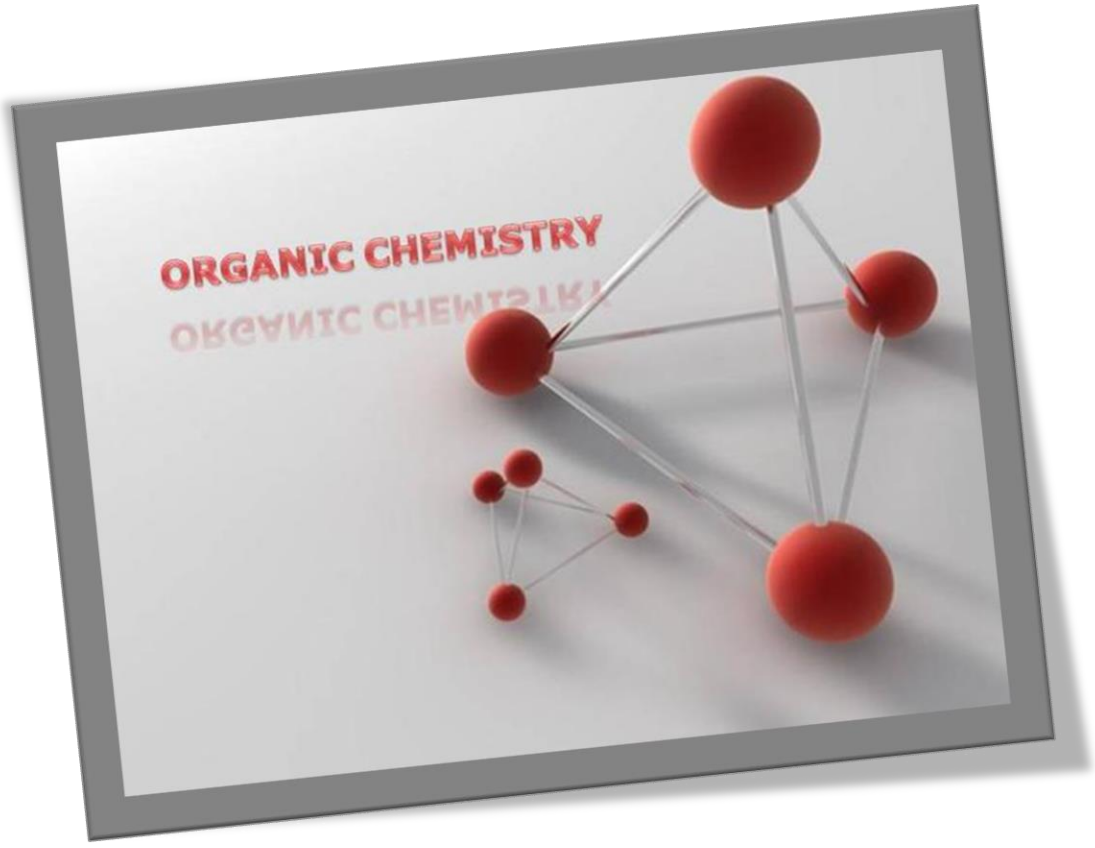
Al-Mustaqbal University College

Department of Radiology Techniques

First Stage

General Chemistry

Seventh Lecture

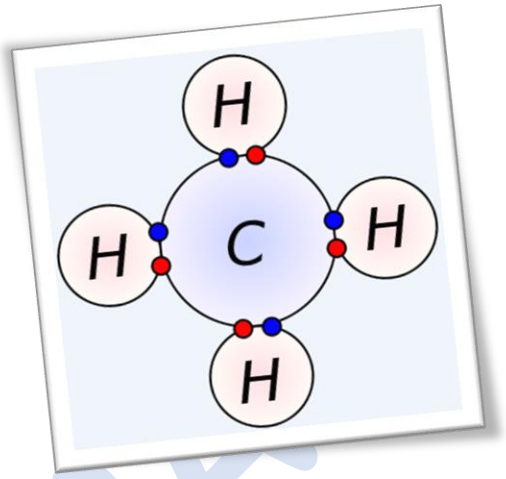


Asst. Lec.

