L.No. 3 Carbon and its Compounds

Q.1 How does carbon occur in nature?

Ans. Carbon is one of the most widely distributed elements, found in earth's crust. It occurs both, in free state as well as in combined state.

In Free State, carbon occurs as diamond, graphite and coal. Diamond and graphite are pure forms of carbon.Coal is an impure form of carbon in which percentage of carbon varies. In combined state carbon occurs as:-

(i) Oxides such as carbon dioxide, and carbon monoxide.

(ii). In the form of natural gas, petroleum products, marsh gas.

(iii) Carbonates in the form of metal carbonates such as.
Magnesium carbonate,($MgCO_3$), Calcium carbonate, ($CaCO_3$), Zinc carbonate, ($Zn\ CO_3$).

iv. In the form of bio-molecules like proteins, fats, carbohydrates etc.

Q.2 Describe the position of carbon in periodic table.

Ans. Carbon is a non-metallic element having symbol 'C'. It has an atomic number of 6 and mass number of 12u. It occurs in three isotopic forms such as $^{12}_{6}C$, $^{13}_{6}C$ and $^{14}_{6}C$ Its electronic configuration is

K , L
2 4

Where K & L are 1st and 2nd shells of carbon respectively.

It belongs to group 14 and is the first member of the group. The other members of the group are Si, Ge, Sn and Pb. Since it occurs at the top of the group 14, this group is also known as carbon family.

Q.3 Discuss unique nature of carbon.

Ans. The unique nature of carbon can be explained in the following points.:-

i. Carbon has the self linking property to form chains of varying lengths and shapes (straight, branched, closed). This property of carbon is known as catenation.

ii. Carbon differs from the next of the elements of its group because of its smaller size and higher electro-negativity.

iii. Carbon shows unique ability to form multiple bonds such as C=C, C≡C, C = O, C ≡ N etc.

iv. Carbon can bind to almost every element in periodic table especially O, H, S etc.

v. Carbon forms complex molecules, therefore the no. of isomers increases.

Q.4 State the reason, why carbon always forms covalent bonds?

Ans. Carbon has six electrons and its electronic configuration is: K , L
2 4

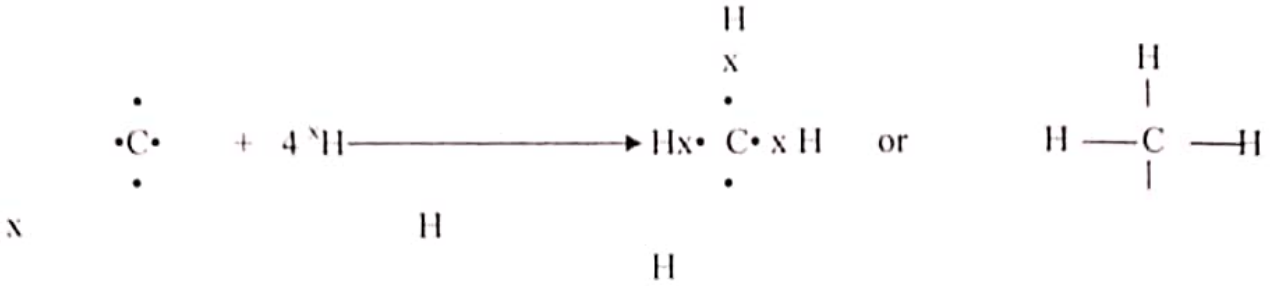
Thus, an atom of carbon contains four electrons in its outer shell (L-Shell). From the electronic configuration of carbon, it seems that carbon can form compounds in three different ways:

1. By losing all four outer most electrons to form C^{4+} ion .
2. By gaining four electrons to form C^{-4} ion.
3. By sharing all the four outer most electrons present in L – Shell and forming four covalent bonds.

Since carbon atom is small in size, so its outer most electrons are strongly bound to the nucleus and therefore large amount of energy is needed to remove electrons from carbon atom.

As a result carbon atom shows no tendency to lose its valence electrons. On the other hand, due to low nuclear charge, carbon is moderately electronegative, so it does not show any tendency to gain electrons. Therefore, the option left for carbon to form

compounds is only by sharing its four electrons forming four covalent bonds to complete its octet.



Q.5 What is allotropy? Give the allotropic forms of carbon.

Ans. The phenomenon of existence of an element in two or more different forms having different physical properties but similar chemical properties is known as allotropy and the various forms as allotropes or allotropic forms. Carbon, sulphur and phosphorus are some of the non-metals that show allotropy. Carbon exists in two allotropic forms:

(1) Crystalline (2) Amorphous

1. **Crystalline forms of carbon:-** crystalline forms of carbon are:
   a) Graphite b) Diamond c) Fullerenes
2. **Amorphous forms of carbon:-** The various amorphous forms of carbon are coal, coke, charcoal, bone or animal charcoal, carbon black etc.
   Among all the known forms of carbon, diamond, graphite and fullerenes are the purest forms.

Q.6 Give a detailed account of Diamond. (occurrence, structure, properties and uses)

Ans. Diamond is the purest form of carbon. The word diamond comes from the two Greek words diaphones means transparent and adamas means extremely hard. Diamond is found in all shapes and sizes. Diamond is found in ancient valcano pipes where it is generally embedded in a soft dark coloured rock called blue ground or Kimberlite rocks.

Diamond can also be prepared artificially by subjecting carbon to very high pressure and temperature. These synthetic diamonds are small but are otherwise indistinguishable from natural diamonds.

Occurrence: Diamond deposits have been found in South Africa, Ghana, Angola, India, Brazil and Eastern Siberia.

In India, diamond are found in Panna (Madhya Pradesh), Wajrakarur (Andrapradesh) and Golconda (Karnataka). The famous Kohinoor diamond was found is Wajrakarur.

Structure:- In diamond each carbon atom is linked to four other carbon atoms directed towards the corners of a regular tetrahedron through covalent bonds. The arrangement gives rise to a closely packed, hard, three dimensional structure which makes the diamond hardest natural substance. All the four valence electrons are engaged in forming carbon- carbon bonds, leaving no free electron. This makes diamond poor conductor of electricity.

Properties of Diamond:-

1) Diamond is a transparent solid having extra ordinary brilliance.
2) It is usually colourless, but we can impart colour to diamond by adding small amount of impurities in the form of metal salts.
3) It is a non-conductor of electricity, but good conductor of heat.
4) It has a high density of $3.5 g/cm^3$.
5) It has a high refractive index of 2.5.
6) It is the hardest natural substance. One can cut a diamond with only diamond.

Use of Diamond:-

1) It is used in Jewellery because the cut and polished diamond sparkles brightly.
2) It is used to cut glasses.
3) It is used for cutting and drilling of rocks.

4) It is used to make radiation proof windows in space satellites because it has ability to keep out harmful radiations.

5) Due to its extra-ordinary sensitivity to heat rays diamonds are used for making high precision thermometers.

Q.7 Give occurrence structure properties and uses of graphite.

Ans. Graphite is a crystalline form of carbon. It finds its name from the Greek word "grapheine" means to write. It is also called black lead because it marks paper black like lead. The chemical symbol of graphite is C.

Occurrence:- Graphite occurs free in nature and is widely distributed throughout the world. Major producers of graphite are USSR, Mexico, India, China, Canada and Srilanka. In India graphite is found in Orissa, Rajasthan, J&K State , Bihar, Karnataka, Tamilnadu etc. Graphite can also be prepared artificially by heating coke to a high temperature.

Structure of Graphite:- The structure of Graphite is altogether different from that of diamond. A graphite crystal actually consists of sheets or layers of Carbon atoms. In a graphite layer, each carbon atom is bonded to three other carbon atoms in the same plane forming hexagonal rings. To satisfy the fourth valency of carbon, each hexagonal ring has three alternate single and double bonds. The various layers are held together by weak Vander – walls forces of attraction. The distance between any two successive layers is 340 pm.

Properties:-

1) Graphite is an opaque, grayish-black in colour, with hexagonal crystals.
2) It is soft and greasy to touch.
3) It is a good conductor of heat and electricity.
4) Its density is 2.3 g/cm^3.
5) It is stable to heat and possesses a high melting point of around $3700^{O}C$.
6) It has a metallic lustre.

Uses:- 1) It is used as a lubricant in fast moving machinery as graphite is soft and slippery.
2) It is used to make electrodes in batteries and electric furnaces.
3) It is used to make the core of lead pencils as it is soft and can mark paper.
4) It is used to make black paints and in printer inks.

Q.8 Comparison of properties of Diamond and Graphite.

