Chapter -8
Carbon and Its Compounds

According to Berzelius (1815), it was believed that organic compounds can be obtained from the living organisms only and can not be synthesized by artificial methods in laboratory. This is known as vital force theory. Later, Substances obtained from living organisms were known as organic compounds and study of carbon compounds or organic compounds was known as organic chemistry.

But in 1828, Wohler synthesized an organic compound urea by heating a mixture of inorganic compounds, ammonium sulphate and potassium cyanate in laboratory

$$\underset{\text{Ammonium Sulphate}}{(NH_4)_2SO_4} + \underset{\text{Potassium cyanate}}{2KCNO} \xrightarrow{\Delta} \underset{\text{Amoniums cyanate}}{2NH_4CNO} + K_2SO_4$$

After this discovery by Wohler, vital force theory was failed and efforts for synthesis of organic compounds started in laboratory. We use many organic compounds in daily life such as in grains, table, chair, petrol, LPG paper, plastic, cloth, oil, soap, detergent, pencil, rubber etc. Carbon element is present in all these substances. Due to the smaller size of carbon atom it forms single, doulbe and triple bonds by making sigma (σ) and (π) bonds. Because of special characteristic properties of carbon atom, the number of compounds formed by carbon atom are greater than the number of compounds formed by other elements.

8.1 Characteristics of carbon atom

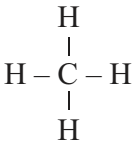
1. The atomic number of carbon atom is Six (6) in periodic table which is denoted as "C" (Symbol)

2. The electronic configuration of carbon atom is $1s^2\ 2s^2\ 2p^2$.

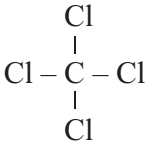
3. The valency of carbon atom is four. Carbon atom can combine with other elements to satisfy its four valencies as follows.

(i) With four monovalent atoms

Example CH_4, CCl_4 etc.



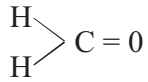
Methane



Carbon tetra chloride

(ii) With two monovalent and one divalent atom

Example- Formaldehyde



(iii) With one monovalent and one trivalent atom. Example - HCN

$H - C \equiv N$ Hydrogen cyanide

(iv) With two divalent atoms

Example CO_2

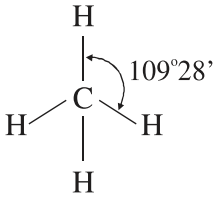
$O = C = O$ carbon dioxide

4. The geometry of carbon atom is tetrahedral in which four valencies of carbon atom are directed towards the four corners of a regular tetrahedron and the carbon atom is situated at the centre of regular tetrahedron. The bond angle between each valency is 109°28'

Regular Tetrahedron: "A tetrahedron has Four triangular faces, one of which is the base and the three corners of the triangular base

are joined to an apex forming the other three triangular faces".

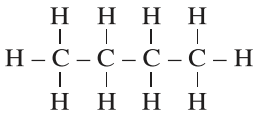
Bond Angle: "The angle in between two adjacent bonds in a molecule is called the bond angle" for example in CH_4 bond angle is $109^0 28'$ with tetrahedral geometry.



Methane (Tetrahedral Geometry)

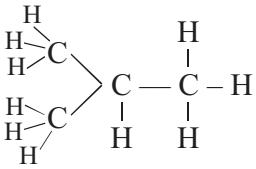
5. Carbon has the special ability to bond to itself, forming branched, unbranched or cyclic chains of carbon to carbon bonds. This property of carbon atom is called "Catenation"

For example Butane



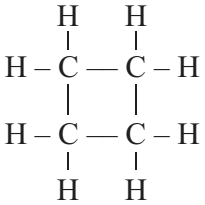
Unbranched chain

Isobutane



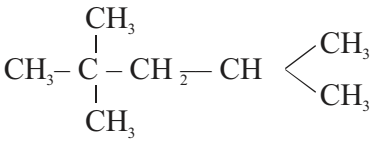
Branched chain

Cyclobutane



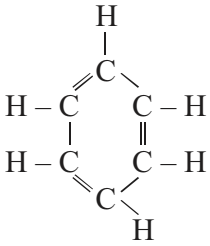
Aliphalic cyclic compound

Isooctane

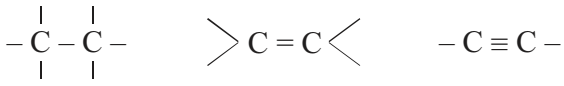


Highly branched

Benzene

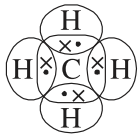


6. Carbon atom can form single, double and triple bond combine with other carbon atom. Example

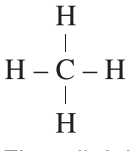


Alkane Alkene Alkyne

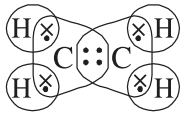
7. Carbon atom and hydrogen atom form covalent bond by equal sharing of electrons due to almost same electronegativities of both. In this process octet of carbon and nearest inert helium gas configuration duet of hydrogen is obtained. Compound so formed by carbon and hydrogen are knwon as hydrocarbons.

