*Topic 1: *Historical Survey on Development & Inportance of Organic Chemistry**

The history of organic chemistry can be traced back to ancient men when medicine men extracted chemicals from plants and animals to treat members of their families.

Jons Berzelius, in 1820 defined organic chemistry as a branch of science.

He classified chemical compounds into 2 main groups:

1. Organic, and

2. Inorganic

He believed in the idea of vitalism and hence propounded a vital false theory in 1815, which states that...

"All organic compounds are produced from living organisms due to the presence of a vital force (it could be pressure, temperature, etc.)."

The theory was abandoned after the discovery by Berzelius' student, Fedrich Wohler, in 1828.

Wohler synthesised Urea by evaporating a solution called Potassium Isoeyande and Ammonium Sulfate to yield Ammonium Syrate (an inorganic substance), which rearranged to Urea

$2KNCO + (NH_4)_2SO_4 \dashrightarrow 2NH_4NCO + K_2SO_4$

$NH_4NCO \dashrightarrow \dashleftarrow H_2N—CO—NH_2$

However, for this discovery, Wohler is known to be the first chemist to synthesise an organic compound.

Also, in 1854 Berthelot synthesised fat by reacting dry Glycerol with Stearic acid at the temperature of 200 Celius to yield Tristerin.

The synthesis of Urea and Fat disproved JJ. Berthelot's theory that...

"Organic substances could not be synthesised in

the laboratory and from inorganic substances."

Since it is impossible to synthesise organic substances from inorganic substances, how best could one define organic compounds?

Organic substances could be rationalised from the early definition of organic chemistry:

"The chemistry of carbon-containing compounds."

This definition cannot even differentiate organic from inorganic chemistry because such inorganic compounds like carbonate (CO_3^{2-}), Bicarbonate (HCO_3^-), Inorganic Carbides (CaC_2) and Syrate (NaSn) contain carbon.

However, this definition has demonstrated that the bulk of carbon compounds are organic substances.

In 1820, JJ. Berthelot made an attempt to explain the nature of organic substances by postulating what he called the theory of radicals.

In this theory, Berthelot proposed that radicals were the real elements of organic chemistry and that radicals could pass from one compound to another without any change.

Although Berthelot's theory of radical is much completely correct in the concept of modern organic chemistry...

...radicals are still believed to be intermediate particles that actually exist in the transformation of organic substances.

Organic Chemistry, therefore, can be defined as a branch of chemistry that studies the structure, properties and reactions of organic compounds, which contain carbon and covalent bonding.

The study of the structure determines the chemical composition and formation

The study of the properties includes physical and chemical properties.

Also, the evaluation of chemical reactivity to understand their behaviour.

The study of an organic reaction includes the chemical synthesis of natural products, drugs and polymers.

IMPORTANCE OF ORGANIC CHEMISTRY

1. Flexibility of carbon

2. Pharmaceutical

3. Environmental contaminants analysis

4. Molecular biology

5. Food Chemistry

6. Employment Opportunity

Topic 2: ***Fullerene (4th Allotrope of Carbon)****

Crystalline forms of carbon were known to exist, which are diamond and graphite, as well as amorphous carbon

In 1985, a team of scientists:

1. *Robert F. Curl*
2. *Harold W. Kroto, and*
3. *Richard E. Smalley*

...in Rice University, discovered a new allotrope of carbon called Fullerene.

The allotrope was named after an American architect, Buckminster Fuller, who designed Geodesic Dome.

The allotrope is called Bulky Ball or Buckminster Football.

Fullerene contains a pentagonal ring and a hexagonal ring with 60 carbon atoms held together by a covalent bond.

It has 20 hexagons and 12 pentagons, and no two pentagons share a net.

Each carbon atom is connected to exactly 3 neighbouring atoms.

Fullerene also exists in various other shapes, in which the carbon atom is arranged in a cage-like structure of hollow sphere (660) ,Elipiso

(670), and tubes (nano tunes).

Note that, in Fullerene, carbon atoms are usually present in the XP2 hybrid form and linked together by covalent bonds.

