Ministry of Higher Education and Scientific Research
AL-Mustaqbal University College of Science
Department of Medical Biology

Organic Chemistry

Lecture 2

Alkanes

By

Dr. Assel Amer Hadi

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}***.
- we can determine the number of hydrogen in the molecule and its molecular formula. For example, decane, with ten carbon atoms, must have (2 x10)+ 2= 22 hydrogen atoms and a molecular formula of C10H22.

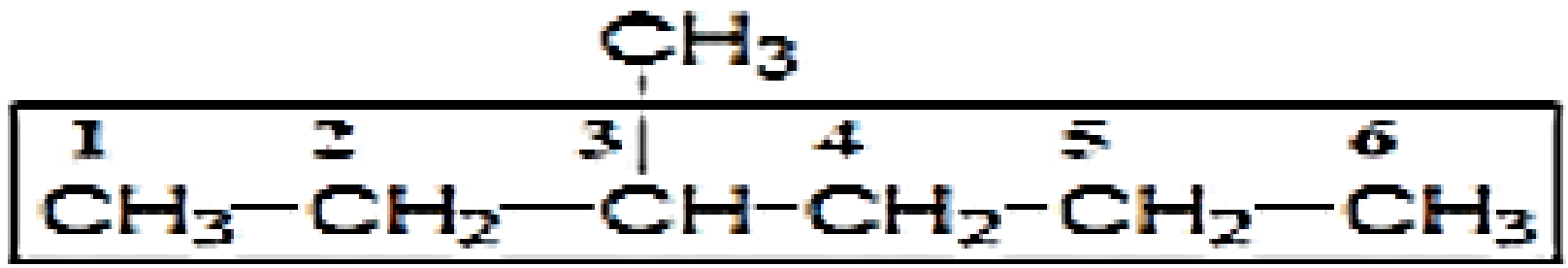
Nomenclature of Alkanes and the IUPAC System

1. The name for an alkane with an un branched chain of carbon atoms consists of a prefix showing the number of carbon atoms in the chain and the ending -ane. The simplest member of Alkane family is methane

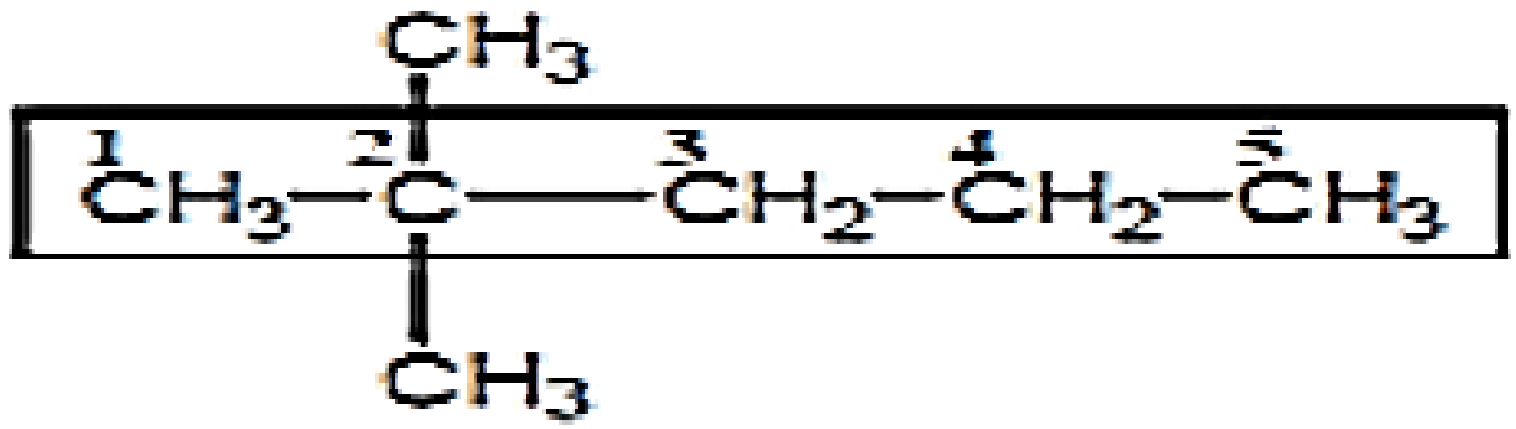
Molecular Formula	Structural formula	Name
CH_4	CH_4	Methane
C_2H_6	$CH3 – CH_3$	Ethane
C_3H_8	$CH3 – CH_2–CH3$	Propane
C_4H_{10}	$CH3 – CH_2–CH2–CH_3$	Butane
C_5H_{12}	$CH3 – CH_2–CH2–CH_2–CH_3$	Pentane
C_6H_{14}	$CH3 – CH_2–CH2–CH_2–CH_2–CH_3$	Hexane
C_7H_{16}	$CH3 – CH_2–CH2–CH_2–CH_2–CH_2–CH_3$	Heptane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

2. For branched-chain alkanes, select the longest chain of carbon atoms as the parent chain; its name becomes the root name. If there is one substituent, number the parent chain from the end that gives the substituent the lower number.