Alaa Salman Al-Labban

ORGANIC CHEMISTRY

Organic Chemistry: is the branch of chemistry that deals with ***carbon compounds***.

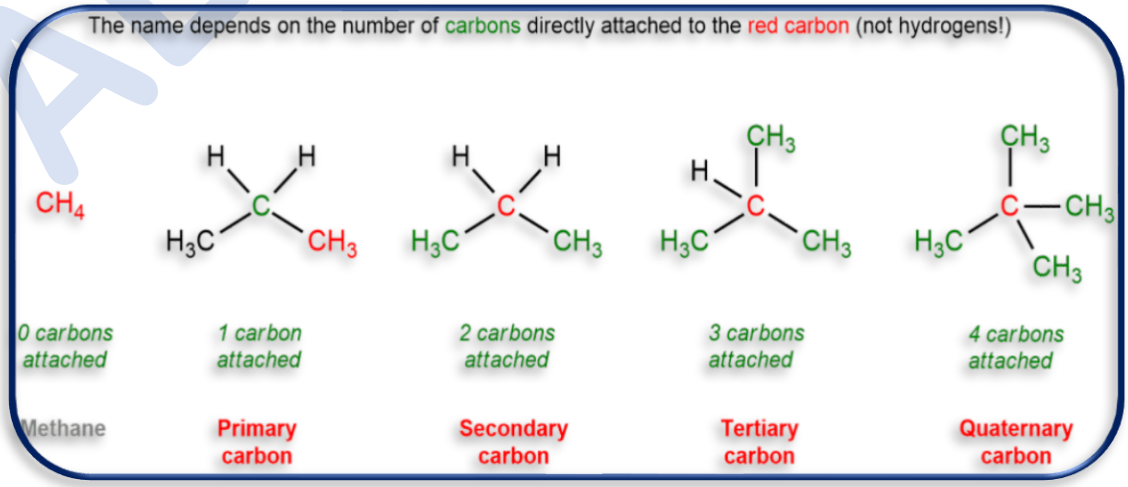


(Study of the structure, properties, composition, reactions, and preparation of carbon compounds).

Organic compounds contain primarily **carbon and hydrogen** atoms.

Carbon atoms classified according to their degree of substitution by other carbons.

- ***Primary carbon*** is directly attached to another one carbon.
- ***Secondary carbon*** is directly attached with two other carbons,
- ***Tertiary carbon*** is directly attached with three other carbons
- ***Quaternary carbon*** is directly attached with four other carbons.



Hydrocarbons

Compounds that contain only ***carbon*** and ***hydrogen***.

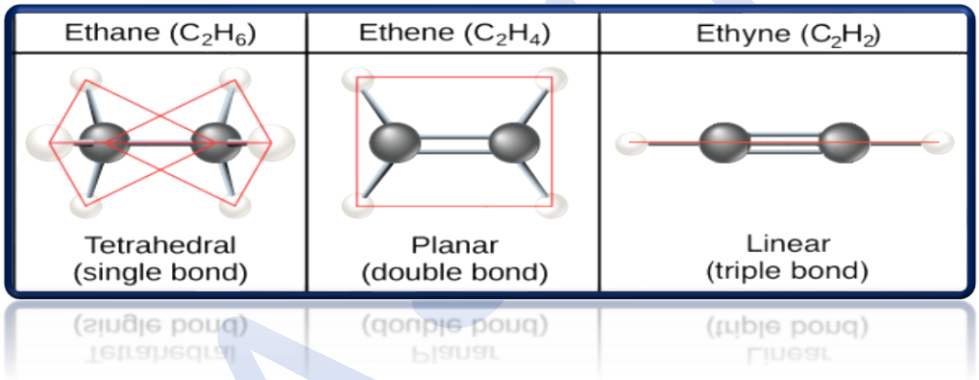
They are divided into two main classes:

1- Aliphatic hydrocarbons include three major groups:

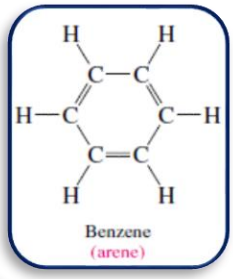
a- Alkanes: contain a carbon–carbon **single** bond.

b- Alkenes: contain a carbon–carbon **double** bond.

c- Alkynes: contain a carbon–carbon **triple** bond.