Ans. The difference between the properties of diamond and graphite is summarized as below:-

Diamond	Graphite
1. Diamond is the hardest substance known.	1. Graphite is soft and soapy to touch
2. Diamond has a density of 3.5 g/cm^3.	2. Graphite has a density of 2.3 g/cm^3.
3. Diamond is transparent and has a high refractive index.	3. Graphite is black and is opaque.
4. Diamond is a non-conductor of heat and electricity.	4. Graphite is a good conductor of heat and electricity.
5. Diamond occurs as octahedral crystals.	5. Graphite occurs as hexagonal rings.

Q. 9 Write a short note on Fullerenes.

Ans. Fullerenes are a class of carbon allotropes. They are spherical in shape and contain even no. of carbon atoms ranging from 60 to 350. The C_{60} fullerene is the most stable and was first to be identified. It contains 60 carbon atoms which are arranged in the shape of a foot ball, therefore it is also called as bucky ball.

These allotropes look like geodesic domes designed by the US Architect Buckminster Fuller, they are called as Buckminster fullerenes. Buckminster fullerene is dark solid at room temp. The properties of fullerene lie between diamond and graphite.

Compounds of Carbon.

The compounds of carbon can be classified into two categories.

1, Inorganic compounds 2, Organic Compounds

1, Inorganic Compounds:- These are the compounds of carbon with metals and non-metals (other than hydrogen). These do not have carbon- carbon bonds in them., these compounds are generally obtained from mineral sources. e.g. Salt from Sea, metal oxides from soils etc.

2. Organic compounds:- These are the compounds of carbon and hydrogen and their derivatives. These contain carbon – carbon bonds. Organic compounds are mostly derived from living organisms e.g. sugar from sugarcane, oils from vegetables, proteins from eggs etc.

Q.10. What are Hydrocarbons? Give the types of hydrocarbons.

Ans. The compounds containing only carbon and Hydrogen are called hydrocarbons i.e.

Carbon + Hydrogen ~~–Hydr~~carbon

e.g. methane (CH_4), ethane (C_2H_6), Ethene (C_2H_4), . The natural source of hydrocarbons is petroleum and natural gas. Both petroleum and natural gas occurs deep inside the earth. Hydrocarbons are regarded as parent organic compounds and all other organic compounds are considered the derivatives of hydrocarbons.

There are two main types of hydrocarbons.

1. Saturated Hydrocarbons.
2. Unsaturated Hydrocarbons.

1) **Saturated Hydrocarbons:-** The hydrocarbons in which all carbon atoms are bonded to each other by single covalent bonds are called as saturated hydrocarbons. Saturated hydrocarbons are also called as alkanes or paraffins. The general formula of alkanes is C_nH_{2n+2} where n= 1,2,3.....

e.g. If n = 1, the alkane is $C_1H_2(1) + 2 = CH_4$ (methane)

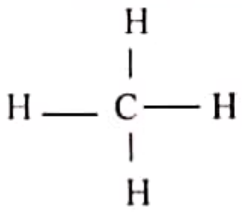
if n = 2, $C_2H_{2x2+2} = C_2H_6$ (ethane)

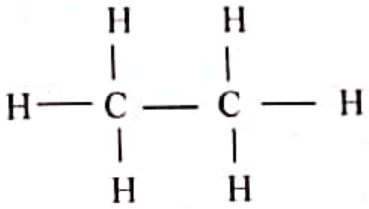
If n = 3 , $C_3H_{2x3+2} = C_3H_8$ (Propane)

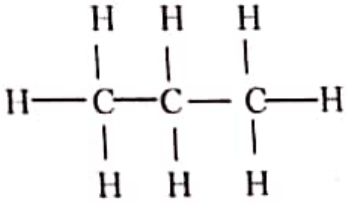
If n = 4, C_4H_{10} (Butane)

If n = 5, C_5H_{12} (Pentane)

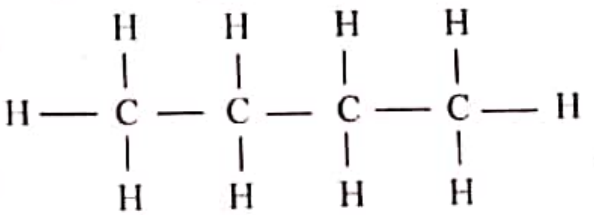
Their structural formulae are as follows:-



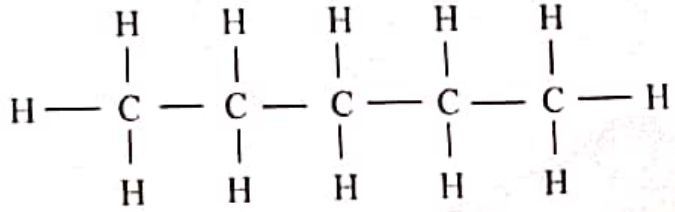




(Methane)(Ethane)(Propane)



Butane



Pentane

Any successive members of alkane differ by CH_2 unit. CH_2 unit is called methylene group.

Unsaturated Hydrocarbons:-

The hydrocarbons which contains double (=) or triple (≡) bonds between carbon atoms are called unsaturated hydrocarbons. Unsaturated hydrocarbons are of two types.

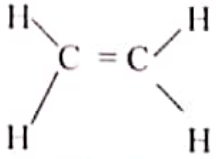
(i) Alkenes:- Unsaturated hydrocarbons containing double bond between carbon atoms are called as alkenes. Alkenes are also called as olefins. The general formula of alkenes is C_nH_{2n} where n = 2,3, 4.....e.g.

If n = 2 , $C_2H_{2\times2} = C_2H_4$ Ethene

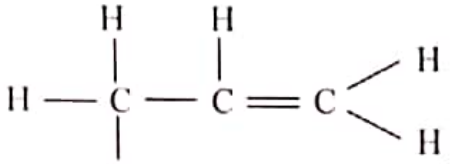
If n = 3 , $C_3H_{2\times3} = C_3H_6$ Propene

If n = 4 , $C_4H_{2\times4} = C_4H_8$ Butene

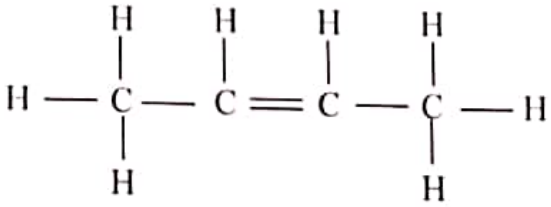
Their structural formulae are:



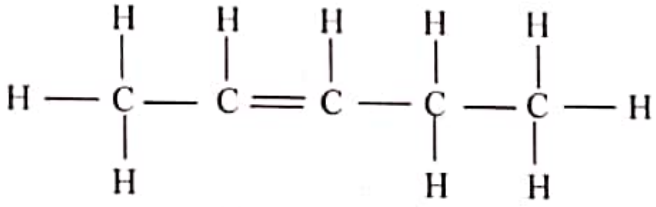
Ethene



Propene



Butene



Pentene

(ii) Alkynes: Unsaturated hydrocarbons containing triple bonds between carbon atoms are called as alkynes. The general formula of alkynes is CnH_{2n-2} . Where n = 2, 3, 4, 5.....

If n = 2, $C_2H_{2\times2} - 2 = C_2H_2$ ethyne

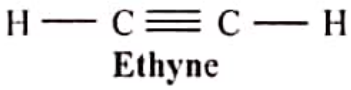
If n = 3, $C_3H_{2\times3} - 2 = C_3H_4$ propyne

If n = 4, $C_4H_{2\times4} - 2 = C_4H_6$ butyne

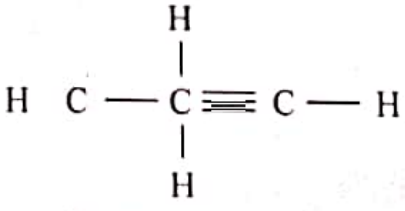
If n = 5, $C_5H_{2\times5} - 2 = C_5H_8$ Pentyne

There structure formulae are as follows :

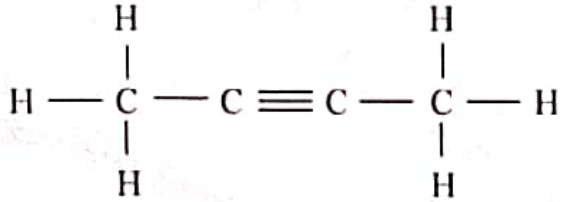
(I)



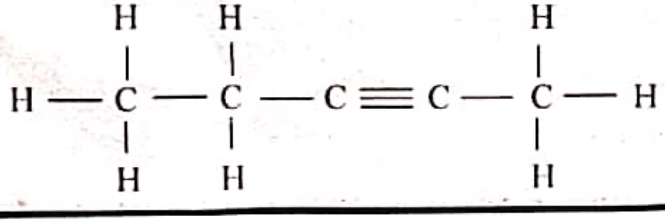
Ethyne



Propyne



Butyne

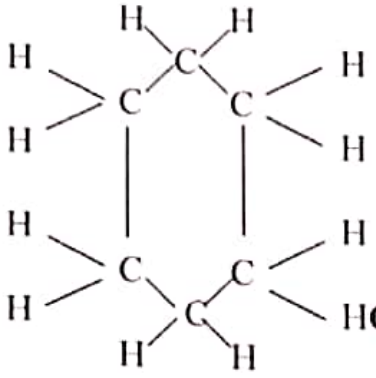


Cyclic Hydrocarbons:-

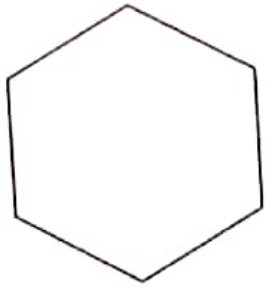
The hydrocarbons in which carbon atoms are arranged in a ring are called as cyclic hydrocarbons. The cyclic hydrocarbons can be saturated or unsaturated.

a)Saturated cyclic hydrocarbons :- Cyclohexane with molecular formula C_6H_{12} is a saturated cyclic hydrocarbon.

