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المحاضرة الاولى

Introduction to Organic chemistry

المادة : عضوية
المرحلة : الثانية
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Introduction to organic chemistry

Organic chemistry :is a is the branch of chemistry that deals with carbon and its compounds. It is fundamental to biology and medicine. Carbon is known to form unlimited number of compounds. Carbon atoms can form chains, they have branches and crosslinks. or rings of all sizes;

Nomenclature

- Find the longest carbon chain in the molecule. This will give you the base of the name:

No of C atoms	Name
1	meth-*ane*
2	eth-*ane*
3	prop-*ane*
4	but-*ane*
5	pent-*ane*
6	hex-*ane*
7	hept-*ane*
8	oct-*ane*
9	non-*ane*
10	dec-*ane*

- Determine the principle function
- al group and its position.

principal functional group	formula	ending becomes
alkane	C-C	-ane
alkene	C=C	-ene
alkyne	C≡C	-yne
alcohol	-OH	-anol
aldehyde	-CH=O	-anal
ketone	>C=O	-anone
carboxylic acid	-COOH	-anoic acid

- Position is indicated, where necessary, by numbering the carbons in the main chain.
- Position need not be indicated for alkanes, as they have no functional group, and aldehydes and acids, as they are terminal functional groups. Positioning numbers are flanked by dash signs.
- Multiple positions for a given functional group are separated by commas and indicated by the prefixes di, tri, tetra, penta, hexa, hepta, octa , nona and deca.

➢ Ancilliary functional groups are given in alphabetical order, with their position at the beginning of the name.

Ancillary functional group	Formula	Prefix
methyl	$-CH_3$	methyl
ethyl	$-C_2H_5$	ethyl
propyl	$-C_3H_7$	propyl
butyl	$-C_4H_9$	butyl
pentyl	$-C_5H_{11}$	pentyl
hexyl	$-C_6H_{13}$	hexyl
heptyl	$-C_7H_{15}$	heptyl
octyl	$-C_8H_{17}$	octyl
nonyl	$-C_9H_{19}$	nonyl
decyl	$-C_{10}H_{21}$	decyl
fluorine	-F	fluoro
chlorine	-Cl	chloro
bromine	-Br	bromo
iodine	-I	iodo
amine	$-NH_2$	amino
hydroxyl	-OH	hydroxy
cyanide	-CN	cyano
benzyl	$-CH_2C_6H_5$	benzyl
phenyl	$-C6H_5$	phenyl

