glacial ethanoic acid and a little amount of concentrated sulphuric acid in a test tube. A sweet smell, due to the formation of an ester, indicates the presence of alcoholic group in the compound.

$R - CH_2OH + CH_3COOH \longrightarrow$

$R - CH_2 - COO - CH_3 + H_2O$

Carboxylic Acids

Carboxylic acids are a class of organic compounds which contain carboxyl group (–COOH) as the functional group. This group is structurally represented as ($-\overset{O}{\overset{\|}{C}}-OH$). Thus, carboxyl group is a combination of the carbonyl ($-\overset{O}{\overset{\|}{C}}-$)and the hydroxyl (–OH) groups.

Formerly, higher members of the carboxylic acids were obtained from fats. Hence, these acids are also called fatty acids.

◈ Classification of Carboxylic Acids

Carboxylic acids are classified according to the number of carboxyl groups present in a molecule of the acid. The acids containing a single carboxyl group in their molecules are known as monocarboxylic acid, while those containing two carboxylic group are called dicarboxylic acids.

Monocarboxylic Acids :

$H-\overset{O}{\overset{\|}{C}}-OH$ formic acid

$CH_3-\overset{O}{\overset{\|}{C}}-OH$ acetic acid

Dicarboxylic Acids :

$\begin{matrix}COOH\\|\\COOH\end{matrix}$ oxalic acid

$\begin{matrix}COOH\\|\\CH_2\\|\\COOH\end{matrix}$ malonic acid

$\begin{matrix}CH_2-COOH\\|\\CH_2-COOH\end{matrix}$ succinic acid

◈ Nomenclature of Monocarboxylic Acid

◆ **Common name :** Common names of monocarboxylic acids have originated from the Latin or the Greek names of the sources from which the acids are obtained.

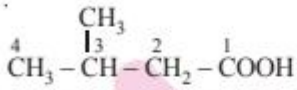
formula	Occurr-ence	Latin or Greek names of the source	Name of acid
1. HCOOH	Ants	Ants are called formica in Latin	formic acid
2. CH_3COOH	Vinegar	Vinegar is called acetum in Latin	acetic acid
3. CH_3CH_2COOH	Butter	Butter is called butyrum in Latin	butyric acid

➤ **IUPAC Names :** In IUPAC system, naming of monocarboxylic acids is done by replacing the end –e of the corresponding hydrocarbon

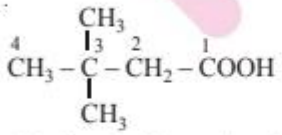
by -oic acid.

formula of acid	Number of carbon atoms	Corresponding hydrocarbon	IUPAC name
1. HCOOH	1	methane (CH_4)	Methanoic acid
2. CH_3COOH	2	ethane (C_2H_6)	ethanoic acid
3. CH_3CH_2COOH	3	propane (C_3H_8)	propanoic acid
4. $CH_3CH_2CH_2COOH$	4	butane (C_4H_{10})	butanoic acid

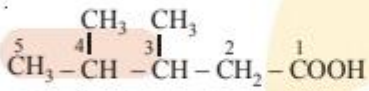
The positions of the substituents are shown by allotting numbers to the carbon atoms to which the substituted groups are linked. The numbering of carbon atoms starts from the carbon atom of the carboxyl group.



3-methyl butanoic acid



3,3-dimethyl butanoic acid



3,4-dimethyl pentanoic acid

◈ Tests for Carboxylic Acid

- ◆ **Sodium Hydrogencarbonate Test :** The organic compound (to be tested) is taken in a test-tube and a pinch of sodium hydrogencarbonate is added to it. Evolution of carbon dioxide gas with brisk effervescence shows that the given organic compound is a carboxylic acid.
- ◆ **Ester Test for Acids :** The organic compound (to be tested) is warmed with some ethanol and 2 or 3 drops of concentrated sulphuric acid. A sweet smell(due to the formation of ester) shows that the organic compound is a carboxylic acid.
- ◆ **Litmus Test :** Some blue litmus solution is added to the organic compound (to be tested). If the blue litmus solution turns red, it shows that the organic compound is acidic in nature and hence it is a carboxylic acid.

EXERCISE - 1

VERY SHORT ANSWER TYPE QUESTIONS

Q.1 Write the formula of two homologous of propane (C_3H_8)

Q.2 Give the general name of the class of compounds having the general formula C_nH_{2n-2}

Q.3 Give the general formula of alkane

Q.4 Give the IUPAC name $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - CH_3$

Q.5 Write the structural formulae for
2-methyl-2 butene

Q.6 Write the formulae of Butanoic acid.