Its structural formula is

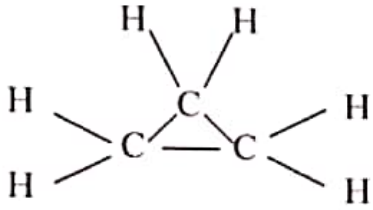


OR

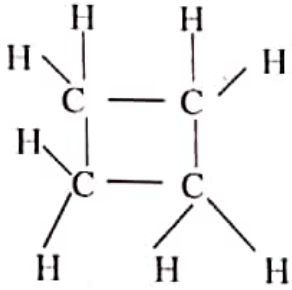


Cyclohexane

Similarly other cyclic hydrocarbons are,

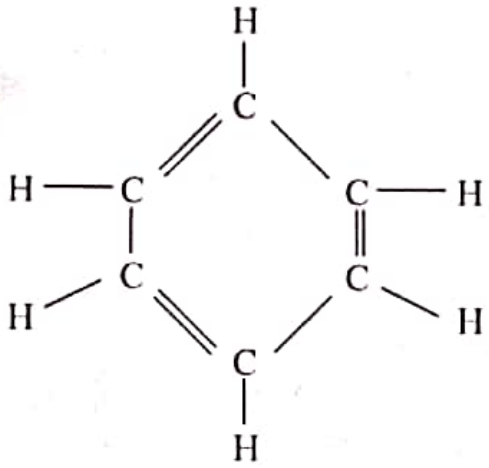


Cyclo Propane



Cyclo butane

b) Unsaturated cyclic hydrocarbons:-Benzene is a well known unsaturated cyclic hydrocarbon its molecular formula is C_6H_6. Its structural formula is:-



Or

cyclo hexene or benzene

Q) What is covalent bond? Give different types of covalent bond?

Covalent bond:- The chemical bond formed by mutual sharing of electrons between two atoms in order to acquire stable nearest noble gas electronic configuration is called covalent bond. The two combining atoms may be similar or dissimilar atoms. The difference between the electro negativities of the combining atoms should be either zero or very small. The compounds which contain covalent bonds are called covalent compounds. The covalent bond is generally formed between two non-metallic elements. The shared pair of electrons becomes the property of both the bonded atoms. For example,

H• + •H ⟶ H ••H. Or H —H

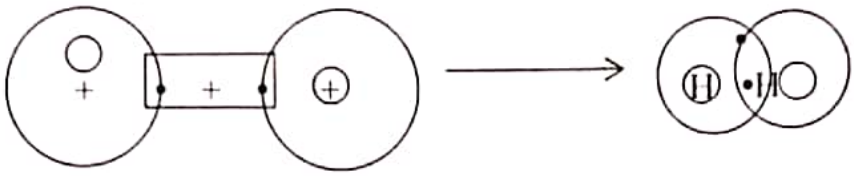
Depending upon the number of electron pairs shared between the two bonded atoms, covalent bond is of three types:-

1. Single covalent bond
2. Double covalent bond
3. Triple covalent bond.

1. Single Covalent Bond:-Single covalent bond is formed by sharing of one electron pair between the two atoms. Example.

Formation of Hydrogen. (H_2) molecule:

Hydrogen atom has one electron in its shell. In order to attain electronic configuration of He, it shares its electron with another hydrogen atom. Thus there is a single covalent bond between two hydrogen atoms

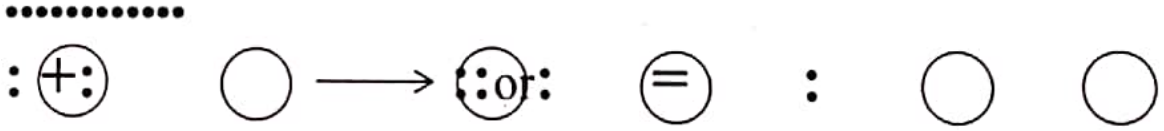


H• + •H ⟶ H:H Or H H —

2) Double covalent bond:- Double covalent bond is formed by sharing of two electron pairs between two atoms in which each atom contributes two electrons. It is represented by putting two short (=) lines between two atoms. e.g.

Formation of oxygen (O_2) molecule:

Oxygen atom has six electrons in its outer most shell. It needs two electrons to complete its octet and attain configuration of neon. Hence, two oxygen atoms combine by sharing two pairs of electrons between them.



2,6 2,6 2,8 2,8

3) **Triple covalent bond:**- Triple covalent bond is formed by sharing of three electron pairs between two atoms in which each atom contributes three electrons. It is represented by three short lines between two atoms, e.g.

Formation of nitrogen (N_2) molecule:

Nitrogen atom has five electrons in its outer most shell. It needs three electrons to complete its octet and attain the configuration of the inert gas neon. Hence, two nitrogen atoms combine by sharing of three pairs of electrons between them and form N_2 having triple covalent bond between two nitrogen atoms.

:N:• :N: ⟶ :N: :N: •• or N ≡ N

2,5 2,5 2,8 2,8

Functional Group: an atom or group of Atoms which largely determines the properties of a compound is known functional group e.g Alcohols contain hydroxyl (OH) group is functional group.

Q. Define Homologous series. Give its characteristics.

Ans. A Homologous series may be defined as a family of organic compounds having similar functional group and same chemical properties. Homologous series of alkanes is given below.

Alkane	**Molecular formula**
Methane	CH_4
Ethane	C_2H_6
Propane	C_3H_8
Butane	C_4H_{10}
Pentane	C_5H_{12}
Hexane	C_6H_4

Characteristics of homologous series.

1) All the members of Homologous series can be represented by a general formula e.g. alkanes by C_nH_{2n+2}
2) Any two adjacent members of a homologous series differ from each other by one carbon and two hydrogen atoms i.e. CH_2 group, by a mass number of 14 units.
3) All the members of a homologous series show similar chemical properties.
4) All the members of a homologous series have the same functional group.
5) The members of a homologous series show a gradation in physical properties.

Q. Discuss the nomenclature of various classes of organic compounds.

Ans:- IUPAC system of Nomenclature:- According to IUPAC system, the name of an organic compound consists of three parts.

(i) Word root (ii) Suffix (iii) Prefix.

(i) **Word root** denotes the number of carbon atoms present in the principal chain, which is the longest chain of carbon atoms.

Chain Length	C_1	C_2	C_3	C_4	C_5	C_6	C_7
Word Root	Meth	Eth	Prop	But (a)	Pent (a)	hex (a)	Hept (a)

C8	C_9	C_{10}	C_{11}	C_{12}
Oct (a)	Non (a)	Dec (a)	Undec (a)	Dodec (a)

Where $C_1, C_2, C_3, \ldots\ldots\ldots\ldots$ represents no. of carbon atoms in the chain.

Note:- Extra 'a' given the parenthesis is used only if the primary suffix to be added to the word root start with a consonant.

(ii) **Suffix** (a) **Primary Suffix**... indicates type of bonds. If carbon atoms are linked with single bonds, the primary suffix is 'ane'.

If by double bond the Primary suffix is 'ene'.

If in triple bond the Primary suffix is 'yne'

(a) Secondary suffix is used to represent the functional group and is attached to primary suffix while writing its IUPAC Name.

(Note:- While adding a secondary suffix to the primary suffix the terminal 'e' of the primary suffix. ane, ene, yne, is replaced by secondary suffix)

(iii) **Prefix:-** Certain characteristics group are not considered functional groups, these are regarded as substituent's such as –F, -Cl, -Br, -I etc. Writing the IUPAC name of an aliphatic compound.