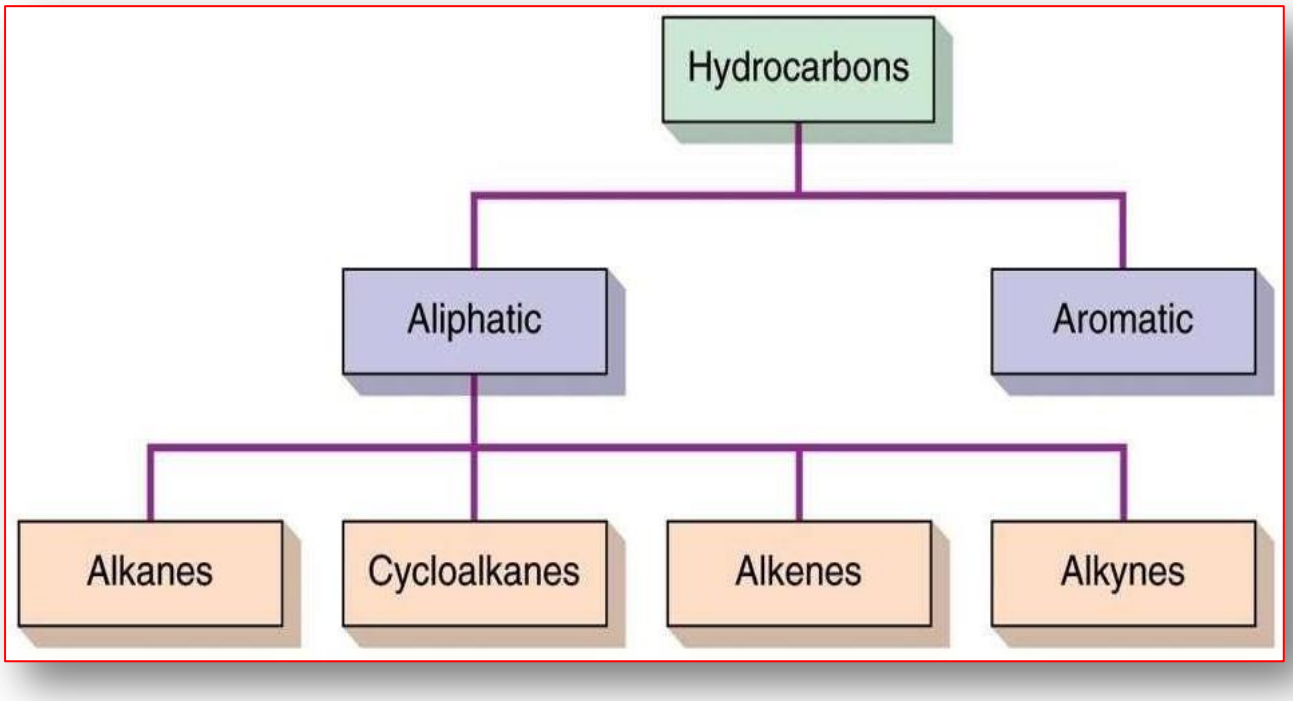
Hydrocarbons

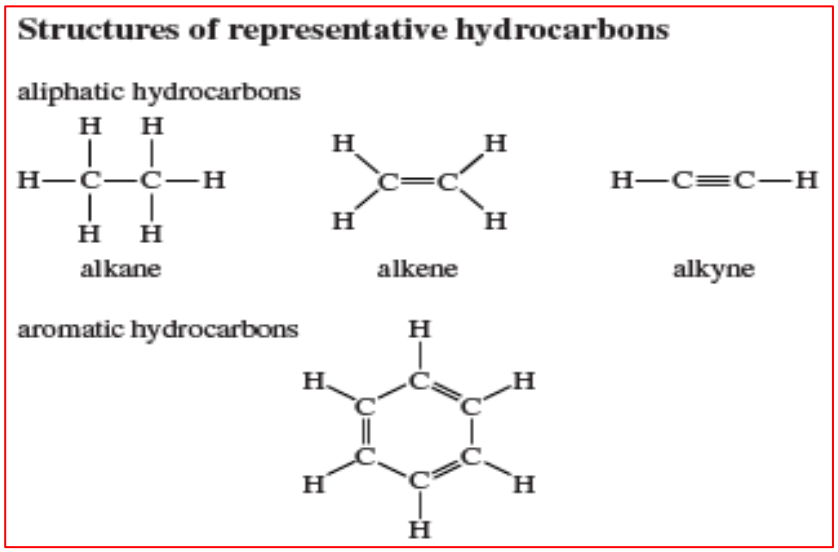
Hydrocarbons are the most simple organic compounds.

- Hydrocarbons contain only carbon (C) and hydrogen (H.)
- For classification purposes, all other organic compounds are considered derivatives of hydrocarbons.