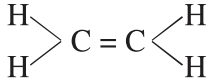


(Electronic formula of methane)

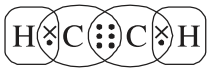


Structural formula of methane





Electron dot strucutre of ethene Structural formula of Ethene



$H - C \equiv C - H$

Ethyne

8.2 Hydrocarbon and its classification

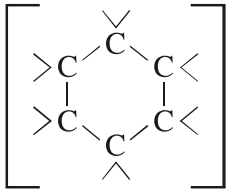
Compounds formed by carbon and hydrogen are known as Hydrocarbons. Example CH_4, C_2H_6, C_2H_4,

8.2.1 Classification of Hydrocarbons

Hydrocarbons

Open chain Hydrocarbons
or
(Acyclic Hydrocarbons)
or
(Aliphatic Compounds)

Closed Chain Hydrocarbons
or
(Cyclic Hydrocarbons)



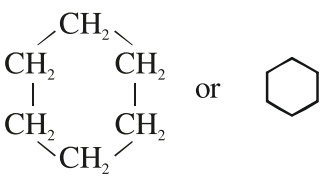
Saturated Hydrocarbons
(Single bond is present in between carbon-carbon atom Example methane, ethane propane etc).

Unsaturated Hydrocarbons

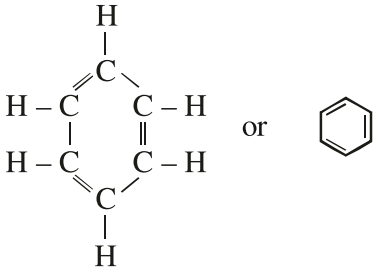
Alkene
(Carbon-carbon double bond is present)
Example: Ethene, propene etc.

Alkyne
(Carbon-carbon triple bond is present)
Example-Acetylene, propyne etc

Alicyclic Hydrocarbons
(Aliphatic compounds)
Burns without smoky flame
Example. Cyclohexane



Aromatic Hydrocarbons
Burns with smoky flame
Example. Benzene



C_2H_2 etc. Generally in nature atoms are not present in free state, they combine with other atoms and form molecule to attain stability. Carbon atom also combines with other atoms like C, H, N, O, S etc and form organic molecules to attain stability.

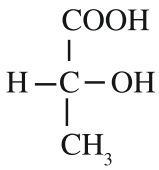
8.3 Nomenclature of organic compounds

To identify and two understand numerous orgnic compounds, naming of these compounds is essential. There are three prevalent systems of naming the organic compounds.

1. Trival System
2. Derived System
3. IUPAC System (International union of pure and applied chemistry)

1. **Trival System:** In this system the compounds are given names which usually refer to the natural source or property of the compuonds.

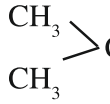
Table 8.1 Nomenclature as per Trival System

Formula	Trival Name	Natural Source
CH_4	Marsh gas	First detected in marshy places
CH_3OH	Wood spirit	First obtainerd by dry distillation of Wood
CH_3COOH	Acetic Acid	Latin: Acetum = Vinegar
HCOOH	Formic acid	Latin: Formica = ants
	Lactic acid	First obtained by distillation of red ants Obtained from lactum (Milk)

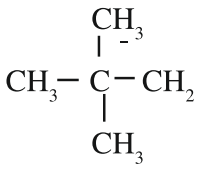
In the trival system, the unbranched hydrocarbons are called normal or n - compounds.

Example- n - pentane

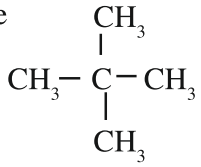
$$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$$

If the compounds have  grouping, it is known as iso-compound

Exmaple isopentane 

If the compound has 

grouping; it is known as Neo-compound

Example- Neopentane 

2. Derived System: In this system of nomenclature the compoounds are named as the derivatives of a simpler compound.

3. **IUPAC System:** International union of pure and applied chemitry adopted a uniform system of naming organic compounds.

Alkane, Alkene and Alkynes (Hydrocarbons) are named as follows-

1. Prefix is used as per number of carbon atoms present in hydrocarbons.
2. Suffix is used as per type of bond present in molecule.
3. Combining prefix and suffix the complete name of hydrcarbon is written.

Table 8.2 Nomenclature as per derived System

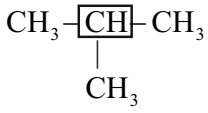
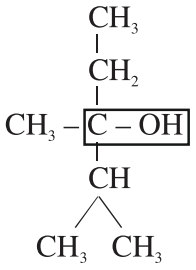
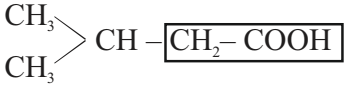
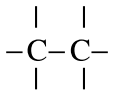
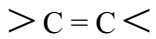
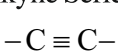
Simple Compound	Derivative of Simple Compound	Name of derivative
CH_4 (Methane)		Trimethyl methane
CH_3OH (Carbinol)		Methyl carbinol
		Methyl Ethyl Isopropyl carbinol
CH_3COOH (Acetic acid)		Isopropyl acetic acid

Table 8.3 Selection fo Prefix.

Number of carbon atoms in molecule	Prefix
C_1	Meth
C_2	Eth
C_3	Prop
C_4	But
C_5	pent
C_6	hex
C_7	hept
C_8	Oct
C_9	Non
C_{10}	Dec

Table 8.4 Selection of Sufix in hydrocarbons

Type of bond in between Carbon-Carbon atom	Suffix
(i) Alkane Series (Single bond) 	– ane
(ii) Alkene Series (double bond) 	– ene
(iii) Alkyne Series (Triple bond) 	– yne

8.3.1: The general formulaof alkane is C_nH_{2n+2}.