Q.7 Write the chemical formula of the simplest hydrocarbon

Q.8 Give two examples of unsaturated hydrocarbons

Q.9 Give IUPAC name of following compounds
$_3 - C \equiv C - CH_3$

Q.10 Write the structural formulae of neo-pentane

Q.11 Write the IUPAC name of the compound CH_3COOH

Q.12 What is Vinegar ?

Q.13 Will CH_3COOH be acidic, neutral or basic.

Q.14 Complete the reaction
$CH_3COOH + NaHCO_3 \rightarrow$

Q.15 Write the molecular formulae of an alkane and an alkene with twenty carbon atoms.

Q.16 Give the names of the following functional group.
$- CHO, > CO$

Q.17 Name the functional groups present in the following compounds
(i) $CH_3CH_2CH_2COOH$ (ii) $CH_3CH_2CH_2OH$

Q.18 To which group of the periodic table does carbon belong.

Q.19 Name the main constituent of alcoholic drinks.

Q.20 What are hydrocarbons?

Q.21 Write the electronic configuration of carbon.

Q.22 Name two allotropes of carbon

Q.23 Write the name of C_{60}

Q.24 What type of bonds are formed by carbon?

SHORT ANSWER TYPE QUESTIONS

Q.25 Write the general formulae of alkanes, alkenes and alkynes.

Q.26 An organic compound 'X' is a constituent of wine and beer. This compound on oxidation forms another organic compound 'Y' which is a constituent of vinegar. Identify the compounds 'X' and 'Y'. Write the chemical equation of the reaction that takes place to form the compound 'Y'.

Q.27 What are alkynes?

Q.28 Write the structural formulae of the isomers of n-butane.

Q.29 What are hydrocarbons? Give two points of difference between saturated and unsaturated hydrocarbons.

Q.30 Define isomers. Give one example of a hydrocarbon other than pentane having isomers.

Q.31 Classify the following compounds as alkanes, alkenes and alkynes.
C_2H_4, C_3H_4, C_4H_8, C_5H_{12}, C_5H_8, C_3H_8, C_6H_6

Q.32 Write two tests to demonstrate that acetic acid (ethanoic acid, CH_3COOH) is acidic in nature.+

Q.33 What is meant by a functional group in an organic compound? Pick out and name the functional groups present in the following compounds
CH_3CH_2OH, CH_3COOH, CH_3COCH_3

Q.34 What is homologous series ? State three characteristics of homologous series.

Q.35 Write chemical equation for the reaction of
(i) ethanol with alkaline potassium permanganate
(ii) ethanoic acid with sodium hydrogen carbonate.
(iii) ethanol with oxygen

Q.36 Give an example of each
(i) a straight chain hydrocarbon
(ii) branched chain hydrocarbon, and
(iii) ring chain hydrocarbon

Q.37 What is alcohol ? Write the molecular formula condensed formula and structural formula of ethyl alcohol. What is its IUPAC name?

Q.38 Write the formulae and names of first three carboxylic acid.

Q.39 Write two tests to demonstrate that CH_3COOH is an acid. What do you understand by saponification of esters?

Q.40 How does ethanoic acid react with
(i) Sodium metal
(ii) Sodium hydrogen carbonate
(iii) Soda lime

Q.41 Complete the following reactions :
(i) $CH_3CH_2OH \xrightarrow{Alk.KMnO_4}$
(ii) $C_2H_5OH + Na \longrightarrow$
(iii) $CH_3CH_2OH + O_2 \longrightarrow$

Q.42 Write the molecular formulae and names of lower and higher homologous of C_4H_6

LONG ANSWER TYPE QUESTIONS

Q.43 Which properties of carbon make it a versatile element. Discuss its bonding in saturated and unsaturated hydrocarbons.

Q.44 Define structural isomerism. Draw the structural formula of all the isomers of butane and pentane.

Q.45 What is an unsaturated hydrocarbon? Name one such hydrocarbon. Give its molecular and structural formula.

Q.46 With the help of a labelled diagram and required chemical equation, describe the formation of ester.

Q.47 Give any two differences between diamond and graphite.

FILL IN THE BLANKS

Q.48 The organic acid present in vinegar is .....

Q.49 The next homologue of C_2H_5OH is .....

Q.50 The functional group present in ethanol is .....

Q.51 Organic compounds having $-\overset{\overset{O}{\|}}{C}-OH$ functional group are known as .....

