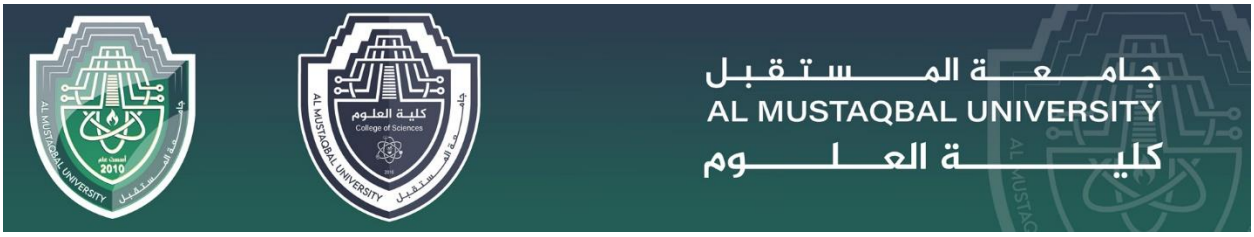


Organic Chemistry

1st stage

Asst. Lect.Zahraa Hazim Hamid

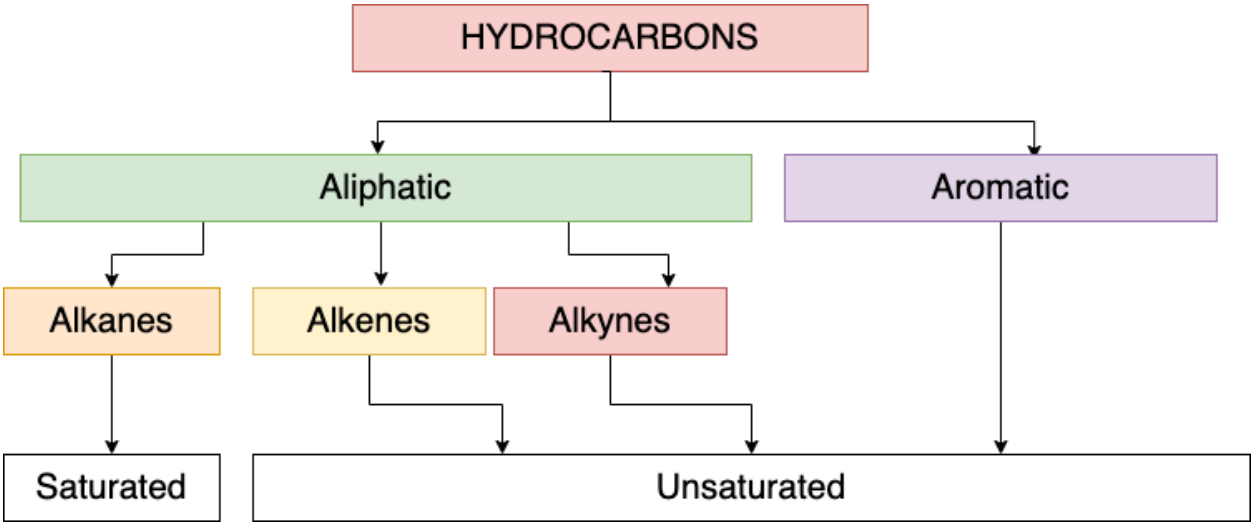
Lecture 2: Hydrocarbons (alkane)

Department of Medical Physics

2024-2025

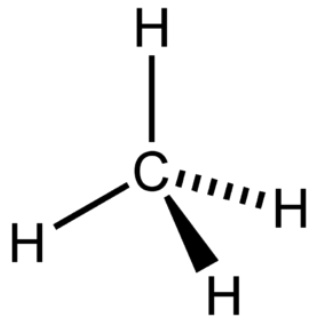
1.1 Hydrocarbons

A **hydrocarbon** is a compound composed of only carbon and hydrogen. Figure 1 shows the four classes of hydrocarbons.



1.1.1 Alkanes

Alkanes are the simplest type of organic compounds and member of a larger class of organic compounds called saturated hydrocarbons that contains only carbon–carbon single bonds. Alkanes have the general molecular formula C_nH_{2n+2}.



The simplest alkane is methane which is CH_4. Alkane molecules have a tetrahedral shape around carbon atoms. Carbon atoms in alkane molecules form sigma bonds with surrounding carbon and hydrogen atoms. As a result, carbon atoms in alkanes are surrounded by 4 pairs of bonding electrons which equally repel each other to form 109.5o bond angles.

1.1.2 Nomenclature of Alkanes

قواعد تسمية الألكانات (Alkanes Naming Rules)

IUPAC NAME

1- Choose the longest continuous chain of carbon atoms.