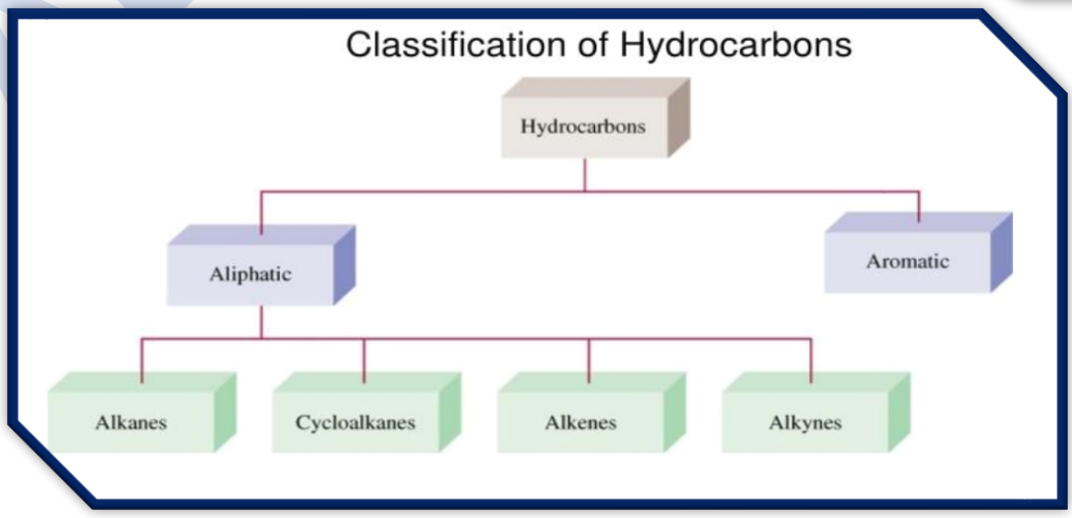


2- Aromatic hydrocarbons



Another name for aromatic hydrocarbons is ***Arenes*.**

The most important aromatic hydrocarbon is ***Benzene***.



Alkanes

Alkanes have the general molecular formula C_nH_{2n+2}

Where (n = 1, 2, 3, …). The essential characteristic of alkanes is that only single covalent bonds are present. The alkanes are known as **saturated hydrocarbons** because they contain the maximum number of hydrogen atoms that can bond with the number of carbon atoms present. The simplest one is methane (CH_4). Ethane (C_2H_6: CH_3CH_3) is next to methane in structural simplicity, followed by propane (C_3H_8: $CH_3CH_2CH_3$).

Methane, Ethane and Propane have one molecular formula.

CH_4	CH_3CH_3	$CH_3CH_2CH_3$
Methane	Ethane	Propane

Note: They do not have isomers.

The isomers are possible from the butane C_4H_{10} two alkanes have this particular molecular formula.

The *n* in ***n*-butane** refer to "normal" and means that the carbon chain is ***unbranched***.

The second isomer has a ***branched*** carbon chain and is called **isobutane.**

$CH_3CH_2CH_2CH_3$	CH_3CHCH_3 (with CH_3 branch)	or	$(CH_3)_3CH$
n-Butane		Isobutane	

n-Butane and isobutane have the same molecular formula but different in structure.