These compounds are also known as saturated compounds or paraffins.

Rules for Nomenclature

1. Longest carbon chain is selected for naming. The atom or group which remains out of the chain is denoted as substituent.

2. If two or more than two chains are having same number of carbon atoms then more substituent containing chain is selected.

3. Names of substituents are written first using their prefixes in alphabetical order.

4. If the number of identical substituents are more than one in a molecule, then number of identical substituents are denoted as per the table 8.5

Table. 8.5 The word used for number of identical substituents

Number of Identical Substiuents	Word used
One	Mono
Two	Di
Three	Tri
Four	Tetra
Five	penta
Six	Hexa
Seven	Hepta
Eight	Octa
Nine	Nona
Ten	Deca

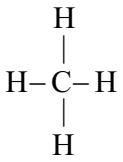
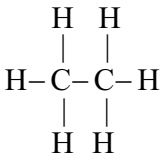
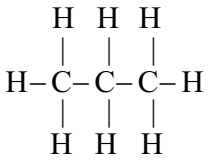
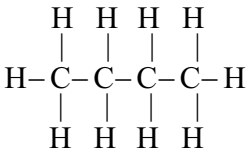
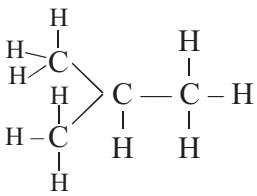
Some important subtituents are as follows

$-CH_3$	methyl
$-CH_2-CH_3$	ethyl
$-CH_2-CH_2-CH_3$	propyl
$-CH<\begin{matrix}CH_3\\CH_3\end{matrix}$	Isopropyl
$-CH_2-CH_2-CH_2-CH_3$	butyl
$-Cl$	Chloro
$-Br$	Bromo
$-I$	Iodo
$-F$	Fluoro
$-NO_2$	Nitro

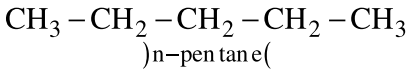
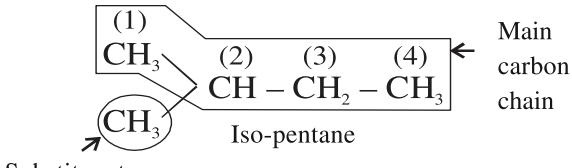
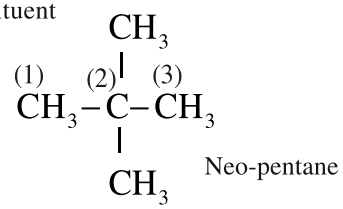
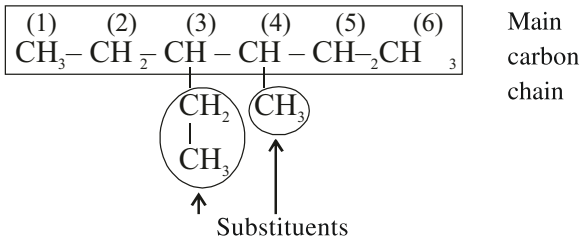
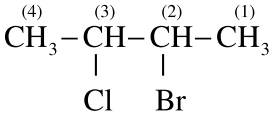
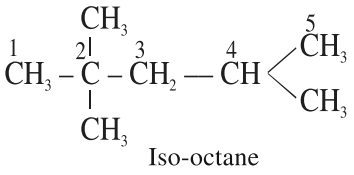
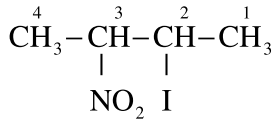
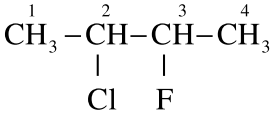
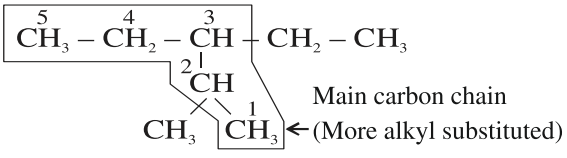
5. **Numbering of substitutents:** Minimum number is given to substituents. If two substituents are symmetrically placed on a carbon chain, the substituent coming first in the alphabetical order is assigned the lower position number.

6. At the time of writing the name of organic compound a comma (,) is written between two numerals and a hyphen (-) between a numeral and the name of the compound.

Table 8.6 Number of carbon atoms, Structural formula and IUPAC Name

Number of carbon	Formula	Structural formula	IUPAC Name
1	CH_4		Meth + ane = Methane
2	C_2H_6		Eth + ane = Ethane
3	C_3H_8		Prop + ane = Propane
4	C_3H_8		But + ane = Butane
5	C_4H_{10}	 (आइसोब्युटेन)	2-Methyl propane

Some other formulae and their IUPAC names

Formula	IUPAC Name
	Pentane
	2-Methyl butane
	2, 2 -Dimethyl propane
	3-Ethyl-4-methyl hexane
	2-Bromo- 3- Chlorobutane
	2, 2, 4 - Trimethyl Pentane
	2-Iodo- 3- nitrobutane
	2-Choloro- 3- fluorobutane
	3-Ethyl-2-methyl pentane

8.3.2 Nomenclature of alkenes

The general formula of alkene is C_nH_{2n}

* In these compounds carbon-carbon double bond is present, hence smallest alkene posses minimum two carbon atoms.

