Introduction to Organic Chemistry

Organic chemistry is the branch of study the chemistry of carbon compounds. Carbon is singled out because it has a chemical diversity unrivaled by any other chemical element. Its diversity is based on the following:

- Carbon atoms bond reasonably strongly with other carbon atoms.
- Carbon atoms bond reasonably strongly with atoms of other elements.
- Carbon atoms make a large number of covalent bonds (four).

Modern Definition of the organic chemistry:-

Earlier, the organic chemistry is defined as the chemistry of the carbon compounds having living source, but still definition doesnot give the complete satisfaction to the organic chemistry and is still incomplete because CO_2, $CaCO_3$ etc. are the compounds of the carbon but not included in the organic compounds.

In Short Organic chemistry is defined as the branch of chemistry which deals with the study of the hydrocarbon and their derivatives.

Vital Force Theory

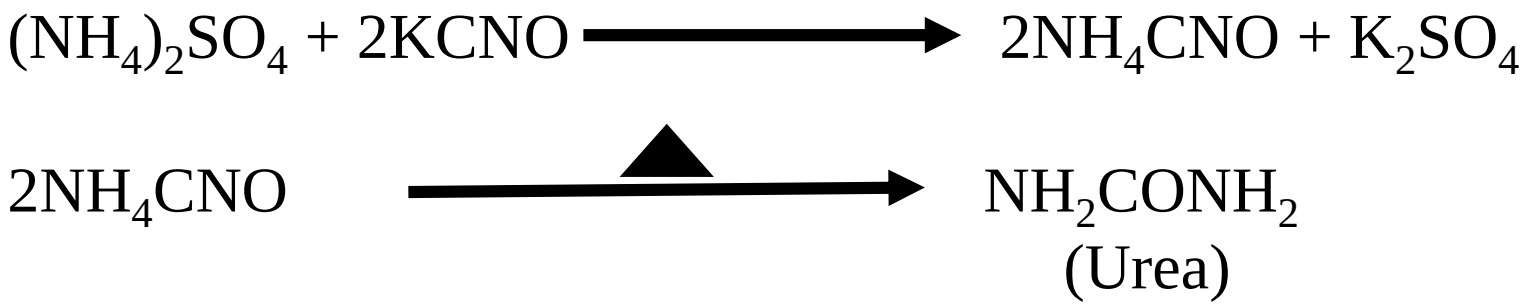
As the organic compounds were believed to be obtained from living organisms (plants and animals), a Swedish chemist Berzelius in 1815 proposed that organic compounds could not be prepared in laboratory and could be only produced by some mysterious force existing in the living organism, which forced was termed as 'Vital Force' (which comes from a Latin word, 'vita' means 'life'), and this theory is known as vital force theory.

According to the vital force theory:

1. All organic compounds were isolated (extracted) from living bodies (plants and animals).
2. The organic compounds were the products of a vital force and could not be synthesized in the laboratory.
3. The organic compounds did not obey the laws of chemical combination to which organic compounds were subjected

Limitations of Vital Force Theory (Fall down of Vital Force Theory)

Friedrich Wohler during the crystallization of ammonium cyanate (NH_4CNO), an inorganic compound, it was accidently superheated into a new fused mass. He analyzed the compound and confirmed the compound to be urea, an organic compound. After this event. he claimed that organic compounds are also possible to prepare in the laboratory



Initially, it was not accepted (fellow society assumed that Wohler was against the god). Later on, it was supported by **Kolbe** *by* the synthetic preparation of acetic acid from its initial constituents ***carbon, hydrogen***, and ***oxygen***. Similarly, it was also supported by **Berthelot** by synthesizing methane (CH_4) from its initial component carbon and hydrogen. By this way, so-called ***'Vital force Theory'*** was kicked out and was no more accepted.

Modern definition of Organic Compound

Organic compounds are hydrocarbon and their derivatives.

Carbon tetrachloride is not a hydrocarbon but an organic compound because it is derived from hydrocarbon methane by the substitution reaction of it with four molecules of chlorine in the presence of sunlight.

Reasons for Separate Study of Organic and Inorganic Compounds

The fundamentals of organic and inorganic chemistry remains same only for the convenience it has been separated from the inorganic. Few points of differences are considered which are listed below

S.N.	Property	Organic compound	Inorganic compound
1	Number	About 5 million (50 lakh), organic compounds are known and contineouly increases each year. This is due to the fact that, carbon has the ability to bond successively to other carbon atoms to form chains of varying lengths and shapes. This property of carbon is called catention and is responsible for the varity and large number of organic compounds.	Total number of inorganic compounds is about one lakh
2	Composition	They contain carbon as an essential constituent along with a few other elements like O,N,S,P, halogen and few metals.	They are formed from any of the known element.
3	Nature	They are mostly covalently bonded compounds	They are ionically or electrovalently bonded compounds.
4	Nature of reactions	Chemical reactions are usually slow.	Chemical reaction are generally fast.
5	Classification	Organic compounds are classified into many classes according to the functional groups present in them.	They do not include many classes. Mostly they are acids, bases and salts.
6	Isomerism	They show or exhibit isomerism	Generally, they do not show isomerism but isomers are limited to a few exception (e.g. the transition elements)

7	Solubility	They are in general insoluble in water but dissolve in organic solvents like alcohol, ether, benzene etc.	They are generally soluble in water but insoluble in organic solvents.
8	Melting and boiling points	They have low melting and boiling points	They have high melting and boiling points.
9	Combustibility	They are generally combustible or flammable	They are generally non-combustible or non-flammable.
10	Conductivity in solution	Their solutions are non-conductors of electricity	Their solutions are conductors of electricity.