	Primary prefix	+ Word root +	Primary suffix	+ Sec. Sufix	IUPAC Name
$CH_3 - CH_2 - CH_3$	X	prop	ane	X	Propane
$CH_3 - CH - CH_2$	X	prop	ene	X	propene
$CH \equiv CH$	X	eth	yne	X	ethyne
$Cl - CH_2 - CH_2 - CH_3$	chloro	prop	ane	X	chloropropane
$Cl - CH_2 - CH = CH_3$	chloro	prop	ene	X	chloropropene
$CH3 - CH_2 - CH_2 - OH$	X	prop	ane	01	propanol
$Cl\ CH_2 - CH - CH_2 - OH$	chloro	prop	ane	01	chloro propanol
$Cl\ CH - CH - CH_2 - OH$	chloro	prop	ene	01	chloro propenol

It is not necessary that all of them may be present in a particular compound.

Q Discuss the nomenclature of different classes of organic compounds.

Ans. The nomenclature of different classes of organic compounds is discussed below:-

1) Alkanes:- General formula C_nH_{2n+2} where n = 1,2,3……
suffix = ane, names word root = Alk, suffix = ane = alkane

2) Alkenes:-
General formula : $C_n H_{2n}$ Where n = 2,3,4 ……
Functional group : C = C (carbon- carbon double bond))
Suffix : ene
Names:- Replace the terminal "ane" of the corresponding alkane by suffix "ene".
The position of double bond is indicated by lowest possible integer. e.g.

n	Formula	Name
2	$CH_2 = CH_2$	ethene
3	$CH_3 - CH = CH_2$	propene
4	$CH_3 - CH = CH - CH_3$	2- butene
4	$CH_2 = CH - CH_2 - CH_3$	1- butene
4	$CH_3 - CH - CH_2 = CH_2$	1- butene

3. Alkynes:-
General formula = $C_n H_{2n-2}$ Where n = 2, 3, 4, ……
Functional group : - C ≡ C -(carbon – carbon triple bond.)
Suffix : yne.
Name : Replace the terminal "ane" of the corresponding alkane by suffix "eye"
Indicate the position of triple bond by lowest possible integer.
e.g.

n	Formula	Name
2	H-C≡ CH	ethyne
3	$H\ C \equiv C - CH_3$	propyne
4	$CH \equiv C - CH_2 - CH_3$	1 – butyne.
4.	CH_3- C ≡C – CH_3	2- butyne.
4	$CH_3 - CH_2 - C \equiv CH$	1- butyne

4. Halo alkanes or alkyl halides.
General formula = RX, when R=Cn H_{2n+1} with n = 1,2,3….. & X = F, Cl, Br, I)
Functional group : F, Cl, Br, I.
Prefix : Floro, chloro, Bromo, Iodo for F, Cl, Br, I respectively.

Name : - Add the prefix halo (Fluro, Chloro Bromo, Iodo,) to the parent alkane. Also indicate the position of functional group (F, Cl Br, I) by lowest integer.

e.g.

n	Formula	Name
1 (X=Cl)	CH_3-Cl	Chloromethane
2 (X=Cl)	CH_3-CH_2-Cl	Chloro ethane
3 (X=F)	$CH_3-CH_2-CH_2-F$	1- Floro propane
3 (X=Br)	$CH_3-\underset{\displaystyle Br}{\underset{\vert}{CH}}-CH_3$	2- Bromo propane.
4 (X=I)	$I-CH_2-CH_2-CH_2-CH_3$	1 – Iodio butane
4 (X=F)	$CH_3-\underset{\displaystyle F}{\underset{\vert}{CH}}-CH_2-CH_3$	2 – Fluoro butane

5. Alcohols:-

General formula : $R-OH$ (Where $R=C_nH_{2n+1}$ & $n = 1,2,3.....$)

Functional group : OH (Hydroxyl)

Suffix : ol

Name : Replace last 'e' of parent alkane by 'ol'

n	Formula	Name
1	CH_3-OH	Methanol
2	CH_3-CH_2-OH	ethanol
3-	$CH_3-CH_2-CH_2-OH$	1-propanol
3	$CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_3$	2- Propanol .
4	$CH_3-CH_2-CH_2-CH_2OH$	1-butanol
4	$CH_3-CH_2-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_3$	2- butanol

6. Aldehydes:-

General formula : RCHO

(where R : C_nH_{2n+1} and $n = 0,1,2,3,4.....$)

Functional group : $-\overset{\displaystyle O}{\overset{\Vert}{C}}-H$ (aldehyde)

Suffix : al

Name : Replace last 'e' of 'parent alkane' by 'al'

n	formula	name
0	$H-\overset{\displaystyle O}{\overset{\Vert}{C}}-H$ / HCHO	methanal
1	$CH_3-\overset{\displaystyle O}{\overset{\Vert}{C}}-H$ / CH_3CHO	ethanal
2	$CH_3-CH_2-\overset{\displaystyle O}{\overset{\Vert}{C}}-HO$	propanal

7. Ketones:- $R-\overset{\overset{O}{\|}}{C}-R'$

General formula : $R-\overset{\overset{O}{\|}}{C}-R'$ (Where R = C_nH_{2n+1} and R′ = $C_{n'}H_{2n'+1}$ and n = 1,2,3, and n′ = 1,2,3, also n & n′ may be same or different.)

Functional group : $-\overset{\overset{O}{\|}}{C}-$ (Ketone)

Suffix = one

Name = Replace last 'e' of 'ane' by 'one'

e.g.

n	n′	Formula	Name
1	1	$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$	2 – Propanone
2	1	$CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$ Or $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$	2 – Butanone
2	2	$CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$	3- Pentanone
3	1	$CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$ Or $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3$	2 – Pentanone

8. Carboxylic acids:

General formula : RCOOH where R=C_nH_{2n+1}, Where n = 0,1,2 .....

Functional group : $-\overset{\overset{O}{\|}}{C}-OH$ (carboxyl)

Suffix : oic acid

Name = Replace last 'e' of alkane by 'oic acid'

n	Formula	Name
0	$H-\overset{\overset{O}{\|}}{C}-OH$	Methanoic acid
1	$CH_3-\overset{\overset{O}{\|}}{C}-OH$	Ethanoic acid

2 $CH_3 - CH_2 - \overset{\overset{O}{\|}}{C} - OH$ Propanoic acid

3 $CH_3 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - OH$ Butanic acid

Q. Discuss some important chemical properties of carbon compounds.

Ans. Some of the important chemical properties of carbon compounds (Hydrocarbon) are discussed as follows:-

1. Combustion:- The process of burning of a carbon compound in air to give carbon dioxide, water, heat and light is known as combustion. Most of the carbon compounds burn in air to produce a lot of heat. e.g. alkanes burn in air to produce a lot of heat, hence are excellent fuels.

When methane burns in sufficient supply of air then carbon dioxide and water vapours are formed with the evolution of large amount of heat.

$$\underset{\text{Methane}}{CH_4} + \underset{\text{Oxygen}}{2O_2} \xrightarrow{\text{Combustion}} CO_2 + 2H_2O + \text{heat} + \text{Light}$$

Saturated hydrocarbons (alkanes) generally burn in air with blue (non- sooty flame.) This is because the percentage of carbon in alkanes is comparatively low- which gets completely oxidized.

Unsaturated hydrocarbons (alkenes and alkynes) burn in air with a yellow sooty flame. This is because the percentage of carbon in alkenes and alkynes is comparatively high.

2. Oxidation Reaction:- Addition of oxygen to any substance is called as oxidation and the substance which is capable of adding oxygen to other substances is called as oxidizing agent. Thus, the reaction in which oxygen is added to any substance is known as oxidation reaction.

e.g.

When alcohol is treated with acidified potassium dichromate or alkaline potassium permanganate, it gets oxidized to carboxylic acids.

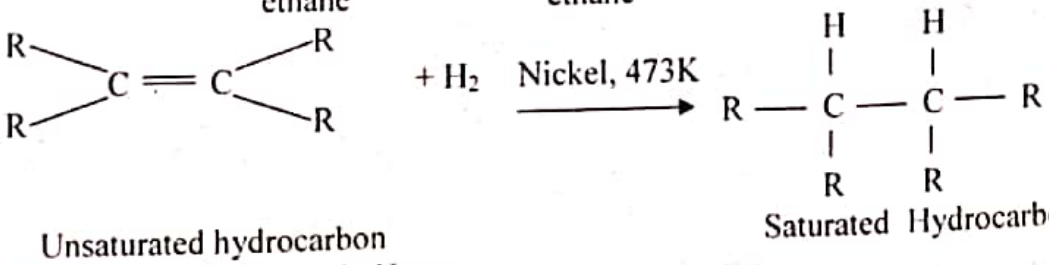
$$\underset{\text{ethanol}}{CH_3 - CH_2 - OH} + 2[O] \xrightarrow[\text{acidified } K_2Cr_2O_7]{\text{alkaline } KMnO_4} \underset{\text{Ethanoic acid.}}{CH_3\overset{\overset{O}{\|}}{C} - OH} + H_2O$$

3. Addition Reactions:-

Reactions which involve addition of two reactants to form a single product are called addition reactions.

