Hydrocarbon

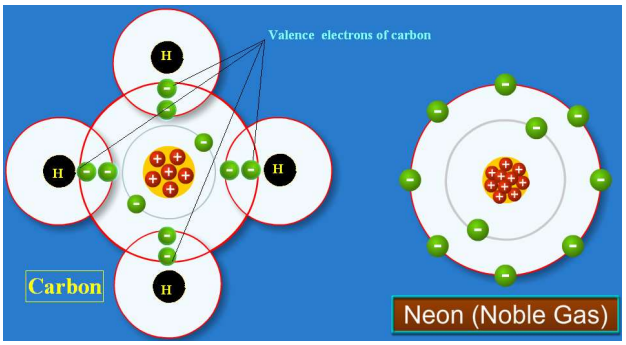
The existence of such a large number of organic compounds is due to the unique properties of carbon.

The unique properties of carbon are:

- Tetra valency
- Catenation
- Formation of multiple bonds

Tetravalency :

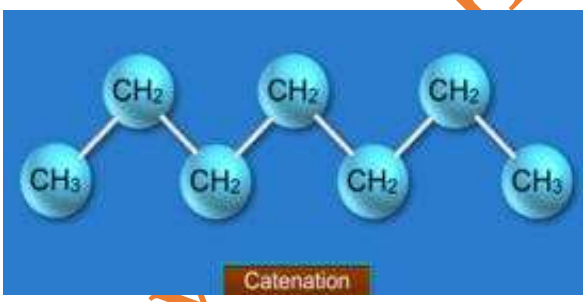
Carbon shares its four valence electrons with other atoms and forms four single covalent bonds to get nearest noble gas formation. This is known as tetravalency.



Catenation:

The property of self linkage among identical atoms to form long chain compounds is known as catenation.

Carbon exhibits maximum catenation, when compared to elements like sulphur and silicon, due to strong carbon-carbon bonds and tetra valency. Due to this catenation, carbon atoms can form various types of straight chains, branched chains and ring structures.



Formation of multiple bonds:

Carbon atoms are capable of forming multiple bonds with other carbon atoms.

Hydrocarbons:

All the carbon compounds which contain just carbon and hydrogen are called hydrocarbons.

Classification of hydrocarbons:

Hydrocarbons are broadly divided into two groups.

- Open chain hydrocarbons
- Cyclic or closed chain hydrocarbons

Open chain hydrocarbons:

Open chain hydrocarbons contain carbon-carbon straight chains. They are further classified into two types.

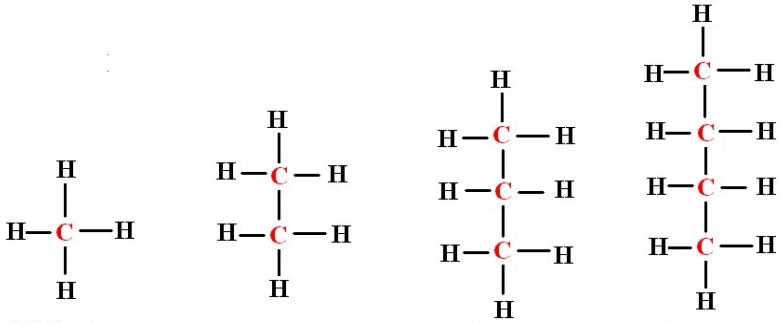
- Saturated hydrocarbons
- Unsaturated hydrocarbons.

Saturated hydrocarbons or Alkanes :

Saturated hydrocarbons are straight chain compounds containing only single covalent bonds. These are also known as alkanes.

General formula of alkanes is C_nH_{2n+2}.

Example: Methane, ethane, propane, butane... etc.



Methane Ethane Propane Butane

Unsaturated hydrocarbons:

Unsaturated hydrocarbons are the straight chain compounds containing double or triple covalent bonds.

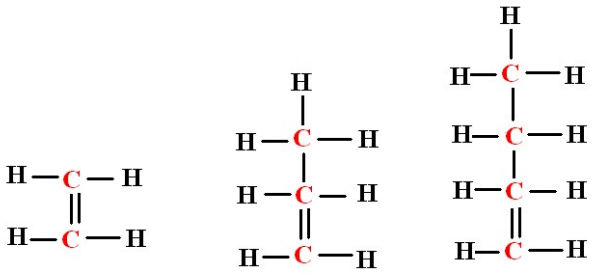
Unsaturated hydrocarbons are classified into two types. They are alkenes and alkynes.

Alkenes:

Hydrocarbons with a double bond between carbon atoms are known as alkenes.

General formula of alkenes is C_nH_{2n}.

Example: Ethene, propene, butene...etc



Ethene Propene 1-Butene

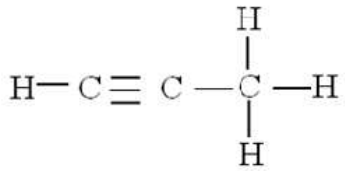
Alkynes:

Hydrocarbons with triple bonds between carbon atoms are known as alkynes.

General formula of alkynes is C_nH_{2n-2}.