* These compounds are known as unsaturated hydrcarbons.

* These compounds give oily liquid reacting with bromine water, therefore these are also known as olefines.

* Suffix- ene is used for this series.

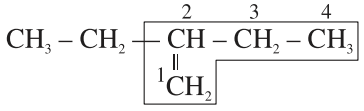
Rules for Nomenclature

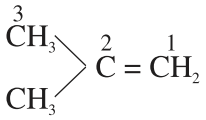
1. Carbon-carbon double bond containing longest chain is selected as a main chain for nomenclature.

2. Minimum number is given to double bond.

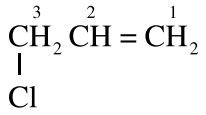
3. Other rules are as per nomenclature of alkanes

some examples.

Formula	**IUPAC Name**
$CH_2 = CH_2$ (Ethylene)	Eth+ene=Ethene
$CH_3 - CH = CH_2$	Prop+ene=Propene
$\overset{4}{C}H_3-\overset{3}{C}H_2-\overset{2}{C}H=\overset{1}{C}H_2$	1-Butene
$\overset{1}{C}H_3-\overset{2}{C}H=\overset{3}{C}H-\overset{4}{C}H_3$	2-Butene
$\overset{5}{C}H_3-\overset{4}{C}H_2-\overset{3}{C}H=\overset{2}{C}H-\overset{1}{C}H_3$	2-Pentene
$\overset{5}{C}H_3-\overset{4}{C}H_2-\overset{3}{C}H_2-\overset{2}{C}H=\overset{1}{C}H_2$	1-Pentene
	2-Ethyl-1-Butene



2-Methyl-1-propene



3-Chloro-1-propene

$\overset{1}{C}H_2 = \overset{2}{C}H-\overset{3}{C}H = \overset{4}{C}H_2$ 1-Chloro-2-Butene

If number of double bonds are more than one, then, di, tri, tetra etc are used to represent number of double bonds. Example

$\overset{1}{C}H_2 = \overset{2}{C}H-\overset{3}{C}H = \overset{4}{C}H_2$ 1, 3-Butadiene or

(Buta -1, 3-diene)

8.3.3. Nomenclature of Alkynes:

* General formula of these compounds is

C_nH_{2n-2}.

* These compounds are also known as unsaturated hydrocarbons

In these compunds carbon carbon triple bond is present hence, smallest alkyne posses two carbon atoms.

* Suffix -yne is used for this series.

Rules for nomenclature

1. Carbon-carbon triple bond containing longest chain is selected as a main chain for nomenclature.

2. Minimum number is given to triple bond .

3. If number of triple bonds are more than one, then di, tri tetra etc are used to represent number of triple bonds.

Examples

Formula	IUPAC Names
$HC \equiv CH$ (Acetylene)	Eth + yne = Ethyne
$HC \equiv C - CH_3$	Prop + yne = Propyne
$\overset{4}{C}H_3 - \overset{3}{C}H_2 - \overset{2}{C} \equiv \overset{1}{C}H$	1-Butyne
$\overset{4}{C}H_3 - \overset{3}{C} \equiv \overset{2}{C} - \overset{1}{C}H_3$	2-Butyne
$\overset{5}{C}H_3 - \overset{4}{C}H(\overset{CH_3}{\text{Substituent}}) - \overset{3}{C} \equiv \overset{2}{C} - \overset{1}{C}H_3$	4-methyl-2-pentyne
$\overset{4}{C}H_2(Cl) - \overset{3}{C}H_2 - \overset{2}{C} \equiv \overset{1}{C}H$	4-chloro-1-butyne
$\overset{1}{H}C \equiv \overset{2}{C} - \overset{3}{C}H_2 - \overset{4}{C} \equiv \overset{5}{C}H$	1, 1, 4-Penta diyne

8.4 Allotropes of carbon

Two or more than two forms of an element which are quite different in properties from each other are known as allotropes and this property is known as allotropy or allotropism".

In nature, carbon elements is present in various forms with different physical properties. For example diamond, graphite, fullerene etc. All these forms are made by carbon atoms and they differ from each other due to difference in bonding of carbon atoms

Crystalline Allotrope: "Allotrope in which carbon atoms are arranged in a definite geometry with definite bond angle is known as crystalline allotrope."