Due to presence of double and triple bonds , unsaturated hydrocarbons are more reactive and hence add hydrogen in presence of a catalyst such as nickel, platinum or palladium to form saturated hydrocarbons. This process is called as catalytic hydrogenation.

e.g. $\underset{\text{ethane}}{CH_2 = CH_2} + H_2 \longrightarrow \underset{\text{ethane}}{CH_3 - CH_3}$



Unsaturated hydrocarbon

Saturated Hydrocarbon

Where R = CH_3, C_2H_5, C_3H_7 etc.

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4. Substitution reaction:-

Reactions which involve the direct replacement (displacement) of an atom or a group of atoms in an organic molecule by another atom or group of atoms without any change in the rest of the molecule are called as substitution reactions. Substitution reaction is an important property of saturated hydrocarbons (alkanes) e.g. saturated Hydrocarbons in presence of heat and light react with chlorine to form substitution products. e.g.

$$CH_4 + Cl_2 \xrightarrow[520-670k]{\text{Sun light}} CH_3Cl + HCl$$

Methane Chlorine Chloro methane

$$CH_3Cl + Cl_2 \not\longrightarrow CH_2Cl_2 + HCl$$

Dichloromethane

Q. Give a detailed account of ethanol (C_2H_5OH).

Ans. Ethanol is the second member of the homologous series of alcohols. The chemical formula of ethanol is C_2H_5OH. The common name of ethanol is ethyl alcohol and is most, common and most widely used.

Physical properties of alcohol.

Some of the physical properties of ethanol are described below.

1) Ethanol is a colourless liquid at room temp. its freezing point is 156K while its boiling point is 351K.
2) It has a distinct smell and a burning taste.
3) Ethanol is soluble in water.
4) It is lighter than water.
5) It has no effect on litmus paper.

Chemical properties of ethanol.

1) **Reaction with sodium:-**

Ethyl alcohol is weakly acidic in nature. It evolves hydrogen with active metals like sodium.

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

Ethanol Sodium Sodium ethoxide

2) **Combustion reaction:-**

It burns in air to form CO_2 and water vapour.

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O + \text{Energy}$$

Ethanol

3) **Oxidation reaction:-**

Ethanol when heated with alkaline potassium permanganate solution or acidified potassium dichromate solution, it gets oxidized to ethanoic acid.

$$CH_3 - CH_2 - OH + 2[O] \xrightarrow[\text{or acidified } K_2Cr_2O_7]{\text{Alkaline } KMnO_4} CH_3COOH + H_2O$$

Ethanol nascent oxygen

4) **Dehydration reaction:-**

Ethanol when heated with concentrated sulphuric acid at 170°C. it gets dehydrated to form ethane.

$$CH_3 - CH_2 - OH \xrightarrow[170\ oC\ (\text{Dehydration})]{\text{Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

Ethanol Ethene Water

5) **Reaction with ethanoic acid:-**

Ethanol reacts with ethanoic acid on warming in presence of H_2SO_4 to form ester.

$$CH_3COOH + C_2H_5OH \longrightarrow CH_3COOC_2H_5 + H_2O$$

Ethanoic acid Ethanol Ester

The reaction in which a carboxylic acid combines with an alcohol to form an ester is called as **esterfication reaction.** In this reaction concentrated H_2SO_4 acts as dehydrating agent.

Uses:-

1) Ethanol is used in the manufacture of paints, varnishes, medicines, perfumes, dyes, soaps and synthetic rubber.
2) Ethyle alcohol is used in alcoholic drinks like whiskey, beer etc.
3) It is used as an antiseptic to sterilize the wounds.
4) Ethyl alcohol is used as a fuel in cars and spirit lamps.
5) It is used in medicines such as tincture iodine, cough syrups, and many tonics.
6) Ethanol is used as a solvent for many organic compounds.

Q) What are harmful effects of drinking alcohol?

Ans 1) Alcohol drinking leads to increased road accidents as it effects the nervous system and the person loses the judgment.
2) Alcohol drinking leads to quarrels and fights which increases the violence and crime in society. This is because alcohol drinking lowers the mental restrain.
3) Alcohol drinking leads to staggered movement, unclear speech, blurred vision, dizziness and vomiting.
4) Alcohol drinking makes a person financially bankrupt.
5) Alcohol drinking for longer periods damages the stomach, liver, heart, brain and ultimately causes death.
6) Adulterated alcohol drinking causes severe poisoning leading to blindness and even death.

Q) Write a short note on denatured alcohol.

Ans. A lot of alcohol is used in industries for manufacturing various products. This alcohol is much cheaper than the alcohol available in markets, as it is supplied to the industries tax free. To avoid its miss use, some poisonous substances such as methyle alcohol etc are added to it which make it unfit for drinking purposes.Such alcohol which has been made unfit for drinking is called denatured alcohol.

Q) Give a detailed account of ethanoic acid (or acetic acid)?

Ans) Ethanoic acid is the second member of the homologous series of carboxylic acids. The chemical formula of ethanic acid is CH_3COOH. The common name of ethanoic acid is acetic acid. A dilute solution of ethanoic acid in water is called vinegar.

Q) Preperation of acetic acid

Ans) A 10 – 12% solution of ethyle alcohol is fermented in presence of enzyme acetobacter and air at 30^0 to 35^0.

$$CH_3 - CH_2 - OH + O_2 \xrightarrow{\text{acetobacter}} CH_3COOH + H_2O$$

Ethanol acetic acid

Physical properties of acetic acid:

1) It is colourles, pungent smelling corrosive liquid. It has a sour taste.
2) Its boiling point is 118^0C.
3) It is soluble in water.
4) Having low melting point (17^0C) it often freezes in winter in cold climates to form ice like solid, this gave rise to its name glacial acetic acid.

(1) Chemical properties:

1) Acetic acid being acidic in nature turns blue litmus into red in colour.

(2) Reaction with alcohols:

Ethanoic acid reacts with ethanol in presence of conc. H_2SO_4 as catalyst to form an ester.

$$\underset{\text{Ethanoic Acid}}{CH_3COOH} + \underset{\text{ethanol}}{C_2H_5OH} \xrightarrow{\text{conc. } H_2SO_4} \underset{\text{ester}}{CH_3-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_3} + H_2O$$

(3) Reaction of ethanoic acid with a base

Ethanoic acid reacts with a base such as sodium hydroxide (NaOH) to give (sodium acetate) salt and water.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + NaOH \longrightarrow \underset{\text{sodium acetate}}{CH_3COONa} + H_2O$$

(4) Reaction with carbonates and bicarbonates

Ethanoic acid reacts with sodium carbonate and sodium bicarbonate to form sodium acetate, carbon dioxide and water.

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

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

Uses

1) Dilute ethanoic acid (vinegar) is used as a food preservative in the preparation of pickles and sauces.
2) Ethanoic acid is used for making cellulose acetate which is an important artificial fibre.
3) Ethanoic acid is used in the preparation of propanone and esters used in making perfumes and flavouring agents.
4) Ethanoic acids is used in the preparation of dyes, plastics and pharmaceuticals.

Q) What are soaps? Give their structure and preparation?

Ans) Soap is a cleansing agent. There are several cleansing agents but soaps are very popular cleansing agents which have been used for more than two thousand years.

Structure

Soaps consist of two parts:

1) A long hydrocarbon chain, which is hydrophobic (water repelling). It is called non-polar tail.
2) An ionic part which is hydrophilic (water attracting). It is called polar head.

$$\underset{\text{Long hydrocarbon Chain (water repelling)}}{C_{15}H_{31}} - \overset{\overset{O}{\|}}{C} - \underset{\text{ionic part (water attracting)}}{O^-Na^+}$$

sodium palmitate

Preparation

Soaps are made from animal fats or vegetable oils. Fats and oils are esters of higher fatty acids and glycerol.

When fats and oils are heated with sodium hydroxide (NaOH) solution they split to form sodium salt of higher fatty acid called as soap and glycerol as byproduct.

$$\underset{\text{(an ester)}}{\text{Fats or oil}} + \underset{\text{(alkali)}}{\text{sodium hydroxide}} \xrightarrow{\text{heat}} \underset{\text{sodium salt of fatty acids}}{\text{soaps}} + \underset{\text{alcohol}}{\text{glycerol}}$$

The process of making soap by the hydrolysis of fats and oils with alkalies is called saponification.

e.g. $\underset{\text{ethyl ethanoate}}{CH_3COOC_2H_5} + NaOH \longrightarrow \underset{\text{sodium acutate}}{CH_3COONa} + C_2H_5OH$

$CH_2COOC_{15}H_{31}$ — CH_2OH

$CH_2COOC_{15}H_{31}$ + 3NaOH (sodium hydroxide) —saponification→ CH_2OH + 3 $C_{15}H_{31}$ COONa (sodium palmatate (soap))

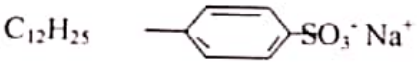
$CH_2COOC_{15}H_{31}$ — CH_2OH

Oil and fats (tripalmitin) — Glycerol

Q) What are Synthetic detergents?