Q.52 The next higher homologue of ethane is .....

Q.53 The general formula C_nH_{2n} for cycloalkanes is the same as that of .....

Q.54 Compounds of carbon with hydrogen alone are called .....

Q.55 Ethene and ethyne are examples of ..... hydrocarbons

Q.56 Ethyne has ..... carbon-hydrogen single bonds.

Q.57 Carbon compounds have usually ..... melting points and boiling points because they are ..... in nature.

Q.58 The property of carbon atoms to form long chains in compounds is called .....

Q.59 The form of carbon which is known as black lead is .....

Q.60 Isomerism is possible only with hydrocarbons having ..... or more carbon atoms.

Q.61 The organic compounds having the same molecular formula but different structures are known as .....

Q.62 The IUPAC name of isobutane is .....

Q.63 Carbon has..... electrons in its valence shell

Q.64 The first member of the alkane series is.....

Q.65 The molecular formula of a compound is C_2H_5COOH. The compound is .....

Q.66 ..... is the functional group present in ethanoic acid.

Q.67 The formula of ethanoic acid is .....

Q.68 The general formula for alkynes is .....

Q.69 Ethanoic acid terns blue litmus solution .....

TRUE OR FALSE TYPE QUESTION

Q.70 Alkenes and alkynes are unsaturated compounds

Q.71 Ethanol is oxidised by alkaline $KMnO_4$ to ethanoic acid

Q.72 Methanol is safe to be used for drinking purpose

Q.73 The reaction of ethanol with conc. H_2SO_4 gives ethane.

Q.74 Carboxylic acids react with alcohols to form esters.

Q.75 The IUPAC name of formic acid is ethanoic acid.

Q.76 The functional group present in ethanol is–OH.

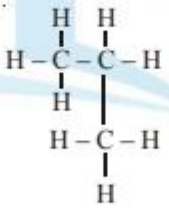
Q.77 Aldehydes and ketones both contain the carbonyl group.

SINGLE CORRECT ANSWER TYPE QUESTIONS

Q.78 Which of the following compounds is not a hydrocarbon ?

(A) $R - CH_3$ (B) RCH_2OH

(C) $RCH = CH_2$ (D)



Q.79 Select an alkane from the following-

(A) C_5H_{10} (B) C_4H_{10}

(C) C_6H_{10} (D) C_6H_8

Q.80 Which of the following pairs are not isomers ?
(A) n-butane and iso-butane
(B) n-pentane and neo-pentane
(C) 1-butyne and 2-butyne
(D) Propane and methyl propane

Q.81 The exceptional ability of carbon to link each other in chains and rings is called
(A) Catenation (B) Coordination
(C) Polymerization (D) Self-combination

Q.82 How many covalent bonds are present in an iso-butane molecule ?
(A) 10 (B) 11
(C) 12 (D) 13

Q.83 In C_6H_{14}, the number of possible isomers is-
(A) 3 (B) 4
(C) 5 (D) 6

Q.84 If a hydrocarbon has any triple bond, it is
(A) Alkyne (B) Alkene
(C) Alkane (D) None of these

Q.85 Compounds made up of carbon and hydrogen only are called
(A) Alkanes (B) Alkenes
(C) Alkynes (D)Hydrocarbons

Q.86 The general formula representing alkanes is-
(A) C_nH_{2n} (B) C_nH_{2n-1}
(C) C_nH_{2n+2} (D) C_nH_{2n+1}

Q.87 Open-chain saturated hydrocarbons are called-
(A) Paraffins (B) Alkenes
(C) Alkynes (D) Alkyl groups

Q.88 The IUPAC name of C_2H_2 is-
(A) Ethylene (B) Acetylene
(C) Ethene (D) Ethyne

Q.89 The functional group present in ketones is-

(A) $-\overset{\overset{O}{\|}}{C}-H$ (B) $-\overset{\overset{O}{\|}}{C}-$

(C) $-O-$ (D) $-\overset{\overset{O}{\|}}{C}-OH$

Q.90 Which of the following compound is an alcohol?

(A) HCHO (B) $CH_3CHOHCH_3$

(C) CH_3COCH_3 (D) CH_3OCH_3

Q.91 The functional group present in organic acids is-

(A) $-\overset{\overset{O}{\|}}{C}-H$ (B) $-\overset{\overset{H}{|}}{N}-\overset{|}{H}$

(C) $-\overset{\overset{O}{\|}}{C}-OH$ (D) $-O-$

Q.92 Wine contains-

(A) CH_3OH (B) C_6H_5OH

(C) C_2H_5OH (D) CH_3COOH

Q.93 The number of isomers for pentane is-

(A) 2 (B) 3

(C) 4 (D) 5

Q.94 Which of the following is an alkyne?