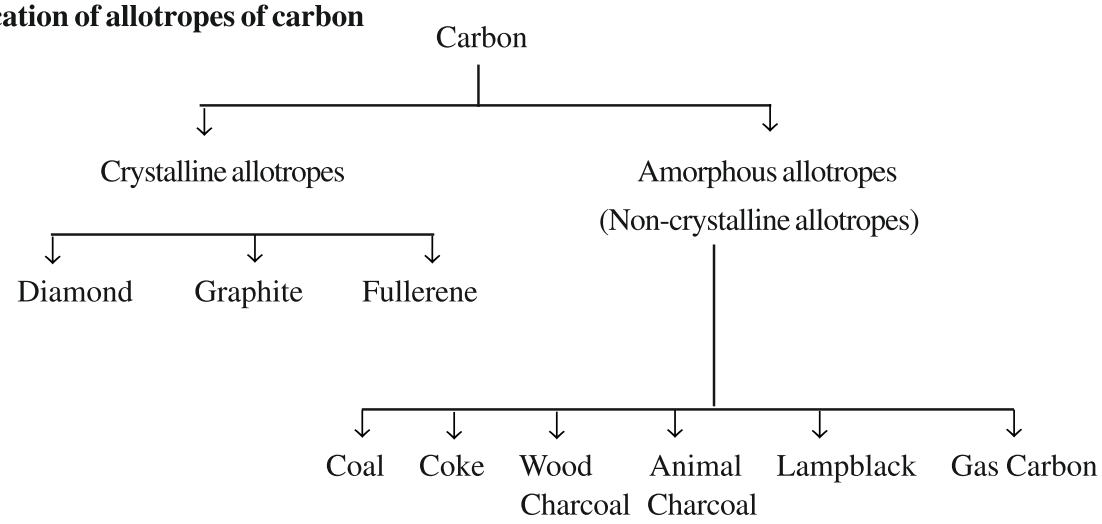
1. **Diamond:** (i) In diamond each carbon atom is bonded with four other carbon atoms in rigid three dimensonal tetrahedral geometry.

(ii) It is the purest from of carbon

(iii) Carbon carbon bond distance in diamond is 1.54 Å.

(iv) Diamond is non-conductor of electricity because all the four valencies of carbon atom are bonded with four other carbon atoms,

Classification of allotropes of carbon



hence, free electrons are not available.

(v) There is a three-dimensinal net work of strong covalent bonds in structure of diamond. It is the cause that diamond is the hardest among the known substances present.

(vi) Melting point of diamond is 3843 K.

(vii) Due to pressure of rocks on layers of coal diamond becomes transparent in nature.

(viii) By subjecting pure carbon at extremely high temperature and pressure, diamond can be synthesized.

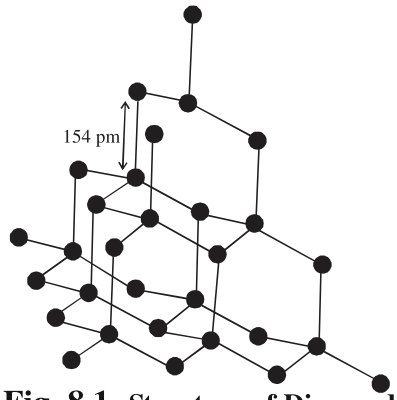


Fig. 8.1 Structure of Diamond

1. Uses of Diamond

(i) It is used as a glass cutter.

(ii) It is used in machines, which are used in cutting rocks and stones.

(iii) It is used in making phonogram needles.

(iv) Diamond is used in manufacturing of gems and jewellery.

2. Graphite

Word graphite is derived from word Grapho, meaning of grapho is "Writing". Graphite is used in our pencils for writing purpose.

(i) In graphite, each carbon atom is bonded with three other carbon atoms in the same plane making hexagonal ring structure. Among these bonds one bond is double bond, hence, valency of carbon atom is satisfied.

(ii) Structure of graphite is two dimensonal structure having regular hexagonal sheets.

(iii) Sheets of graphite slide over one another due to presence of weak bonds and more distance in between them . It is the cause that graphite is used as a dry lubricant..

(iv) Due to presence of free electrons and vacant space in between two layers of graphite it is a good conductor of electricity.

(v) Graphite is a soft and greyish black cloured substance.

(vi) It is a smooth and slippery substance.

Table 8.7 Comparative study of Diamond and Graphite

S.No.	Property	Diamond	Graphite
1.	Structure	Tetrahedral	Hexagonal and arranged in layers
2.	Physical state	Colourless and Transparent	Shiny opaque and Greyish black coloured
3.	Hardness	Hardest substance	soft and smooth
4.	Specific density	3.51	2.25
5.	Electrical Conductivity	Non-conductor of electricity	Good conductor of electricity

(vii) It is a shiny substance.

Uses of Graphite: 1. Graphite is used in pencil

2. It is used as a dry lubricant

3. It is used in making electrodes.

4. It is used to polish the things made up of iron.

5. It is used as a moderator in nuclear atomic reactor.

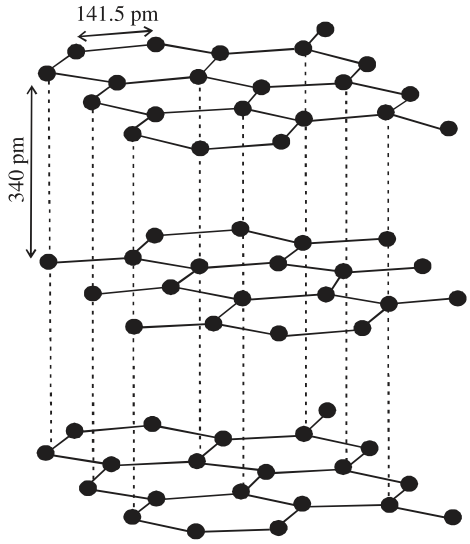


Fig. 8.2 Structure of Graphite

3. Fullerene:

1. The structure of fullerene is similar to foot ball.

2. The name of fullerene is a reference to Buck minister Fuller, a popular American architect.

3. The molecule of fullerene contains C_{60}, C_{70} or more carbon atoms.

4. The most stable fullerene is C_{60} which is known as Buckminister Fullerene.

5. C_{60} contains total 32 faces; out of these 20 are hexagonal and 12 are pentagonal. It has a football like structure, hence, known as "Buckyball".