Ans) A synthetic detergent is the sodium salt of long chain benzene sulphonic acid which has cleansing properties in water. Synthetic detergents are called as soapless soaps because though they act like a soap in having the cleansing properties but they do not contain the usual soap molecule like sodium stearate etc. e.g. sodium n-dodecyle benzene sulphonate. Synthetic detergents are better cleansing agents than soaps because they do not form insoluble calcium and magnesium salts with hard water and therefore it can be used for washing even in hard water synthetic detergent have structures similar to that of soaps. e.g.

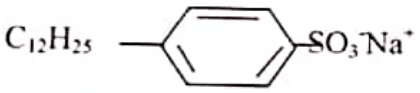
(i) Sodium n – dodecyl benzene sulphonate



It also consists of two parts.

(i) A long hydrocarbon chain, hydro phobic (water repelling) in nature called as non-polar tail.

(ii) An ionic part hydrophilic (water attracting) in nature called as polar head.



Non-polar tail (hydrophobic) — polar head (hydrophilic)

Synthetic detergents are made from long chain hydrocarbons obtained from petroleum and these are made from by-products of oil refining and so are petroleum based.

The washing powders available in the markets contain about 15 – 30% detergents by weight. The remaining part of washing powders contain other chemicals which are added to impart it other desired properties, e.g. a mild bleaching agent such as sodium perborate is added to washing powders to produce whiteness in clothes.

Q. Write the advantages of synthetic detergents?

Some of the advantages of synthetic detergents over soaps are:

(i) Synthetic detergents can be used for washing even in hard water.

(ii) Synthetic detergents can be used even in acidic solutions.

(iii) Synthetic detergents have higher solubility than that of soaps.

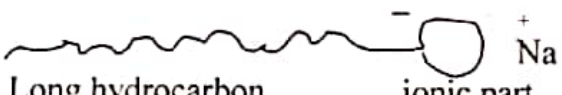
(iv) They have better cleansing action.

Q) Write a note on cleansing action of soaps and detergents?

Ans) Soaps are sodium or potassium salts of higher fatty acids. e.g. sodium palmitate, $C_{15}H_{31}COO^- Na^+$. A soap molecule consist of two parts:-

i) A long chain hydrocarbon non-polar part ($C_{15}H_{31}$) which is soluble in oil or grease.

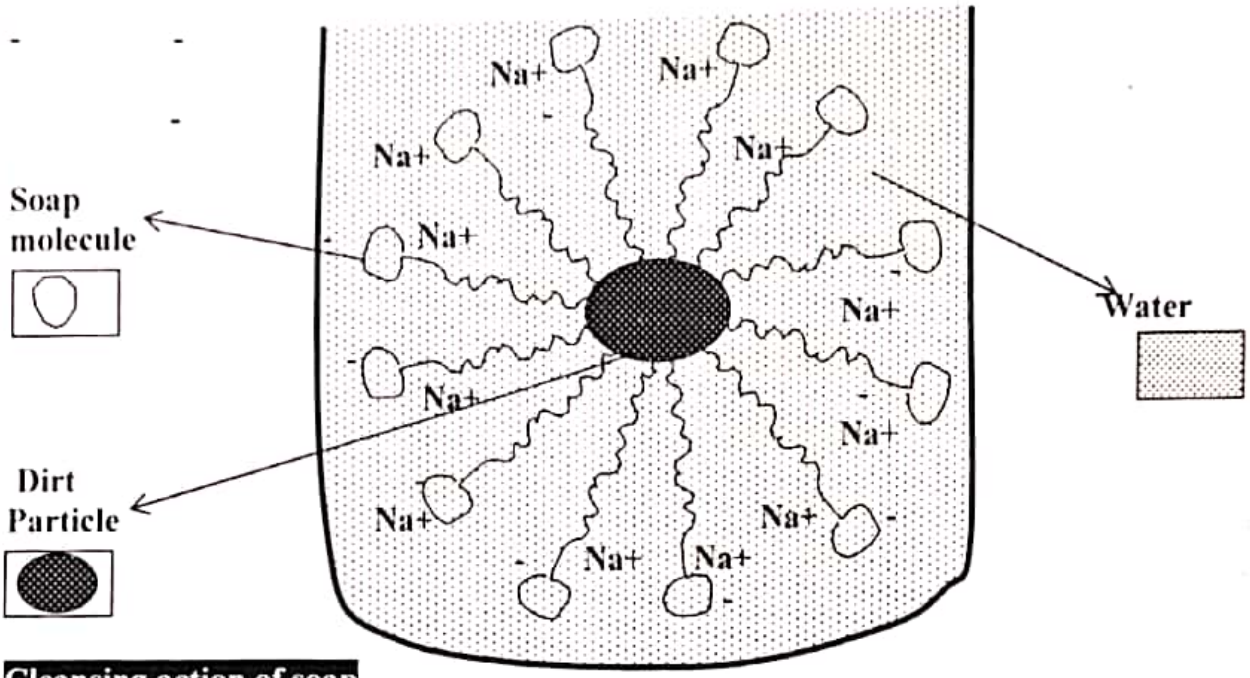
ii) Ionic part or polar part ($-COO^- Na^+$) which is soluble in water. A molecule of soap can be represented as:



Long hydrocarbon Chain — ionic part

When soap molecules dissociate in water, they give rise to carboxylate ion ($RCOO^-$) and cation (Na^+). When soap is added to dirty clothes, dipped in water, the hydrocarbon part of the carboxylate group dissolves in greasy or oily dirt parts while the polar (COO) group remains attached to water and result in the formation of micelles. These micelles can not coalesce and hence form stable emulsion in water.

These small droplets along with dirt can be easily washed away with water. Thus, soap helps in removing greasydirt by producing a stable oil in water type emulsion.



Cleansing action of soap

Q) Difference between soaps and detergents?

Ans) The main points of difference between soaps and detergents are given below:

Soaps	Detergents
1) Soaps are sodium salt of long chain fatty acids	1) Detergents are sodium salt of long chain alkyl sulphates
2) They can not be used in acidic solutions.	2) They can be used even in acidic solutions.
3) Soaps are prepared from animal fat or vegetable oil.	3) Detergents are prepared from hydrocarbon of petroleum.
4) Soaps are not suitable for washing purpose when water is hard.	4) Synthetic detergents can be used for washing even when water is hard.
5) Soaps are biodegradable.	5) Some of the detergents are non-biodegradable.
6) Soaps have relatively weak cleansing action.	6) Synthetic detergents have a strong cleansing action.

Q) What are the limitations (disadvantages) of soaps?

Ans) Soaps are not suitable for washing clothes with hard water because of the following reasons:

1) Hard water contains salts of calcium and magnesium i.e. bicarbonates, chlorides and sulphates of calcium and magnesium when soap is added to hard water, these calcium and magnesium ions of hard water form insoluble greasy scum or ppt. with soap which sticks to the cloth and makes it dull. This makes cleansing of clothes difficult.
2) Soap is not suitable in acidic solutions. Since in acidic solutions free fatty acids are obtained which are not effective as cleansing agents. So washing has to be done in alkaline medium.

Textual questions

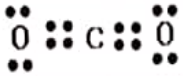
Q.1) What would be the electron dot structure of carbon dioxide which has the formula CO_2?

Ans) The distribution of electrons in carbon and oxygen is represented as:

Carbon: K = 2 L = 4

Oxygen: K = 2 L = 6

Valency of carbon is 4 and that of oxygen is 2, therefore carbon atom shares its four valence electrons with two oxygen atoms. Thus the electronic dot structure of CO_2 is as:

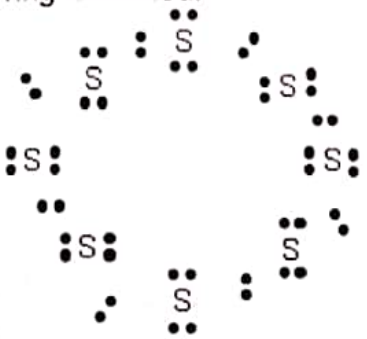


Q.2) What would be the electron dot structure of a molecule of sulphur, which is made up of eight atoms of sulphur? (Hint – The eight atoms of sulphur are joined together in the form of a ring.)

Ans) Sulphur has atomic no. 16. Its electronic configuration is

K	L	M
2	8	6

Since sulphur atom is short of two electrons so as to complete its octet. Therefore, each sulphur atom shares two valance electrons with two neighboring sulphur atoms and an eight membered ring is formed.

