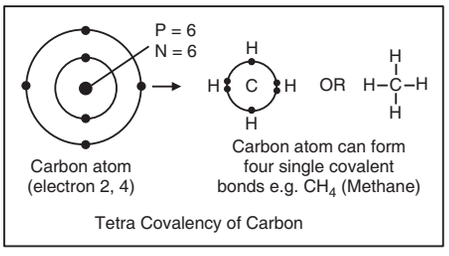
28. Carbon and its Compounds

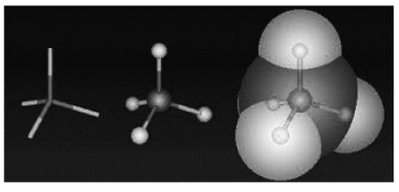
- Diamond has a three-dimensional network of covalently bonded carbon atom. It is hard and colourless. It has high melting and boiling point and is a good conductor of heat but poor conductor of electricity.
- Graphite is soft, black, and slippery in nature and has a layered structure. It is a good conductor of electricity.
- Fullerenes contain carbon atoms arranged in closed structures similar to football.
- Charcoal, coke and carbon black are micro-crystalline forms of carbon.
- The compounds of carbon can be classified as organic and inorganic.
- Carbon monoxide and carbon dioxide are two important inorganic compounds of carbon.
- Organic compounds of carbon are hydrocarbons and their derivatives.
- Hydrocarbons are classified as saturated and unsaturated. The saturated hydrocarbons contain carbon-carbon single bonds whereas the unsaturated hydrocarbons contain carbon-carbon multiple bonds.
- Isomers have same molecular formula but different structure.
- Some simple functional groups include halo-, hydroxyl-, carbonyl, carboxylic acid etc.
- Compounds containing the above functional groups exhibit characteristic properties and have important uses in our daily life.

Build Your Understanding

Tetravalency of carbon



Tetra Covalency of Carbon



Carbon can form long chains of carbon atoms. This unique property of forming long chains is known as **catenation**

Allotrops of carbon

Carbon show three allotropic forms

- Diamond
- Graphite
- Fullerens

Diamond

- High density 3.51 gcm^{-3}
- M.P. 3500°C
- Do not conduct electricity but good conductor of heat

Uses

- For cutting and grinding hard material (glass)
- For making Jewellery
- Rock drilling

Graphite

- Density 2.2 gcm–3
- M.P. 3700°C (in vacuum)
- Good conductor of electricity

$$\text{Graphite} \xrightarrow[\text{High Temperature}]{\text{High atm Pressure}} \text{Diamond}$$

Uses

- used as lubricant in machines
- making electrodes in dry cells and electric arcs
- making pencil lead

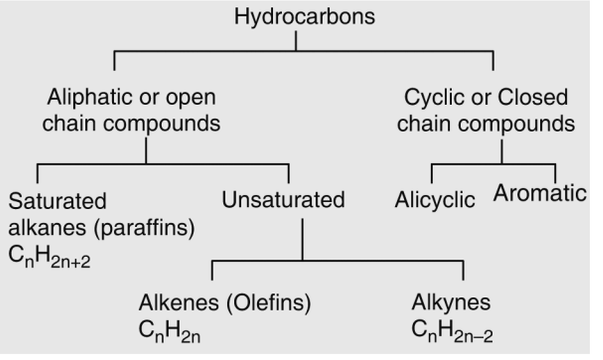
Fullerens

Fullerens have closed structure like foodball so it is also known as Buckminister fullerens C_{60}

$$\text{Vapourized carbon} \xrightarrow{\text{Condensed}} \text{Fullerences}$$

Hydrocarbons

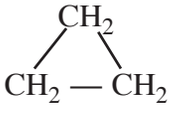
Contain carbon and hydrogen only



Aliphatic hydrocarbons: Derived from the Greek word aleiphar meaning fat. They are derived from fat.

Acyclic: strairght chain

Cyclic: form rings of carbon atoms



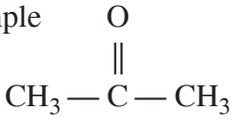
Aliphatic can be divided into: saturated and unsaturated hydrocarbons: Saturated hydrocarbon single bond in unsaturated multiple bonds (double and triple bonds)

IUPAC Nomenclature

For IUPAC naming, we must have idea about word root of carbon skeleton

No. of Carbon atom	Word root	No. of Carbon atom	Word root
1	meth	5	pent
2	eth	6	hex
3	prop	7	hept
4	but	8	oct

Rules

1. Alkane (CH_4)
   Word root + ane ⟶ meth + ane ⟶ Methane
2. Alkene (C_2H_4)
   Word root + ene ⟶ eth + ene ⟶ ethene
3. Alkyne (C_2H_2)
   Word root + yne ⟶ eth + yne ⟶ ethyne
   CH_3OH → Methane → replace 'e' by ol → Methanol
   C_2H_5OH → Ethane → replace 'e' by ol → Ethanol
   Alcohols: Synthesis of acetic acid, additive petrol, spirit
   Aldehyde and ketones: As solvent, polish removes
   Carboxylic acid: Ascorbic acid vitamin C citrus fruits.
4. Ketone
   For example
   
   Propane → replace 'e' by one → propanone
5. Carboxylic Acid.
   For example CH_3COOH
   Ethane → replace 'e' by oic acid → ethanoic acid

Functional groups

Functional groups is an atom or a group of atoms which is responsible for characteristic properties of a compound.

Functional group	Class	General formula	Example	IUPAC Name
$-C=C-$	alkene	C_nH_{2n}	$H_2C=CH_2$	Ethene
$-C\equiv C-$	alkyne	C_nH_{2n-2}	$HC\equiv CH$	Ethyne
$-OH$	alcohols	$R-OH$	CH_3OH	Methanol
$-\overset{\overset{O}{\|}}{C}-H$	aldehydes	$R-\overset{\overset{O}{\|}}{C}-H$	CH_3CHO	Ethanal
$-\overset{\overset{O}{\|}}{C}-$	ketones	$R-\overset{\overset{O}{\|}}{C}-R$	$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$	Propanone
$-\overset{\overset{O}{\|}}{C}-OH$	carboxylic acids	$R-\overset{\overset{O}{\|}}{C}-OH$	CH_3COOH	Ethanoic Acid
$-\overset{\overset{O}{\|}}{C}-O-$	esters	$R-\overset{\overset{O}{\|}}{C}-OR$	$CH_3COOC_2H_5$	Ethyl ethanoate

Stretch Yourself

1. Methyl alcohol to harmful but ethylalcohol is not why?
2. Name the property of diamond which makes it brilliant when cut and polished.
3. Suppose in nature tetravalent of carbon is lost. What will happen then?

Test Yourself

1. Why diamond is used for cutting glass?
2. Explain the tetracovalency of carbon.
3. Carbon has a tendency to form long chain compounds. Why?
4. Write down possible isomers of C_4H_{10}.
5. Write down the IUPAC names of the following

(i) $CH_3 - CH = CH_2$

(ii)
$$\begin{array}{l} \quad\quad CH_3 \\ \quad\quad | \\ CH_3 - CH - CH_3 \end{array}$$

(iii)
$$\begin{array}{l} \quad\quad O \\ \quad\quad \| \\ CH_3 - C - CH_3 \end{array}$$

(iv) $HCHO$

(v) $CH_3 - C \equiv C - H$