6. C_{60} is non conductor of electricity and carbon carbon bond distance in C_{60} is 1.40 Å.

7. Fullerene looks like the geodesic dome.

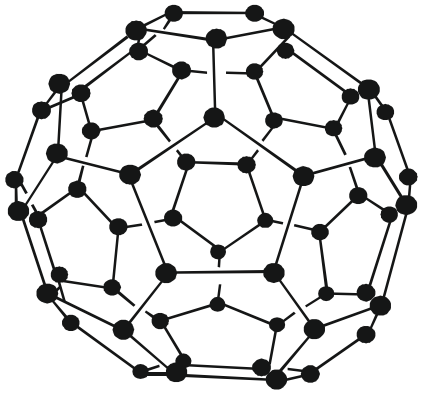


Fig. 8.3 Structure of Fullerene

Uses of Fullerene

1. It is used in purification of natural gas

2. It is used in molecular bearing

3. Technically it is an important allotrope of carbon it behaves like super conductor at higher temperature

8.5 Some Important Organic Compounds Useful in Daily Life

8.5.1 Chloro-Fluoro Carbon or freons: "Freons are polychlorofluoroalkanes". Compounds in which carbon atom is linked with chlorine and fluorine are known as chlorofluorocarbon (CFC) or freons.

Synthesis of Freons: When carbon tetrachloride (CCl_4) is reacted with hydrogen fluoride (HF) in presence of $SbCl_5$, it gives freon-11

$$CCl_4 + HF \xrightarrow{SbCl_5} CCl_3F + HCl$$

Trichloromonofluoro methane
Freon–11

Nomenclature of Freons- The number of carbon, hydrogen and fluorine atoms present in the molecular formula of freon are used for nomenclature of freons as follows.

Freon - XYZ Here

(i) X = One less than the number of carbon atoms in freon molecule (C-1)

(ii) Y = One more than the number of hydrogen atoms in freon molecule (H +1)

(iii) Z = Number of fluorine atoms in freon molecule.

Uses of Freons: 1. Freons are used as inert solvents.

2. Freons are used as refrigerants in refrigerator, airconditioner and cold storages.

Table 8.8 Nomenclature of Some Important freons

Molecular Formula	X	Y	Z	Nomenclature of Froen
$CFCl_3$	0	1	1	Freon -11
CF_2Cl_2	0	1	2	Freon -12
$C_2F_2Cl_4$	1	1	2	Freon -112
$C_2F_3Cl_3$	1	1	3	Freon -113

8.5.2. CNG (Compressed natural gas):

Compressed natural gas is known as CNG. CNG is composed mainly of methane and some other hydrcarbons. CNG has less percentage of carbon, therefore, its combution yields less CO (carbon monoxide) and CO_2 (Carbondioxide). For this reason CNG is less harmful for nature in comparison to other petroleum products. Layers of gases which are found in deep underground above petroleum are known as natural gases. During the extraction of petroleum, natural gases are also obtained. When natural gas is compressed at high temperature it is known as compressed natural gas.

CNG is diffrent from LPG. By fractional distillation of petroleum, the gas which are released along with many other components of petroleum are known as petroleum gases. When these gases are compressed at high pressure and converted into liquid state, then it is known as LPG (Liquid Petroleum Gas)

CNG is more safer than LPG, because it is lighter than LPG. So when there is a CNG leakage then it spreads out in air wheares LPG is heavier so it collects in lower layers which increases the chance of accident.

Uses of CNG:

1. It is used as fuel.

2. CNG is used in place of petrol and diesel in vehicles used for transportion.

8.5.3. **Polymers -** When a number of simple molecules unite with each other to form a long chain molecule with high molecular mass and same emprical formula. This long chain molecule having repeating structural units is called a polymer and the starting simple molecule as monomers. This process in known as polymerisation. Polymers are mainly classified in two categories.

1. Natural Polymers
2. Synthetic Polymers

1. **Natural Polymers**: Polymers which are directly obtained from nature. For example natural rubber, Starch, cellulose, resin etc.

Natural Rubber: It is obtained from rubber free in liquid form. This liquid is known as Latex.

Natural rubber is a polymer of isoprene.

$$n\left[CH_2 = CH - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH_2\right] \xrightarrow{\text{Polymerisation}} \left[-CH_2 - CH = \underset{\displaystyle CH_3}{\underset{|}{C}} - CH_2\right]_n$$

Isoprene

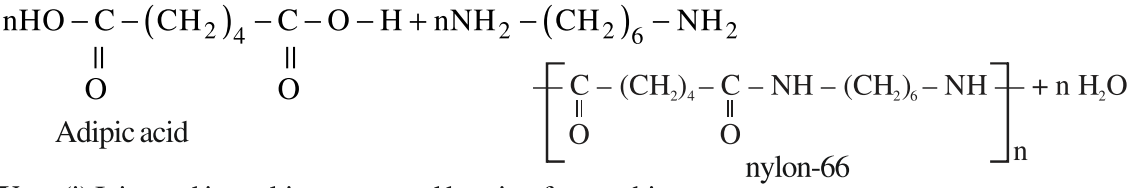
Polyisoprene
(Nautral rubber)

When acetic acid is added in latex, it is converted into solid. The rubber so obtained is soft and has low tensile strength. To improve its tensile strength and elasticity it is heated with sulphur (S). This process is known as vulcanization. Rubber obtained after valcanization is strong, hard, elastic and highly resistant to wear and tear.