No. of C atoms	Name of alkane	Molecular formula	Name of alkyl group	Formula
1	Methane	CH_4	Methyl	$-CH_3$
2	Ethane	C_2H_6	Ethyl	$-C_2H_5$
3	Propane	C_3H_8	Propyl	$-C_3H_7$
4	Butane	C_4H_{10}	Butyl	$-C_4H_9$
5	Pentane	C_5H_{12}	Pentyl	$-C_5H_{11}$
6	Hexane	C_6H_{14}	Hexyl	$-C_6H_{13}$
7	Heptane	C_7H_{16}	Heptyl	$-C_7H_{15}$
8	Octane	C_8H_{18}	Octyl	$-C_8H_{17}$
9	Nonane	C_9H_{20}	Nonyl	$-C_9H_{19}$
10	Decane	$C_{10}H_{22}$	Decyl	$-C_{10}H_{21}$

Nomenclature

Nomenclature in organic chemistry classified into two types: ***common*** and ***systematic*****.**

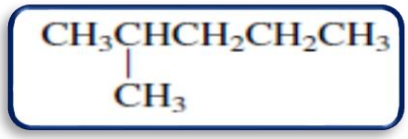
n-butane, isobutane, *n*-pentane, isopentane, and neopentane are **common names**.

$CH_3CH_2CH_2CH_2CH_2CH_3$

IUPAC name: hexane

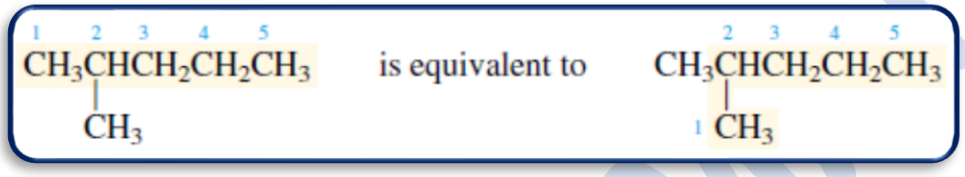
(common name: *n*-hexane)

Consider the C_6H_{14} isomer represented by the Structure

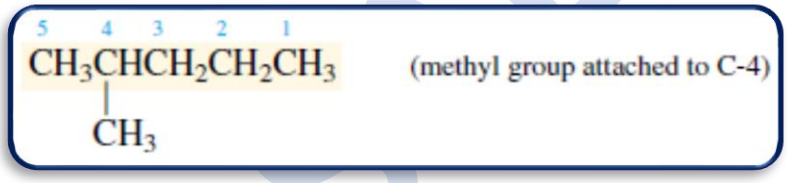


1. Pick out the ***longest continuous carbon chain*.**
2. Identify the **substituent** groups attached to the parent chain.
3. Number the longest continuous chain in the direction that gives the **lowest** number to the **substituent** group.

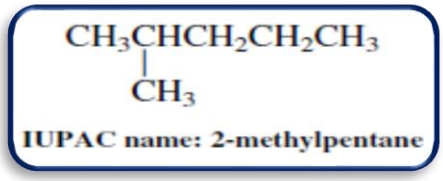
   The numbering rule:

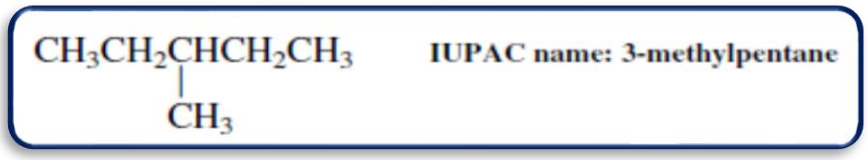


   The following numbering **is incorrect**:



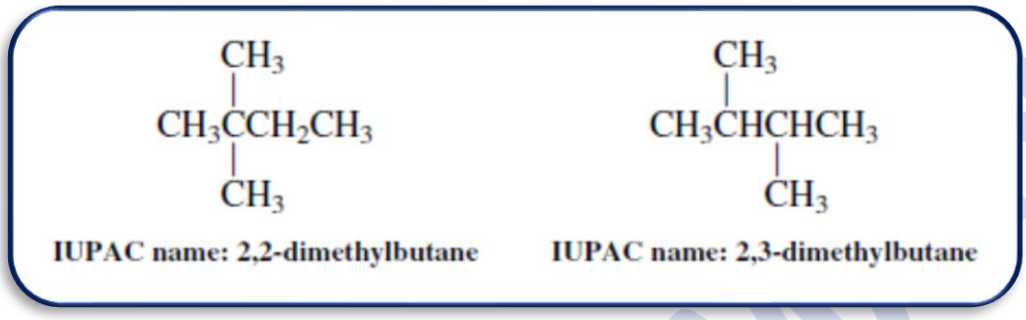
4. Write the name of the compound. The parent alkane is the **last** part of the name and is preceded by the names of the **substituent** groups and their numerical locations **(locants)**. Hyphens separate the locants from the words.

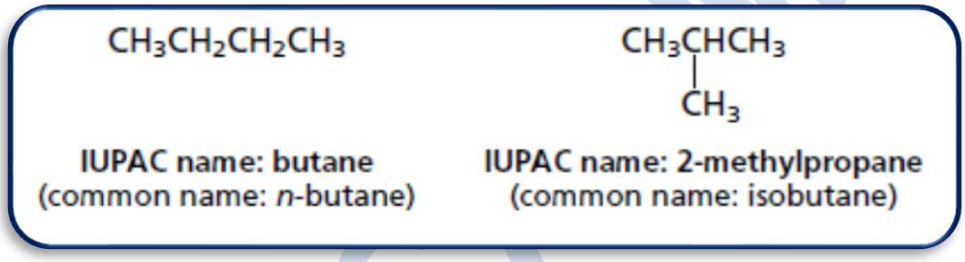




When the same substituent appears more than once, use the multiplying prefixes di-, tri-, tetra-, and so on.

They separated from each other by **commas** and from the words by **hyphens**.





Properties of Alkanes

An older name for alkanes is ***paraffin hydrocarbons*.**

1. Alkanes are **insoluble** in **water** but **soluble** in **organic solvents**.
2. Alkanes are below pentane are **gases** while alkanes have (5 – 17) carbon atoms are **liquids** and those above 17 C atoms are **solid** (**waxes**).
3. Alkanes burn easily in air. **All** hydrocarbons yield ***carbon dioxide*** and ***water*** as the products of their combustion.

Reactions of Alkanes

1. Combustion Reactions:

Alkanes are generally not considered to be very reactive substances. However, under suitable conditions they do react. For example, natural gas, gasoline, and fuel oil are alkanes that undergo highly exothermic combustion reactions:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O \qquad \Delta H^\circ = -890 \text{ kJ } (-212.8 \text{ kcal})$$

Methane — Oxygen — Carbon dioxide — Water

$$(CH_3)_2CHCH_2CH_3 + 8O_2 \longrightarrow 5CO_2 + 6H_2O \qquad \Delta H^\circ = -3529 \text{ kJ } (-843.4 \text{ kcal})$$

2-Methylbutane — Oxygen — Carbon dioxide — Water

2. Halogenation of Alkanes:

Is the replacement of one or more hydrogen atoms by halogen atoms is another type of reaction that alkanes undergo.

When a mixture of methane and chlorine is heated above 100°C or irradiated with light of a suitable wavelength, methyl chloride is produced:

$$CH_4(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + HCl(g)$$

methyl chloride

If an excess of chlorine gas is present, the reaction can proceed further:

$$CH_3Cl(g) + Cl_2(g) \longrightarrow CH_2Cl_2(l) + HCl(g)$$

methylene chloride

$$CH_2Cl_2(l) + Cl_2(g) \longrightarrow CHCl_3(l) + HCl(g)$$

chloroform

$$CHCl_3(l) + Cl_2(g) \longrightarrow CCl_4(l) + HCl(g)$$

carbon tetrachloride

Cycloalkanes

Alkanes whose carbon atoms are joined in rings are known as cycloalkanes.

They have the general formula C_nH_{2n}

Where (n = 3, 4, 5, …). The simplest cycloalkane is **cyclopropane**, C_3H_6.