اختيار اطول سلسلة ممكنة من ذرات الكاربون

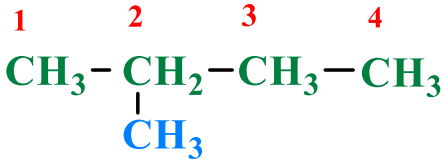
2- Number the chain starting from the end closest to a branch to give the branches the lowest possible numbers.

الترقيم من الجهة الأقرب للتفرع بحيث يكون للتفرع اقل الأرقام الممكنة

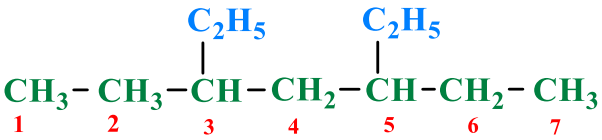
3- Use the prefixes di-, tri-, or tetra- if there are identical branches in the compound.

Molecular Formula	Structural formula	Name
CH_4	CH_4	Methane
C_2H_6	$CH3 – CH_3$	Ethane
C_3H_8	$CH3 – CH_2–CH3$	Propane
C_4H_{10}	$CH3 – CH_2–CH2–CH_3$	Butane
C_5H_{12}	$CH3 – CH_2–CH2–CH_2–CH_3$	Pentane
C_6H_{14}	$CH3 – CH_2–CH2–CH_2–CH_2–CH_3$	Hexane
C_7H_{16}	$CH3 – CH_2–CH2–CH_2–CH_2–CH_2–CH_3$	Heptane
C_8H_{18}	$CH3 – CH_2–CH2–CH_2–CH_2–CH_2–CH_2–CH_3$	octane

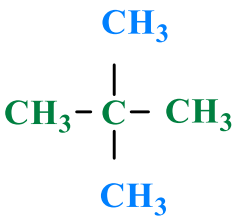
Examples



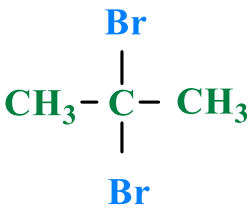
2-methyl butane



3,5 di ethyl heptane

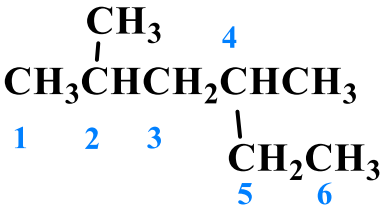


2,2 dimethyl propane



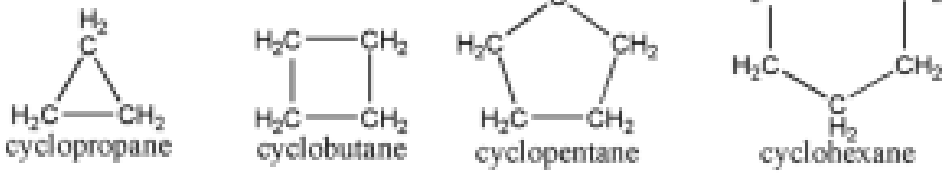
2,2 dibromo propane

Q/ whish is correct



1.1.3 Cycloalkanes

Cyclic alkanes (or cycloalkanes) have carbon and hydrogen atoms that are bonded together with single bonds.



In such bonds, the carbon atoms bond together to form a loop.

1.1.4 Physical and Chemical Properties of Alkanes

Physical Properties:

1. State at Room Temperature:

• 1-4 carbon atoms are gases (e.g., methane, ethane).

• 5-17 carbon atoms are liquids (e.g., pentane, heptane).

• 18 or more carbon atoms are solids (e.g., paraffin wax).

2. Boiling and Melting Points:

• Increases with the number of carbon atoms.

• Larger alkanes have higher boiling and melting points due to stronger van der Waals forces.

3. Solubility:

• Alkanes are insoluble in water but soluble in organic solvents like benzene and ether.

Chemical Properties of Alkanes

1. Combustion

Alkanes burn in oxygen to produce carbon dioxide and water.

(Methane burns to form CO_2 and H_2O)

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$$

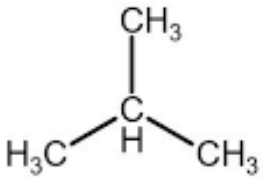
2. Inertness:

Alkanes are generally unreactive with most substances like acids, bases, and oxidizing agents under normal conditions due to their strong C-H and C-C bonds.

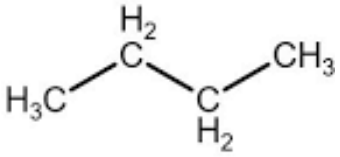
3. Isomerism:

Alkanes with 4 or more carbon atoms can have different structural forms (isomers).

Example: Butane (C_4H_{10}) has two isomers: n-butane and isobutane.



isobutane



n-butane
butane