(A) C_6H_6 (B) C_6H_{12}

(C) C_6H_{10} (D) C_6H_{14}

Q.95 The general formula of cyclic alkanes is-

(A) C_nH_{2n+2} (B) C_nH_{2n-2}

(C) C_nH_{2n-1} (D) C_nH_{2n}

Q.96 A carboxylic group is present in-

(A) Ethylene (B) Methanoic acid

(C) Formaldehyde (D) Ethanol

Q.97 The functional group is an alcohol is-

(A) $-\overset{\overset{O}{\|}}{C}-O-$ (B) $-\overset{\overset{O}{\|}}{C}-OH$

(C) $-OH$ (D) $-\overset{\overset{H}{|}}{C}=O$

Q.98 Vinegar is a dilute solution of-

(A) Acetic acid (B) formic acid
(C) Ethyl alcohol (D) Acetylene

Q.99 The functional group in aldehydes is-
(A) —CHO (B) $-\overset{|}{\underset{|}{C}}=O$
(C) –COOH (D) –COOR

ONE OR MORE THAN ONE CORRECT ANSWER TYPE QUESTION

Q.100 Which of the following are alkanes-
(A) C_3H_8 (B) C_5H_{12}
(C) C_2H_4 (D) C_2H_2

Q.101 Which of the following are alkenes?
(A) C_3H_6 (B) C_6H_{12}
(C) CH_4 (D) C_3H_8

Q.102 Which of the following are alkynes?
(A) C_4H_6 (B) C_6H_{10}
(C) C_6H_{12} (D) C_6H_{14}

Q.103 Which of the following are unsaturated hydrocarbons?
(A) C_2H_2 (B) C_2H_4
(C) C_2H_6 (D) C_3H_8

Q.104 Which of the following compounds are alcohols?
(A) CH_3OH (B) $CH_3CHOHCH_3$
(C) HCHO (D) CH_3COCH_3

Q.105 Which of the following are allotropes of carbon-
(A) Diamond
(B) Graphite
(C) Buckminsterfullerene
(D) Methane

COLUMN MATHING TYPE QUESTIONS

Q.106

Column-I	**Column-II**
(A) Methane	(P) C_2H_6
(B) Ethane	(Q) C_4H_{10}
(C) Propane	(R) CH_4
(D) Butane	(S) C_3H_8

Q.107 **Column-I** **Column-II**

Compound IUPAC Name

(A) $CH_3–CH_2–CH_2–CH_3$ (P) 3, 3-dimethyl butene

(B) $CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH–CH_3$ (Q) 2-methyl propane

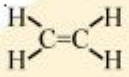
(C) $CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}–CH_3$ (R) 2-methyl-2-butene

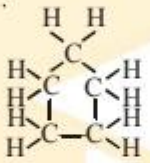
(D) $CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle \overset{\displaystyle CH_3}{|}}{C}}–CH=CH_2$ (S) Butane

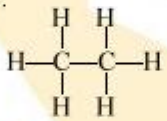
Q.108 **Column-I** **Column-II**

Compound Structural Formula

(A) C_2H_6 (P) H–C≡C–H

(B) C_2H_2 (Q) 

(C) C_2H_4 (R) 

(D) C_5H_{10} (S) 

Q.109 **Column-I** **Column-II**

Hydrocarbon Molecular formula

(A) Butene (P) C_4H_6

(B) Butyne (Q) C_6H_6

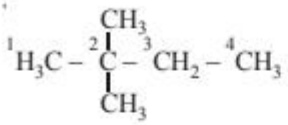
(C) Benzene (R) C_6H_{10}

(D) Hexyne (S) C_4H_8

EXERCISE - 2

SINGLE CORRECT ANSWER TYPE QUESTIONS

Q.1 In the structure



Which one is quarternary carbon atom

(A) C – 1 (B) C – 2

(C) C – 3 (D) C – 5

Q.2 IUPAC name of tertiary butyl alcohol is-

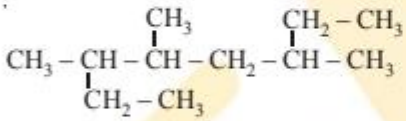
(A) Butan-1-ol

(B) Butan-2-ol

(C) 2-methyl propan-1-ol

(D) 2-methyl propan-2-ol

Q.3 What will be the IUPAC name of the given compound



(A) 2, 5 -diethyl-4-methylhexane

(B) 3, 4, 6- trimethyloctane

(C) 2, 5, 6 - trimethyloctane

(D) 3, 5-dimethyl-6-ethylheptane

Q.4 Which represents an alkane-

(A) C_5H_8 (B) C_8H_6

(B) C_9H_{10} (D) C_7H_{16}

Q.5 As the number of carbon atoms in a chain increases the boiling point of alkanes-