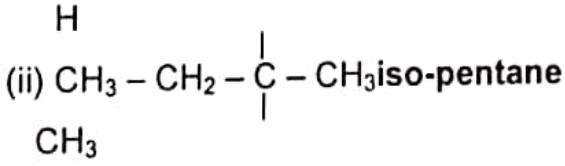


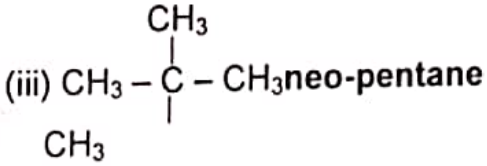
Q.3) How many structural isomers can you draw for pentane?

Ans)

we can draw three structural isomers for pentane

(i) $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ **n- pentane**

(ii)  **iso-pentane**

(iii)  **neo-pentane**

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

Ans) The two properties of carbon responsible for existence of huge number of carbon compounds are (i) Catenation (ii) Small size and tetra valency of carbon.

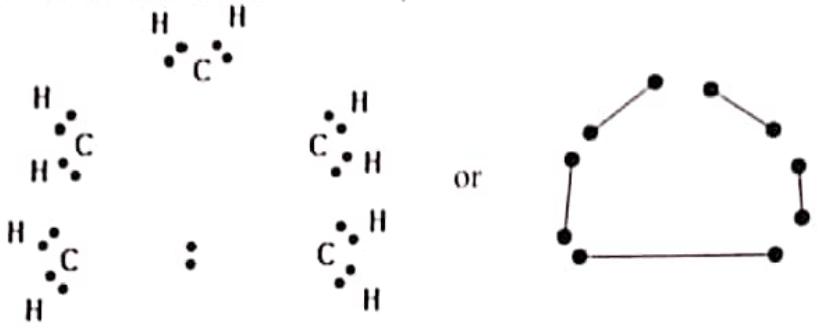
(i) Catenation: The property of forming bonds with atoms of the same element is called catenation (self linking property). Carbon shows maximum tendency for catenation in the periodic table. This is because of strong carbon – carbon bonds as compared to other atoms. It is due this property that organic compounds have long chain, branched chains and ring structure of carbon atoms, which is one of the reasons for existence of large number of organic compounds.

(ii) Tetra valency and Small size :- Due to its tetra valency, carbon atoms can form covalent bonds with four other carbon atoms or with a large number of other atoms such as hydrogen, oxygen, nitrogen, sulphur, chlorine and other more atoms.

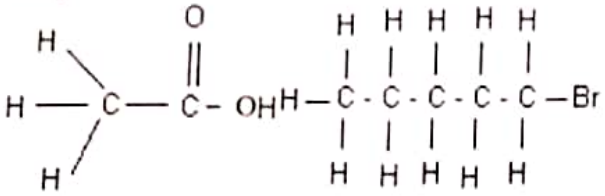
Due to its small size, carbon forms multiple bonds with other carbon atoms or with oxygen and nitrogen. The reason for the formation of strong bonds by carbon with other elements is its small size. Thus tetra valency together with small size of carbon is the another reason for existence of large number of organic compounds.

Q.5) What will be the formula and electron dot structure of Cyclopentane?
Ans) In cyclopentane each carbon atom shares its two valence electrons with two neighbouring carbon atoms and two valence electrons with two hydrogen atoms.
Formula of Cyclopentane is C_5H_{10}

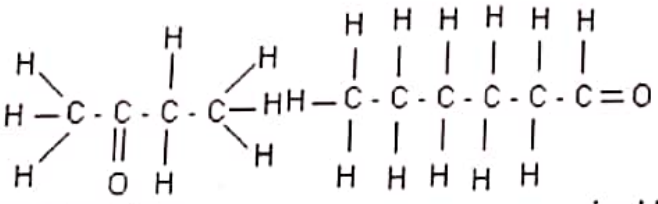
Electron dot structure Cyclopentane is



Q.6) Draw the structures for the following compounds.
i. Ethanoic acid ii. Bromopentane iii. Butanone iv. Hexanal
Ans)



i. Ethanoic acid ii. Bromopentane

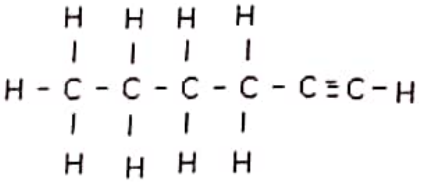


iii. Butanone iv. Hexanal

Q.7) How would you name the following compounds?

i. $CH_3 - CH_2 - Br$ ii. $H - C = O$

1– bromo ethane Methanal



iii.

1 – Hexyne

Q.8) Why is the conversion of Ethanol to Ethanoic acid an oxidation reaction?
Ans) The conversion of ethanol into ethanoic acid is called an oxidation reaction because oxygen is added to it during this conversion.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\substack{\text{Nascent}\\\text{Oxygen}}}{2[O]} \xrightarrow{\text{alkaline KMno4}} \underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Water}}{H_2O}$$

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

Ans) When a mixture of oxygen and ethyne is burnt, it burns completely producing a blue flame. This blue flame is extremely hot which produces a very high temperature which is used for welding metals. But the mixture of ethyne and air is not used for welding purposes because burning of ethyne in air produces a sooty flame due to incomplete combustion, which is not too hot to melt metals for welding.

Q.10) What are oxidizing agents?

Ans) The substances which are capable of adding oxygen to other substances are called as oxidizing agents, e.g. alcohols are converted to carboxylic acids in presence of alkaline potassium permagnate or acidified potassium dichromate. In this reaction potassium permagnate and potassium dichromate act as oxidizing agents.

$CH_3CH_2 - OH \xrightarrow{\text{alkaline KMno4 + heat}} CH_3COOH$

Alsooxidizing agents are the substances that gain electrons in a redox reaction and whose oxidation number is reduced.

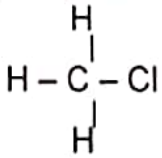
Q.11) Explain the nature of the covalent bond using the bond formation of CH_3Cl.

Ans) The atomic numbers and the electronic configuration of C,H and Cl are given below.

	Carbon	Hydrogen	Chlorine
	C	H	Cl
Atomic No.	6	1	17
K	K=2	K=1	K=2
L	L=4		L=8
			M=7

CH_3Cl(methyl chloride) is made up of one carbon atom, three hydrogen atoms and one chlorine atom. Carbon atom has 4 valence electrons, each hydrogen atom has one valence electron, and chlorine atom has 7 valence electrons. Carbon atom shares its four valence electrons with three hydrogen atoms and 1 chlorine atom to form methyl chloride as follows:

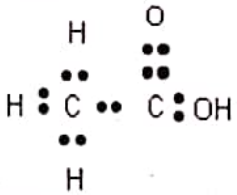
From the above reaction, in the dot structure of methyl chloride (CH_3Cl) there are four pairs of shared electrons between carbon and other atoms. Each pair of shared electrons constitutes one single covalent bond. So, methyl chloride has four single covalent bonds.

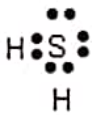


Q.12) Draw the electron dot structures for

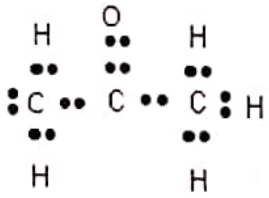
i. Ethanoic acid ii. H_2S iii. Propanone iv. F_2

Ans)





i Ethanoic acidii. H_2S



iii. Propanoneiv. F_2

Q.13) How can ethanol and Ethanoic acid be differentiated on the basis of their physical and chemical properties?

Ans) (i) Ethanol has a pleasant smell whereas ethanoic acid has the smell of vinegar.
(ii) Ethanol has a burning taste whereas ethanoic acid has a sour taste.
(iii) Ethanol has no action on litmus paper whereas ethanoic acid turns blue litmus paper red.
(iv) Ethanol has no reaction with sodium hydrogencarbonate but Ethanoic acid gives brisk effervescence with sodium hydrogencarbonate.
(v) Alkaline potassium permagnate loses its colour in ethanol while as it retains its colour in ethanoic acid.

Q.14) Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Ans) The soap consists of two parts (i) the organic tail or non polar part which is soluble in oil and greese and is insoluble in water. (ii) The polar part which is soluble in water and is insoluble in oil.

When soap is added to water, the ionic part dissolves in water while as non-polar part remains insoluble in water. Because of mutual repulsion of the ionic part of the soap molecules they achieve a unique orientation by forming a cluster of molecules. This cluster of molecules is called micelle. In this organic tail remains in the interior of the cluster and ionic ends are on the surface of the cluster.

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

Ans) Carbon and its compounds are used as fuels for most of the applications because they burn in air releasing a lot of heat energy.

Q.16) Explain the formation of scum when hard water is treated with soap.