<<image here>>

A large current is passed between two graphite electrons in an inert atmosphere, such as Helium Gas, which gives rise to a carbon plasma reaching the anode and cathode, which cools instantaneously and leaves behind a soothing residue from which the Bulky Ball can be extracted.

TYPES OF FULLERENE

It exists in two major families depending on some distinct properties and applications.

It includes:

1. *The closed bulky balls*
2. *The open-ended cylindrical carbon nanotubes*

However, there are also hybrid structures that can exist between these two classes.

PROPERTIES OF FULLERENE

1. *Its behaviour and structure are temperature dependent... As the temperature is increased,*

Fullerene gets converted into the Carbon 70

2. Its structure can change under different pressure

3. It's a good conductor of electricity (physical property)

CHEMICAL PROPERTIES OF FULLERENE

1. It's stable (to chemical reactions) but not totally unreactive (chemical property)

2. In chemical reactions, Fullerene acts as an electrophile

3. It acts as an electron-accepting group, and it's characterised as an oxidising agent

4. When dumped or crystalline with alkaline earth metals, it showcases super-conductivity properties

5. It's stereo magnetic

6. It's soluble in many solvents like Carbon Disulphide. It's the only allotrope known to be soluble.

<u>APPLICATIONS OF FULLERENE</u>

1. It's one of the nanomaterials that have valuable applications in the field of bio-medicine. It possesses an exceptional anti-oxidant capacity, which has made it a great ingredient to be used in sunscreen, skin whitening, and anti-ageing products.

2. They are being investigated for their potential use as a drug delivery system for cancer, AIDs, and other diseases.

3. It's used a lubricant and ball bearing

4. It's used as a catalyst by attaching it to metal

5. It's used as organic voltaic (N-type material)

6. It's used in the purification of contaminated *water from free radical*

7. It's used as a composite to strengthen materials

NANOTUBES

They are made up of graphene sheets. It is form by rolling the sheets ,They are two types:

1. Single wall CNTs (Carbon Nano Tubes), and

2. Multi walls CNTs

PROPERTIES OF NANOTUBES

1. It possesses a high tensile strength

2. Better thermal conductivity

3. Shows electrical conductivity similar to that of copper

USES OF NANOTUBES

1. Used in biomedical applications

2. CNT-based graphics

3. CNT-based fabrics and fibres (in bullet-proofs)

4. It's used as an adsorbent for gas

5. It acts as a conductor

6. It's used in cosmetics

GRAPHENE

An allotrope of carbon, It has single-layer of *carbon atoms arranged in hexagonal form.*

PROPERTIES OF GRAPHENE

1. It's the lightest material.

2. It has good thermal and electrical conductivity.

3. Good optical property — able to transmit 97.7% of light

APPLICATIONS OF GRAPHENE

1. Touchscreen of LCD or LED displays

2. Used in super-conductors

3. Used in DNA sequence

4. Used in batteries, transistors, etc.

5. Used in drug delivery systems for the treatment of cancer

NANOSTRUCTURES

They are structures that range between 1 nm (molecular scale) and 100 nm in at least one dimension.

Nano Surfaces, Cylindrical Nano Surfaces and Nanospheres are common nanostructures.

NANOCHEMISTRY

It's a branch of NanoScience that deals with the chemical applications of nanomaterials in *nanotechnology.*

It involves the study of the synthesis and characterisation of materials of nanoscale size.

It's a relatively new branch of chemistry concerned with the unique properties associated with assemblies of atoms or molecules of nanoscale (approx. 1 - 100 nm).

A nanometer is a billionth of a meter. 1 nm = 10^-9 m.

A nanoparticle is a small particle that ranges between 1 - 100 nm in size.

NANOTECHNOLOGY

It's the design, characterisation, production, and application of structures, devices, and systems by controlled manipulation of size and shape at the nanometer scale (atomic, molecular and macromolecular scale) that produces structures, devices, and system with at least one novel/superior characteristics or properties.