- Hydrocarbons can be divided into aromatic and aliphatic hydrocarbons

Classification of Hydrocarbon



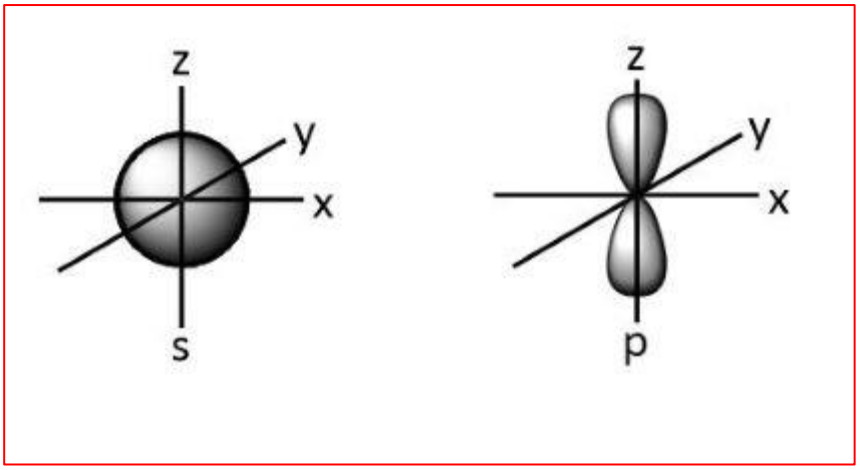


Atomic Orbitals of the Fundamental Elements in Organic Compounds

Hydrogen, carbon, nitrogen, oxygen, and the halogens are the most common elements present in organic molecules.

Concepts of Atomic Orbitals:

Each electron in an atom occupies a region around the nucleus called an *orbital*. An orbital can hold a maximum of two electrons. There are different types of orbitals known as *s, p, d,* and *f*. For organic compounds, the most important ones are the *s* and *p* orbitals. The *s* orbital is spherical in shape, while the *p* orbital resembles two lobes (a dumbbell shape) oriented along an axis.



Element	Symbol	Atomic Number	Electron Configuration
Hydrogen	H	1	$1s^1$
Helium	He	2	$1s^2$
Lithium	Li	3	[He] $2s^1$
Beryllium	Be	4	[He] $2s^2$
Boron	B	5	[He] $2s^2$ $2p^1$
Carbon	C	6	[He] $2s^2$ $2p^2$
Nitrogen	N	7	[He] $2s^2$ $2p^3$
Oxygen	O	8	[He] $2s^2$ $2p^4$
Fluorine	F	9	[He] $2s^2$ $2p^5$
Neon	Ne	10	[He] $2s^2$ $2p^6$
Sodium	Na	11	[Ne] $3s^1$

Hydrogen (H):

Hydrogen has an atomic number of 1. A hydrogen atom contains a single electron, which occupies the first energy level (shell) and is found in the spherical 1s orbital.

Carbon (C):

The electron configuration of carbon shows that the four electrons in its second (outer) shell are distributed as $2s^2\ 2p^2$.

Nitrogen (N):

The electron configuration of nitrogen indicates the presence of three unpaired electrons in the three p orbitals.

Oxygen (O):

The electron distribution in the outer shell of oxygen shows that it has six electrons occupying the outer orbitals.

Halogens (X):

Halogens have five electrons in their outer shell p orbitals. Two of the p orbitals contain paired electrons, while the third p orbital contains a single unpaired electron, making halogens monovalent.

Chemical Bonds:

Chemical bonds are the forces that hold atoms together to form molecules with lower energy and greater stability.

Ionic Bond:

An ionic bond results from the complete transfer of one or more electrons between two atoms with different electronegativities. One atom has a strong attraction for electrons, while the other has a weak attraction.

Thus, an ionic bond is defined as an *electrostatic attraction* between a positively charged ion (cation) and a negatively charged ion (anion).

Covalent Bond:

A covalent bond is formed when atoms share valence electrons to achieve the electron configuration of the nearest noble gas.

Hybridization in Organic Chemistry

Hybridization is the concept of mixing atomic orbitals in an atom to form new hybrid orbitals that are suitable for forming covalent bonds in molecules. It explains the shape and bonding properties of organic molecules.

Types of Hybridization:

1. **sp Hybridization:**
    - Formed by mixing one s orbital and one p orbital.
    - Produces two linearly arranged hybrid orbitals (180° apart).
    - Example: Acetylene (C_2H_2), where carbon is sp hybridized.
2. **sp^2 Hybridization:**
    - Formed by mixing one s orbital and two p orbitals.
    - Produces three hybrid orbitals arranged in a trigonal planar geometry (120° apart).
    - Example: Ethylene (C_2H_4), where carbon is sp^2 hybridized.
3. **sp^3 Hybridization:**
    - Formed by mixing one s orbital and three p orbitals.
    - Produces four hybrid orbitals arranged in a tetrahedral geometry (109.5° apart).
    - Example: Methane (CH_4), where carbon is sp^3 hybridized.