Ans) The hard water contains calcium and magnesium ions. When water is treated with soap, the calcium and magnesium ions of water combine with soap molecules to form an insoluble precipate of calcium and magnesium salts of soap. This precipate formed by the action of soap with hard water is called scum.

Q.17) What change will you observe if you test soap with litmus paper (red and blue)?

Ans) Soap is the salt of a strong base (NaOH) and a weak acid (carboxylic acid), so a solution of soap in water is basic in nature. Being basic, a soap solution turns red litmus paper blue.

Q.18) What is hydrogenation? What is its industrial application?

Ans) Hydrogenation is a process in which unsaturated hydrocarbons are converted into saturated hydrocarbons by the addition of hydrogen in presence of a catalyst.

The process has a great industrial applications as it is used to convert vegetable oils to vanaspati ghee.

Vegetable oil + H_2 $\xrightarrow{\text{catalyst}}$ vanaspati ghee

Q.19) Which of the following hydrocarbons undergo addition reactions:
C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4

Ans) Alkenes and alkynes (unsaturated hydrocarbons) undergo addition reactions. From the above hydrocarbons C_2H_2 is an alkyne, whereas C_3H_6 is an alkene. So, C_3H_6 and C_2H_2 will undergo addition reactions.

Q.20) Give a test that can be used to differentiate chemically between butter and cooking oil.

Ans)Butter contains saturated compounds while as cooking oil contains unsaturated compounds. Since bromine water is decolourized by the addition of unsaturated compounds. Thus bromine water test can be used to differentiate chemically between butter and cooking oil. Add bromine water to a little of cooking oil and butter taken in separate test tubes.

a. Decolourising of bromine water by cooking oil shows it is a unsaturated compound.
b. Butter does not decolourise bromine water shows it is saturated compounds.

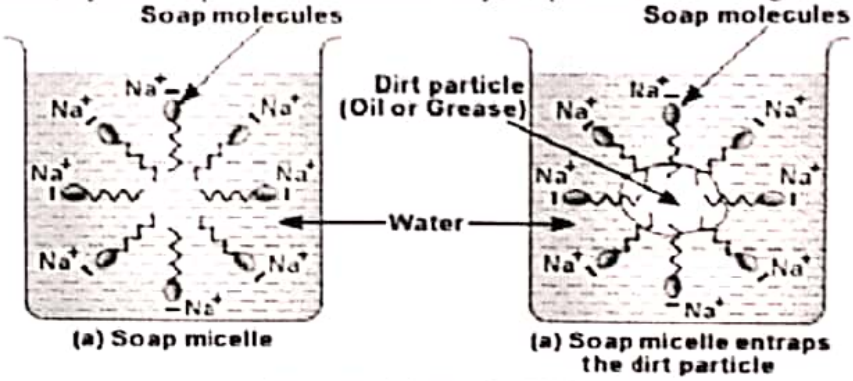
Q.21) Explain the mechanism of the cleaning action of soaps.

Ans)We all know that soap is used to remove dirt and grime from substances. Generally dirt and grime get stuck because they have an oily component, which is difficult to remove by plain brushing or washing by water. A soap molecule has two parts, a head and a tail i.e. the long chain organic part and the ionic part.

A soap molecule has a tadpole like structure shown below.

The organic part is water insoluble but is soluble in organic solvents or in oil or grease. The ionic part is soluble in water, as water is a polar solvent. When soap is added to water in which dirty clothes are soaked, the two parts of the soap molecule dissolve in two different media. The organic tail dissolves in the dirt, grime or grease and the ionic head dissolves in water. When the clothes are rinsed or agitated,

the dirt gets pulled out of the clothes, by the soap molecule. In this way soap does its cleaning work on



Cleansing action of soap

dirty and grimy clothes or hands.

The soap molecules actually form a closed structure because of mutual repulsion of the positively charged heads. This structure is called a micelle. The micelle pulls out the dirt and grime more efficiently.

Q.22) Would you be able to check if water is hard by using a detergent?

Ans) Detergents are generally ammonium or sulphonate salts of long chains of carboxylic acids. The charged ends of these compounds do not form insoluble precipitates with calcium and magnesium ions in hard water. Thus we would not be able to check whether a sample of water is hard by using a detergent, this is because a detergent forms lather easily even with hard water.

Q.23) People use a variety of methods of wash clothes. Usually after adding the soap, they 'beat' the clothes on a stone, or beat is with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes?

Ans)It is necessary to shake to get clean clothes because the soap micelles, which entrap oily or greasy particles on the surface of dirty clothes, have to be removed from their surface. When the clothes which are wet by soap solution are beaten, the micelles containing oil or greasy dirt particles get removed from the surface of dirty clothes and go into water and the dirty cloth gets cleaned.

EXTRA QUESTIONS

Q.1) A piece of black electrode used in dry cell on strong heating in air gave a colourless gas which turned lime -water milky. What was the material of the electrode?

Ans)We know that graphite is used for making the electrodes. So, the piece of black electrode used in the dry cell is made of graphite (which is an allotrope of carbon element). This is confirmed by the fact that the piece of electrode, on strong heating in air, gave a colourless gas, carbon dioxide which turned lime-water milky. As graphite on strong heating yields carbon dioxide. Thus, the material of the electrode is graphite.

Q.2) Why does graphite conducts electricity, but not diamond?

Ans)In case of diamond, each carbon atom of a single crystal is surrounded by four other carbon atoms by covalent bonds such that they form four corners of a regular tetrahedron. Because of four covalent bonds with each carbon atom there are no free electrons available. Due to the non-availability of free electrons within crystalline structure, diamond acts as a bad conductor of electricity.

In case of graphite, every carbon atom in a single crystal is covalently bonded to three carbon atoms. As each carbon atom has four valence electrons, one valence electron is left free for each carbon atom. These free electrons can be easily made to flow within the crystalline structure of graphite by applying electric potential. Thus, graphite is a good conductor of electricity.

Q.3) Write three important uses of ethanol.

Ans) The three important uses of ethanol are:

(i) Ethanol is used as a solvent to dissolve varnishes, medicines and other organic compounds

(ii) It is used as beverage (for drinking as an intoxicant) in different forms, viz; Brandy, Whisky etc.,

(iii) It is used for industrial purposes in the name of denatured spirit.

(iv) It is used as a fuel in cars and spirit lamps.

Q.4) State what you will observe when sugar crystals is heated strongly. State what you will observe when sugar crystals is treated with conc. Sulphuric acid.

Ans)The sugar crystal will initially melt. Gradually, they turn brown and start swelling up. They give off large amount of steam. Finally black porous residue of carbon is left behind.

The sugar crystals will initially turn brown. Lot of frothing takes place with the evolution of large amount of heat and steam is given off. Finally a black porous residue of carbon is left behind.

Q.5) How are the molecules of aldehyde and Ketone structurally different?
Ans)In aldehyde, the carbon atom of the carbonyl group is attached to one alkyl group (R) and one hydrogen atom but in ketone, the carbonyl group is attached to two alkyl groups.

Q.6) What change has been made in the composition of detergents to make them biodegradable?
Ans)Branched chain detergents are generally non-degradable. Detergents made from long chain hydrocarbons having the minimum branching in their molecules are degraded more easily.

Q.7) A hydrocarbon molecule contains 4 hydrogen atoms. Give its molecular formula, if it is an: (i) alkane, (ii) alkene (iii) alkyne.
Ans)(i) An alkane containing 4 hydrogen atoms in its molecule is methane, CH_4.
(ii) An alkene containing 4 hydrogen atoms in its molecule is ethane, C_2H_4
(iii) An alkyne containing 4 hydrogen atoms in its molecule is propyne, C_3H_4

Q.8) Why common salt is added in soap making?
Ans)Common salt is added to the mixture to make the soap come out of solution. Though most of the soap separates out on its own but some of it remains in solution. Common salt is added to precipitate out all the soap from the aqueous solution. Actually, when we add common salt to the solution, then the solubility of soap present in it decreases, due to which all the soap separates out from the solution in the form of a solid.

Q.9) What is meant by denatured alcohol? What is the need to denature alcohol?
Ans)The alcohol which is rendered unfit by mixing it with some poisonous substances, such as methanol, pyridine, copper sulphate, etc is known as denatured alcohol. Ethanol is an important industrial chemical. Therefore, it subjected to very small excise duty. To prevent its misuse for drinking purpose, there is a need to denature alcohol.

Q.10) What is meant by the term "functional group"?
Ans)A functional group in an organic compound is an atom (other than hydrogen) or a group of atoms binded together in a unique fashion which determines the properties of the molecule and is usually the site of chemical reactivity in an organic molecule.
e.g. In CH3 CH2 – OH (-OH) is the functional group (-OH is the functional group for alohols).
In CH3 CHO (-CHO) is the functional group (– CHO is the functional group of aldehydes).