2. Synthetic polymers: Man made polymers are known as synthetic polymers or artificial polymers. For example artificial fiber, plastic, synthetic rubber etc.

A. **Artificial fiber**: For example Nylon-66, Terylene, Rayon etc.

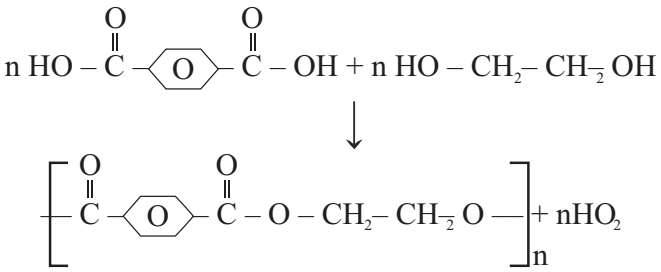
(i) Nylon-66: It is synthesized by condensation of adipic acid (six carbon atoms) and hexamethylene diamine (six carbon atoms) hence, it is knwon as nylon-66.



Uses (i) It is used in making gears and bearing for machines.

(ii) It is used in making tyres, clothes, fibers, ropes, brush etc.

(ii) Terylene: It is synthesized by condensation of ethylene glycol and terephthalic acid. It is also known as "Dacron".

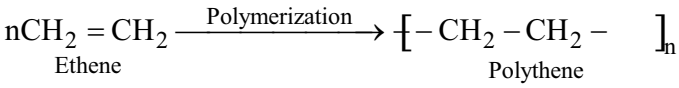


Uses: It is used in making clothes, sail of boats, belts, mangnetic tape, films etc.

(iii) **Rayon**: Initially cellulose is washed by sodium hydroxide solution and then dissolved in carbondisulphide (CS_2). This solution is passed through fine holes and mixed with dilute sulphuric acid. The fine shiny fibers of rayon are formed.

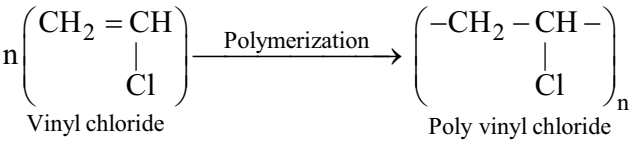
Uses: It is used in making clothes, threads, carpets etc.

(B) **Plastic (i) Polythene:** At high temperature and pressure in presence of catalyst, ethene molecules are polymerized to give polythene. It is flexible and strong plastic.



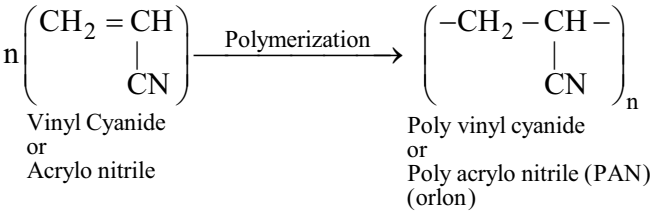
Uses: It is used in making carry bags, pipes, tubes etc.

(ii) Poly vinyl Chloride: It is obtained by polymerization of viny chloride.



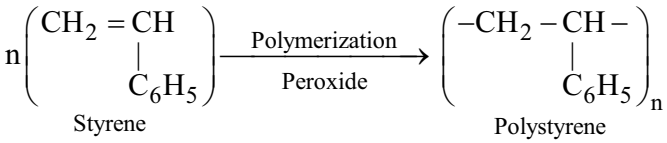
Uses: It is used in making pipes, shoes, sandals, bags, rain coats, toys, phonogram recorder, electric insulator layers. etc

(iii) Poly acrylonitrile or orlon: It is obtained by polymerisation of vinyl cyanide



Uses: It is used in making sweater, pillow, mattresses etc.

(iv) **Poly Styrene**: It is obtained by polymerization of vinyl benzene (styrene)



Uses: It is used in making tea cups, bottle caps, parts of refrigerator, wall tiles, packing material etc.

(c) Synthetic rubber: These are mainly of two types

(i) Buna- S (synthesized by butadiene and styrene)

(ii) Buna-N (Synthesized by butadiene-and acrylonitrile)

In presence of CO_2, 2-3,dimethyl-1,3 - butadiene is catalysed by sodium catalyst to give rubber like product. Which is named as Buna. Here Bu-represents butadiene and Na-represnts sodium catalyst.

Uses Used in making oil containers, Fuel tanks, tyres tubes, medical instruments, petrol tapes shoe soles etc.

Important Points

1. Carbon is tetravalent is nature. these four valencies are oriented towards four corners of a regular tetrahedron.

2. There is an important property in carbon atom by which it forms number of compounds bonding with carbon-carbon. This property is known as "catenation".

3. Covalent bond is present in between carbon and hydrogen. Compounds composed by carbon and hydrogen are known as hydrocarbons.

