Carbon and its compounds

Symbol-C

Atomic no-6

Atomic mass-12

Valency- 4

Carbon present in earth crust -0.02%

Carbon present in atmosphere-0.03%

Carbon chemistry is living chemistry because carbon circulate through air animals and plants by means of complex reaction i.e known as carbon cycle .

Exceptions- diamond and graphite which are covalent solids having high melting and boiling points.

Allotropes of carbon

Diamond	***Graphite***
1)Use in jewellery	1) use in making Electrodes.
2) use in removing of Cataract.	2) used as good lubricant
3)Diamonds are used For making precision Thermometer and Protective window for Spacecraft.	3)for the manufacture of gramophone record and electrotyping.

Buckminsterfullerene

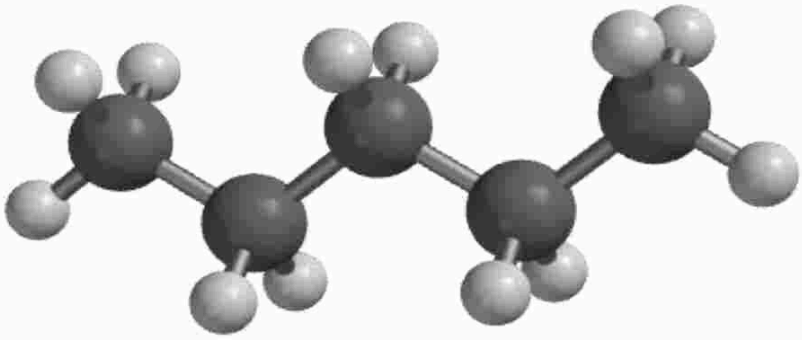
1)wonderful lubricants

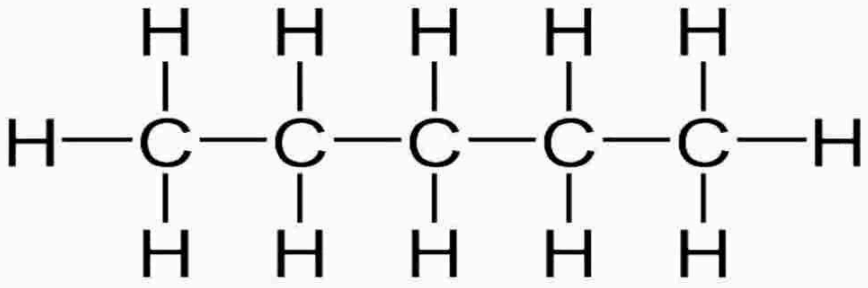
<u>Carbon has versatile nature</u> -the unique nature of carbon atom and the arrangement of the bond carbon form with other atom enable the existence of large number of organic compound.

Large number of carbon compound is formed due to self linking property and covalent bond.

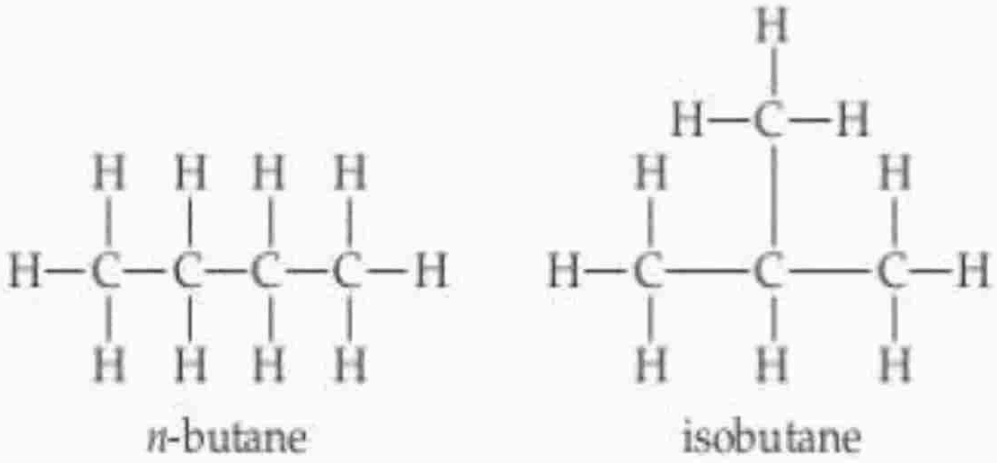
Isomerism- carbon compound has same molecular formula but different structured formula is knowns as isomerism.