Example: Ethyne, propyne ...etc

Ethyne



Propyne

Cyclic or closed chain hydrocarbons:

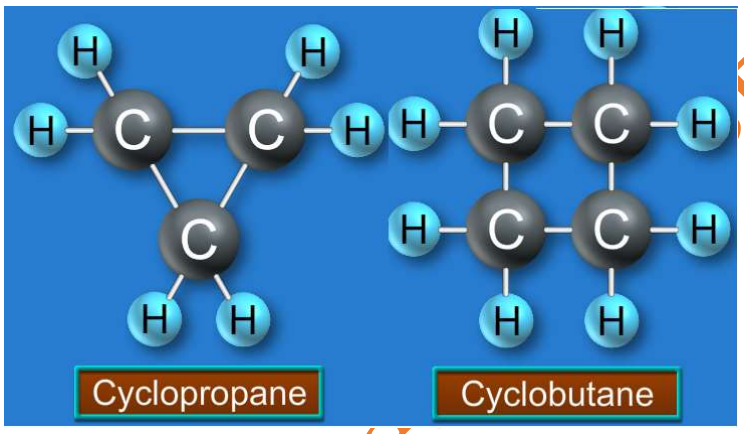
The compounds of carbon which contain a closed ring of carbon atoms are called as cyclic hydrocarbons. They are of two types.

- Alicyclic hydrocarbons
- Aromatic hydrocarbons

Alicyclic Hydrocarbons:

Alicyclic hydrocarbons are in the form of a carbon cycle. They contain three or more carbon atoms.

Example: Cyclopropane, Cyclo butane.



Alicyclic compounds does not follow Huckel's rule.

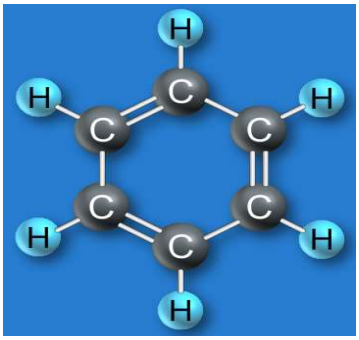
Aromatic Hydrocarbons:

The cyclic compounds which contain a single and a double bond at alternate positions and exhibit special properties are known as aromatic compounds.

Huckel's rule (4n+2 rule): According to Huckel's rule the hydrocarbons which contains 4n+2 (where n = 0, 1, 2, 3, …etc) number of delocalized pi electrons which are present in a ring structure are called aromatic compounds.

Example:

Benzene: Benzene (C_6H_6) containing a six membered carbon ring with alternate single and double bonds is an aromatic compound.



Homologous Series:

A series of organic compounds with the same general formula but differ from adjacent members by "$-CH_2-$" group are referred to as homologous series of compounds.

And successive members of homologous series differ from one another in their mass by 14 units.

Example:

Homologous series of alkanes:

General formula of homologous series of alkanes is C_nH_{2n+2}.

Number of carbon atoms	Molecular formula	Structure of the molecule	Name of the alkane	Molecular mass
n =1	CH_4	CH_3-H	Methane	16
n =2	C_2H_6	CH_3-CH_2-H	Ethane	30 (16+14)
n =3	C_3H_8	CH_3-CH_2-CH_2-H	Propane	44 (30+14)
n=4	C_4H_{10}	CH_3-CH_2-CH_2-CH_2-H	Butane	58 (44+14)
n=5	C_5H_{12}	CH_3-CH_2-CH_2-CH_2-CH_2-H	Pentane	72 (58+14)
n =6	C_6H_{14}	CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-H	Hexane	86 (72+14)
n = 7	C_7H_{16}	CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-H	Heptane	100 (86+14)

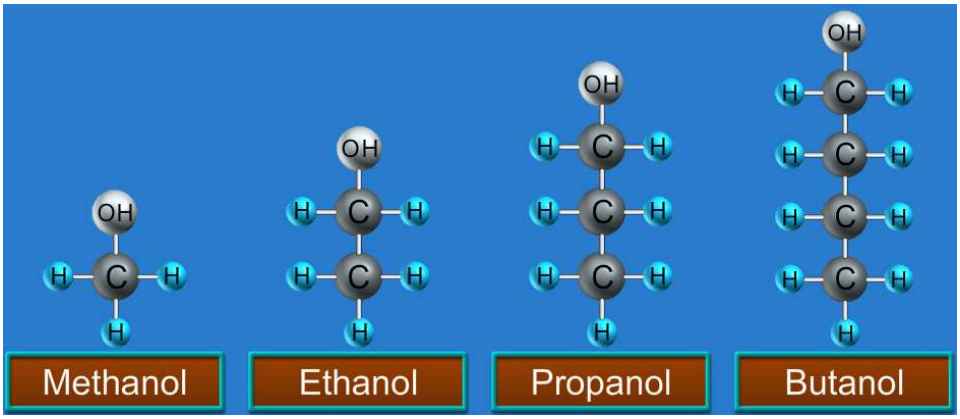
Homologous series of alcohols:

CH_3–OH : Methanol

CH_3–CH_2–OH : Ethanol

CH_3–CH_2–CH_2–OH : Propanol

CH_3–CH_2–CH_2–CH_2–OH : Butanol



The difference between methanol and ethanol, the difference between ethanol and propanol is by a 'CH_2'group.

Similarly the homologous series of alkanes:

CH_4, C_2H_6, C_3H_8, C_4H_{10}.....