4. Hydrocarbons are classified into three categories.

   (i) Alkane, (ii) Alkene, (iii) Alkyne

5. Carbon-carbon single bond is present in alkane, in alkene it is double bond and in alkyne it is triple bond.

6. There are three methods for nomenclature of organic compounds.

   (i) Trival system (ii) Derived system (iii) IUPAC-System

7. IUPAC system is accepted globally at present.

8. There are two main allotropes of carbon

   (i) Crystalline allotropes (ii) Amorphous allotropes

9. Diamond, graphite and fullerene are main crystalline allotropes.

10. Diamond is hardest among the known substances, bright and non conductor of heat and electricity

11. Graphite is soft, smooth and greyish black substance. It is good conductor of heat and electricity.

12. The fullerene molecule posses 60 to 70 carbon atoms. It is denoted as C_{60} or $C_{70.}$. It behaves as super conductor at higher temperature.

13. Polychlorofluoroalkanes are known as freons. These are used a refrigerants.

14. Compressed natural gas is known as CNG. It is used as fuel and an alternative of petrol and diesel for vehicles.

15. When a number of simple molecules unite with each other to form a long chain molecule is knonw as a polymerization. Simple molecules are known as monomers and huge molecule is known as polymer.

16. Polymers are of two types

   (i) Natural polymers

   (ii) Synthetic polymers

17. Main artifical fibers are Nylon-66, Terylene, Rayon etc.

18. Some important plastics are polythene, polyvinyl chloride, orlon, polystyrene etc.

19. Natural rubber is a polymer of isoprene.

20. To improve the quality and tensile strength of natural rubber it is heated with sulphur., It is known as vulcanization.

21. Buna-S and Buna-N are two types of synthetic rubber.

Practice questions

Objective type questions

1. The value of bond angle in methane is

   (a) $109^0 28'$ (b) 120^0

   (c) 180^0 (d) 105^0

2. C_5H_{10} hydrocarbon is

   (a) Pentane (b) Pentene

(c) Pentyne (d) Pentadiene

3. The molecular formula of Freon -11 is

(a) $CFCl_3$ (b) $C_2F_2Cl_4$

(c) CF_2Cl_2 (d) C_2F_4Cl

4. Natural rubber is polymer of

(a) Neoprene (b) 1, 3-Butadiene
(c) Isoprene (d) Buna-N

5. Which allotrope of carbon is good conductor of electricity.

(a) Diamond (b) Graphite

(c) Fullerene (d) Coke

6. To improve the quality and tensile strength of natural rubber it is heated with sulphur. This process is known as

(a) Polymerization (b) Saponification

(c) Vulcanization (d) Equalization

7. If number of carbon atoms are 3 then prefix used is

(a) Eth- (b) Prop-
(c) But- (d) Pent-

8. The IUPAC name of $CH_2 = CH - CH_2 - Cl$ is

(a) 1-chloro-2-propene

(b) Prop-1-chloro-2-ene

(c) 3-chloro-2-propene

(d) 3-chloro-1-propene

Very short type questions

9. Write the general formula of alkane, alkene and alkynes.

10. Hydrocarbons are made up of which two elements.

11. Write the full name of IUPAC.

12. Give the definition of Vulcanization.

13. How many number of carbon atoms are possible in Fullerene?

14. Which type of geometry is present in carbon atom?

15. Write the definition of Freon.

16. Name the scientist who synthesized first organic compound?

17. Write the full form of CNG.

18. Give the name of monomers by which orlon is formed by polmerization process.

19. Name the allotropes of carbon

20. Write the IUPAC name of Isobutane.

21. Write the full name of PAN

22. By polymerization of which monomer, PVC is formed.

Short type questions

23. Write any three differences between diamond and graphite.

24. What do you understand by catenation tendency of carbon atom?

25. Write the IUPAC name and strucutral formula of the following

(i) C_5H_{12} (ii) C_4H_8

(iii) C_3H_4

26. Write two uses of freon

27. Why CNG is better than LPG as a fuel?

28. Why diamond is hard and graphite is soft.

29. Write any four characteristics of Fullerene.

30. Draw the sketch of clasification of hydrocarbons.

31. Write the uses of graphite

32. Write the main characteristics of carbon atom

33. Write the IUPAC names of following

(i) Iso-octane (ii) $\begin{matrix} CH_3 \\ CH_3 \end{matrix} > C = CH_2$

(iii) Neopentane (iv) $CH_3 - \underset{\underset{Br}{|}}{CH} - \underset{\underset{Cl}{|}}{CH} - CH_3$

34. What is plastic? Write names of main plastic polymers.

35. Write the utilities of diamond and Fullerene.

36. Explain the nomenclature of Freon.

Essay type questions

37. What do you mean by synthetic polymers? Write their process of synthesis and uses.

38. Write a note on following

(i) Freon (ii) CNG

(iii) Natural Rubber

39. (a) Write the main rules applied in nomeclature of alkanes.

(b) Write the formula for the following

(i) Neopentane (ii) Isopentane

(iii) 1, 3-Dichloropropane

(iv) 3-Ethyl-4-methyl hexane

(v) 3-methyl-1-butene

Answer key

1.	(a)	2.	(b)	3.	(a)
4.	(c)	5.	(b)	6.	(c)
7.	(b)	8.	(d)		