(A) Increases

(B) Decreases

(C) Remains same

(D) May increase or decrease

Q.6 Isomerism in saturated hydrocarbon is due to-

(A) Change in the valence of carbon

(B) Change in the ratio of elements in compounds

(C) Formation of branches in the chain of C atoms

(D) Formation of double bond

Q.7 Ethane, with the molecular formula (C_2H_6) has-

(A) 6 covalent bonds

(B) 7 covalent bonds

(C) 8 covalent bonds

(D) 9 covalent bonds

Q.8 While cooking, if the bottom of the vessel is getting blackened on the outside, if means that-

(A) The food is not cooked completely

(B) The fuel is not burning completely

(C) The fuel is wet

(D) The fuel is burning completely

Q.9 How many structural isomers can you draw for pentane?

(A) 3 (B) 4

(C) 5 (D) 6

Q.10 Butanone is a four-carbon compound with the functional group :

(A) Carboxylic acid (B) Aldehyde

(C) Ketone (D) Alcohol

Q.11 The number of electron pairs shared by the two atoms which are bonded by a double bond is-

(A) 1 (B) 2

(C) 3 (D) 4

ONE OR MORE THAN ONE CORRECT ANSWER TYPE QUESTIONS

Q.12 Which of the following hydrocarbons don't have isomers-

(A) C_2H_6 (B) C_5H_{12}

(C) C_4H_{10} (D) C_3H_8

Q.13 Which of the following statements are correct-

(A) Carbon is a non-metal

(B) The electronic configuration of carbon is $1s^2, 2s^2\ 2p^2$

(C) The valency of carbon is 4

(D) Dimond and graphite are the two common allotropes of carbon

Q.14 Which of the following statements are correct-

(A) Graphite is softer than diamond

(B) Graphite is a good conductor of electricity

(C) Graphite is harder than diamond

(D) None of these

Q.15 Which of the following statements are incorrect-

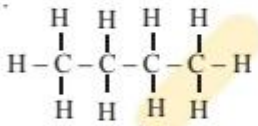
(A) Diamond is extremely hard

(B) Diamond is an allotrope of oxygen

(C) Diamond is good conductor of electricity

(D) None of these

Q.16 A compound has the following structural formula



The compound is-

(A) An alkane

(B) An alkene

(C) An alkyne

(D) A paraffin hydrocarbon

Q.17 Which of the following statements are correct-

(A) Diamonds are used for making Jewellery

(B) Diamonds are used in cutting instruments

(C) Graphite is used for making the cores of our pencils

(D) None of these

Q.18 Which of the following is/are combined state of carbon-

(A) Wood (B) Coal

(C) CO_2 (D) None of these

PASSAGE BASED QUESTIONS

Passage - 1 (Q.19 to Q.25)

Representation of organic compounds - The organic compounds are represented in different ways. The common methods of representation are-

(i) Molecular formula

(ii) Electron dot structure

(iii) Structural formula

(iv) Condensed structural formula

(i) Molecular formula -

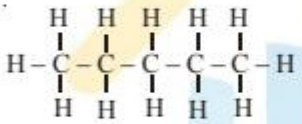
The molecular formula of a compound gives the number of various atoms present in the molecule.

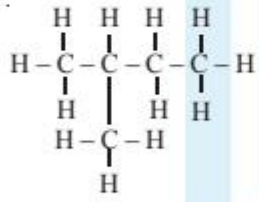
(ii) Electron dot structure - This represents the bonding in the molecules in terms of electrons represented by dots and crosses.

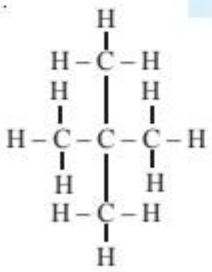
(iii) Structural formula - The structural formula gives the arrangement in which different atoms are connected in the molecule. In the structural formula of a compound, the shared pair of electrons in a covalent bond is indicated by a line drawn between the two atoms connected by that bond.