Eg. Pentane





Methyl group (functional group) hang off 2n carbon largest chain of 4 carbon i.e. Butane



Organic compound- compound of carbon containing usually hydrogen and other elements like O, N, S and P are known as organic compound.

Hydrocarbon ***(contains only hydrogen and carbon atoms)***

Saturated — Single covalent

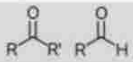
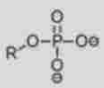
unsaturated — double and triple bond

Bond Between carbon And Hydrogen.	between carbon and Hydrogen.
Alkane c-c	alkene c=c
General formula CnH_2n+_2	formula-CnH_2n
It under go substitution Reaction.	alkyne-c=c Formula CnH_2n-_2 It under go action Reaction.

#functional group:-

Atom or group of atom which provide certain specific properties when attached to a carbon chain is called functional group.

Functional group

functional group name	structure	properties	common functions	commonly found in
Hydroxyl	R–OH	• polar • hydrophilic	tends to make things more soluble in water	• hugely abundant in sugars and alcohols
Carbonyl		• polar	the site of enzymatic c-c bond breaking/making	• every sugar has one
Carboxyl		• acidic • charged (-)	multifaceted, biological acid	• amino acids • fatty acids • acetic acids • other acids
Amino	R–NH$_2$	• basic • charged (+)	biological base, maintains 3D structure of large molecules, defines base pairs in nucleic acids	• amino acids neurotransmitters • bases of nucleic acids
Thiol (Sulfhydryl)	R–SH	• polar	form di-sulfide bonds, enzymatic properties	• amino acid-cystine • acetyl-CoA
Phosphate		• acidic • charged (-) • hydrophilic	regulation, energy, structure	• phospholipids • DNA backbone • NTP • protein regulation

#Chemical properties of carbon compounds.

- **combustion**:- the process of burning of carbon compound in air to give carbon dioxide ,water ,heat and light is called combustion.
- $CH_4 + 2O_2 \xrightarrow{\text{combustion}} Co_2 + 2H_2O +$ heat + light.

(Methane) (oxygen) (carbon dioxide) (water)

- $2CH_3CH_2OH + 7O_2 \longrightarrow 4CO_2 + 6H_2O$ + Heat + light.

(ethanol)

➢ Most of the hydrocarbon are used as fuel as they released energy on burning in air

For eg. Methane in CNG

Butane in LPG

Oxidation reaction:- oxidation is addition of oxygen carbon compounds get easily oxidized on combustion.

$CH_4 + O_2$ ---------- $Co_2 + H_2O$

(addition of oxygen)

Alcohol undergo oxidation in presence of oxidizing agents like alkaline potassium permanganate ($KMnO_4$) to form carboxylic acid.

$CH_3\text{-}CH_2\text{-}OH \xrightarrow{\text{ALKALINE } KMnO_4} CH_3\text{-}C\text{-}OH$

[ethanoic acid]

- **Substitution reaction**:- the reaction in which one or more hydrogen atom of a hydrocarbon are replaced b some other atom is called a substitution reaction.

- $CH_4 + Cl_2 \xrightarrow{\text{sunlight}} CH_3Cl + HCL$
- $CH_3Cl + Cl_2 \xrightarrow{\text{sunlight}} CH_2Cl_2 + HCL$
- $CH_2Cl_2 + Cl_2 \xrightarrow{\text{sunlight}} CHCl_3 + HCL$
- $CHCl_3 + Cl_2 \xrightarrow{\text{sunlight}} CCl_4 + HCL$

Additional reaction:- the reactions in which an unsaturated hydrocarbon combines with other substance to form a single products is called addition reactions.

$CH_2{=}CH_2 + H_2 \xrightarrow[\text{HEAT}]{\text{Ni catalyst}} CH_3\text{-}CH_3$

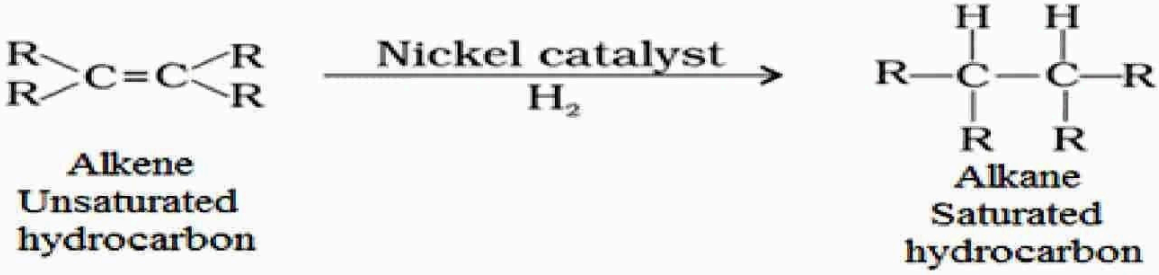
(ETHENE) (ETHANE)