Importance of Organic Chemistry

Organic chemistry plays a vital role in our daily life because the existence of living life is not possible without organic compounds. It is because organic compounds are present in-

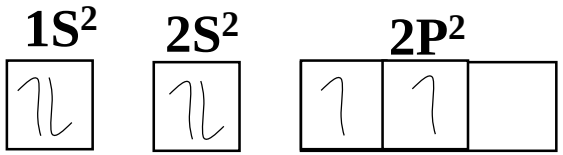
a) Food: Food is mainly composed of organic compounds.

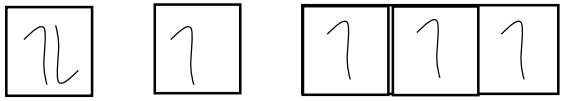
b) Clothes: Fibers which are used for clothing are composed of organic compounds

c) Medicines: Medicines are composed of organic compounds
likewise, Analgesics, Insecticides and pesticides, explosives etc.

Tetra valency & Catenation property

The atomic number of the carbon is six i.e. contains the six electron.

Carbon in ground state(G.S) = 

Carbon in excited state (E. S) = 

This indicates that, there is only two half- filled electrons in ground state so carbon act as divalent But the experimental observation indicates tetravalency in combined state. The electron present in The 2S orbital shifted to 2P orbital in excited state. *Thus four half-filled orbital opens the possibility of the tetravalency*. On the other hand, carbon atom has not in the positon of lose or gain the electrons, therefore have less tendency to form the ionic bond, but can share each of the unpaired electron with others to form the octet.

This characteristics of the carbon atom to form the four covalent bond is called tetravalency. It can makes the four bond with same or different atom or group of atoms. Therefore organic compound has so many number as compared to the inorganic compounds.

Catenation *is the self-linking property of carbon i.e carbon atoms form bonds with another carbon atom in a long chain as well as in closed chain form*.

Functional Group

Organic compound consists of two parts, the reactive (active) part, which is known as a functional group and a skeletal part consisting of carbon and hydrogen atoms, which is known as the alkyl group (-R). Its general formula is CH_3OH and simply is denoted by: R-OH

Thus, a functional group is defined as an atom or group of atoms linked with carbon which determines characteristic properties of the organic compounds. The chemical properties of an organic compound solely depend on upon the nature of functional group present in *the* molecule. For instance-

The functional group of alcohol is -OH

The functional group of aldehyde is -CHO.

The functional group of carboxylic acid is -COOH

COMPOUND NAME	FORMULA
Carboxylic acid	-COOH
Sulphonic acid	$-SO_3H$
Ester	-COOR
Acid chloride	-COCl
Acid amides	$-CONH_2$
Nitrile	-CN
Aldehyde	-CHO
Ketone	>C=O
Alcohol	-OH
Phenol	$-C_6H_6O$
Thiols	-SH
Amines	$-NH_2$
Ether	-OR
Alkene	>C=C<
Alkyne	-C≡C-

Homologous series

When organic compounds containing same functional group are arranged in series on the basis of their increasing molecular weight having the difference of -CH_2 (methylene group) in between two consecutive compounds, such series is called homologous series.

The individual members of a homologous series are known as homologous and the process is known as homology.

Different members of a homologous series can be represented by a single common formula for e.g. Alkane (C_nH_{2n+2}), Alcohol ($C_nH_{2n+1}OH$) etc.

Homologous series of Alkane

Formula	IUPAC name
CH_4	Methane
CH_3-CH_3	Ethane
CH_3-CH_2-CH_3	Propane
CH_3-CH_2-CH_2-CH_3	Butane
CH_3-CH_2-CH_2-CH_2-CH_3	Pentane
CH_3-CH_2-CH_2-CH_2-CH_2-CH_3	Hexane

Characteristics of a homologous series

l) All the members of a homologous series contains same general formula and have similar structures.

2) Two successive members of a series *are* different in their molecular formula by a $-CH_2$ unit or 14 atomic mass (a.m.u)

3) Due to the presence of the same functional group, all the members of a homologous series are almost similar in chemical properties.

4) All the members of the same homologous series can be prepared by the similar general methods of preparation.

5) *There* is a regular gradation in the physical properties like melting point density etc. among the members of *the* same homologous series

6)The first member of a homologous series is somewhat different in the chemical properties of the subsequent members.