(iv) Condensed structural formula - In condensed structural formula, the arrangement of carbon atoms are shown but the bonds between hydrogen atoms are not shown.

Q.19 Which of the following is structural formula of neo-pentane-

(A) 

(B) 

(C) 

(D) None of these

Q.20 Which of the following are molecular formula of hexene and hexyne-

(A) C_6H_{12}, C_6H_{10} (B) C_6H_{10}, C_6H_{12}

(C) C_6H_{12}, C_6H_{14} (D) None of these

Q.21 Number of carbon and hydrogen atoms respectively in iso-butane respectively is-

(A) 4, 8 (B) 4, 10

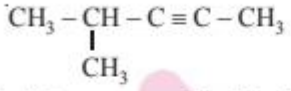
(C) 10,4 (D) 8, 4

Q.22 Number of C–H bonds in ethane are-

(A) 4 (B) 2

(C) 6 (D) None of these

Q.23 Number of C–H and C–C single bonds respectively in structure given below are-



(A) 4, 10 (B) 10, 4

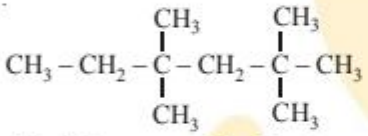
(C) 10, 7 (D) 7, 10

Q.24 Which of the following are molecular formula of heptane and heptene-

(A) C_7H_{12}, C_7H_{14} (B) C_7H_{16}, C_7H_{14}

(C) C_7H_{14}, C_7H_{12} (D) C_7H_{14}, C_7H_{16}

Q.25 Number of C–H and C–C bonds respectively in compound given below are-



(A) 21, 10 (B) 22, 9

(C) 9, 22 (D) 10, 21

ANSWER KEY

EXERCISE-1

A. Very Short Type Answer

1. C_4H_{10}, C_5H_{12}

2. Alkynes

3. C_nH_{2n+2}

4. 2-methyl butane

5. $CH_3-\overset{\overset{CH_3}{|}}{C}=CH-CH_3$

6. $CH_3CH_2CH_2COOH$

7. CH_4(methane)

8. C_2H_4, C_3H_6

9. 2-butyne

10. $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

11. Ethanoic acid

12. Dilute solution of acetic acid

13. Acidic

14. $2CH_3COOH + NaHCO_3 \xrightarrow{heat} CH_3COONa + CO_2 + H_2O$

15. Alkane - $C_{20}H_{42}$

Alkene - $C_{20}H_{40}$

16. –CHO - Aldehydic

$\diagdown\!\!\diagup CO$ - Ketonic

17. (i) Carboxyl acid group

(ii) Alcoholic group

18. 14

19. Ethanol

20. Compounds containing C and H

21. $1s^2$, $2s^22p^2$

22. Diamond, Graphite

23. Buckminsterfullerene

24. Covalent bond

D. Fill in the blanks

48. Ethanoic acid

49. C_3H_7OH

50. Alcohol

51. Carboxylic acids

52. Propane

53. Alkenes

54. Hydrocarbons

55. Unsaturated

56. Two

57. Low, Covalent

58. Catenation

59. Graphite

60. Four

61. Isomers

62. 2-methyl propane

63. 4

64. CH_4

65. Propanoic acid

66. –COOH

67. CH_3COOH

68. C_nH_{2n-2}

69. Red

E. True and False

70. True **71.** True **72.** False **73.** False

74. True **75.** False **76.** True **77.** True

F. Single Choice Questions

78. (B) **79.** (B) **80.** (D) **81.** (A)

82. (D) **83.** (C) **84.** (A) **85.** (D)

86. (C) **87.** (A) **88.** (D) **89.** (B)

90. (B) **91.** (C) **92.** (C) **93.** (B)

94. (C) **95.** (D) **96.** (B) **97.** (C)

98. (A) **99.** (A)

G Multiple Choice Quesitions -

100. (A, B) **101.** (A,B) **102.** (A, B)

103. (A,B) **104.** (A,C,D) **105.** (A,B,C)

H Match the column type questions -

106. A → R, B → P, C → S, D → Q

107. A → S, B → R, C → Q, D → P

108. A → S, B → P, C → Q, D → R

109. A → S, B → P, C → Q, D → R

EXERCISE - 2

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Ans.	B	D	B	D	A	C	B	B	A	C	B	A,D	A,B,C,D
Q.No.	14	15	16	17	18	19	20	21	22	23	24	25	
Ans.	A,B	B,C	A,D	A,B	A,B,C	C	A	B	C	B	B	B	