- Unsaturated hydrocarbons add on hydrogen in the presence of catalyst such as **nickel** or **palladium** to form saturated hydrocarbons.

- The addition of hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called <u>hydrogenation.</u>

➢ The process of hydrogenation is used to prepare vegetable ghee from vegetable oils.

$$\text{Vegetable oil} + H_2 \xrightarrow{\text{Ni, 473 K}} \text{Vanaspati ghee}$$



Some important carbon compounds.

- **<u>Ethanol</u>** (C_2H_5OH)

  <u>Physical properties</u>

  (i)Ethanol is a colourless liquid having a pleasant smell.

  (ii)It is volatile liquid having boiling 78C.

  (iii)It is soluble in water in all proportion.

  <u>Chemical properties</u>

  Combustion:- ethanol undergoes combustion giving Co_2 and H_2O along with release of energy.

  $C_2H_5OH + 3O_2 \xrightarrow{\text{combustion}} 2CO_2 + 2H_2O + \text{Heat} + \text{light.}$

  (ethanol)

Reaction with sodium metal

$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5O\text{-}Na + H_2$

Oxidation:

$CH_3CH_2OH + 2(O) \xrightarrow{\text{alkaline}[KMnO_4]} CH_3COOH + H_2O$

(nascent oxygen)

Dehydration :

$CH_3\text{-}CH_2OH \xrightarrow{\text{conc.}H_2SO_4:170.c} CH_2{=}CH_2 + H_2O$

(Ethanol) (ethene)

Concentrated sulphuric acid acts as dehydration agent.

Reaction with ethanoic acid

$CH_3COOH + C_2HOH \xrightarrow{\text{conc.}H_2SO_4} CH_3COOC_2H_5 + H_2O$

This reaction in which a carboxylic acid combines with an alcohol to form an ester is called esterification.

- ***Uses of ethanol:***
  I. It is used in the manufacture of points, varnishes, medicine, dyes, perfume etc.
  II. It is used as fuel in cars along with petrol it is also used as fuel in spirit lamps.

III. It is used as an antiseptic to sterilize wounds and syringes in hospital and dispensaries.

- ***Harmful effects:***

I. It depresses in the central nervous system.
II. It causes lack of coordination, metal confusion and drowsiness.
III. It affects kidney and liver function

Methanol (CH_3OH)

- Methanol is poisonous as it is oxidized to methanal (CH_3CHO) in liver which rapidly reacts with the protoplasm (liquid present in cell) and coagulates it,

$CH_3OH \xrightarrow{\text{liver}} CH_3CHO$
(METHANOL) (METHANAL)

- It damages optic nerve causing permanent blindness in a person
- **Denatured alcohol** is ethyl alcohol which has been made unfit for drinking purposes by adding small amounts of poisonous substances like methanol, pysidene, copper sulphate.

#ETHANOIC ACID (acetic acid)

- Vinegar is 5-8% aqueous solution of acetic acid making acetic acid the main component of vinegar apart from water.

 # Physical properties

- It is a sour, colourless liquid having smell of vinegar.
- Its boiling point is 118.C
- When pure ethanol is cooled is freezes to give a solid which look like a glacier due to which it is known as glacial acetic acid.

#chemical properties

(i)*reaction with sodium carbonate*

$2CH_3COOH + Na_2Co_3$ --------- $2CH_3COONa + Co_2 + H_2O$

(ii) *reaction with sodium hydroxide*

$CH_3COOH + NaOH$ -------- $CH_3COONa + H_2O$

(iii) *reaction with alcohols* (formation of ester)

$CH_3COOH + C_2H_5O \xrightarrow{\text{conc.}H_2SO_4} CH_3COOC_2H_5 + H_2O$

#USES OF ETHANOIC ACID

1. It is used in form of vinegar as a preservative for food and pickels.
2. It is used to form esters which are used in perfumes and sweets.