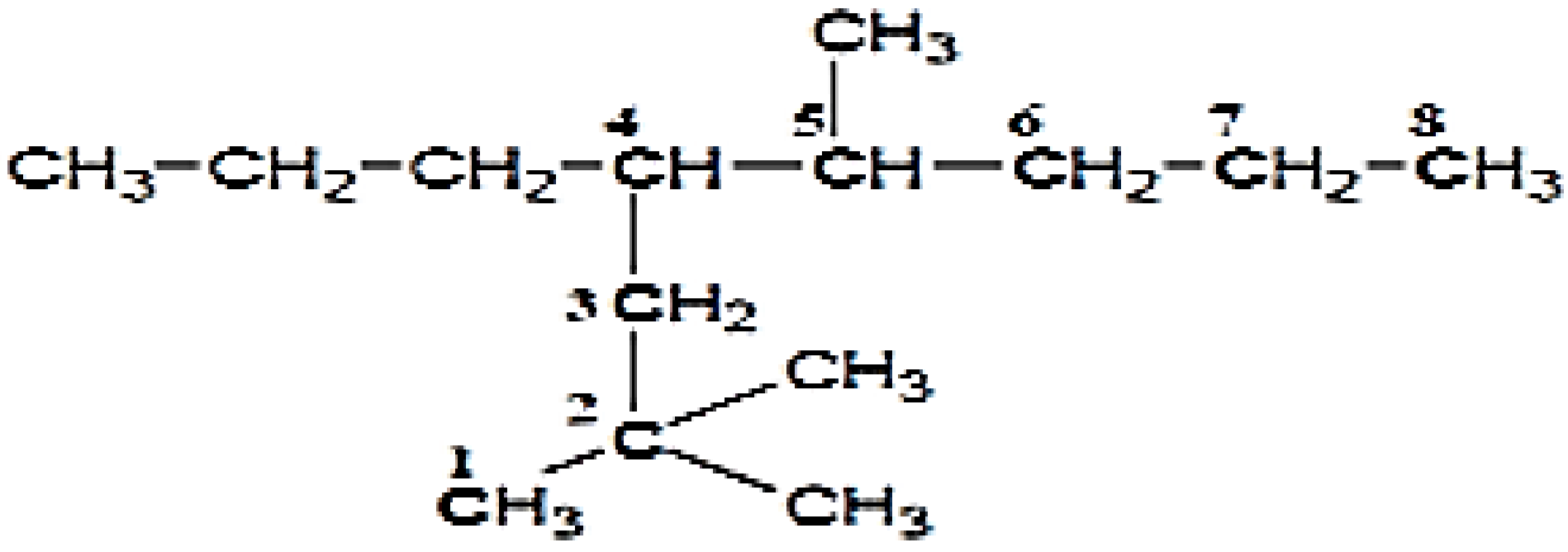
3- Give each substituent on the parent chain a name and a number. The number shows the carbon atom of the parent chain to which the substituent is bonded. Use a hyphen (-) to connect the number to the name.



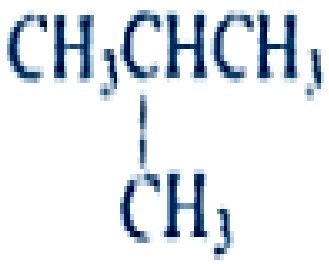
3-Methyl hexane



2,2-Dimethyl pentane



2,2,5-Trimethyl-4-propyl octane



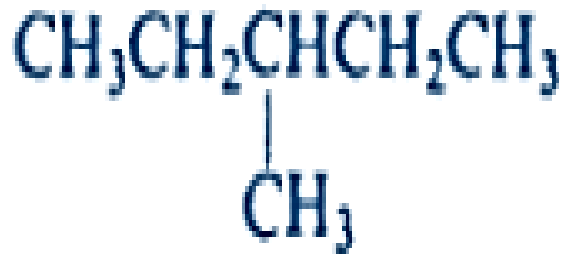
I

Methylpropane

(Isobutane)

II

2-Methylpentane



III

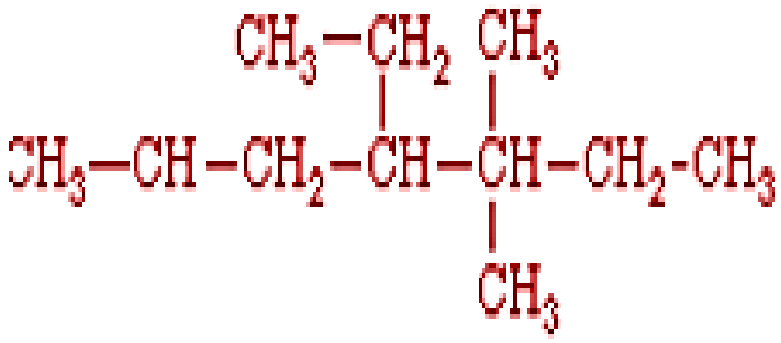
3-Methylpentane

A substituent group derived from an alkane by the removal of a hydrogen atom is called an alkyl group; it is commonly represented by the symbol R We name alkyl groups by dropping the -ane from the name of the parent alkane and adding the suffix-yl. The substituent derived from methane, for example, is methyl

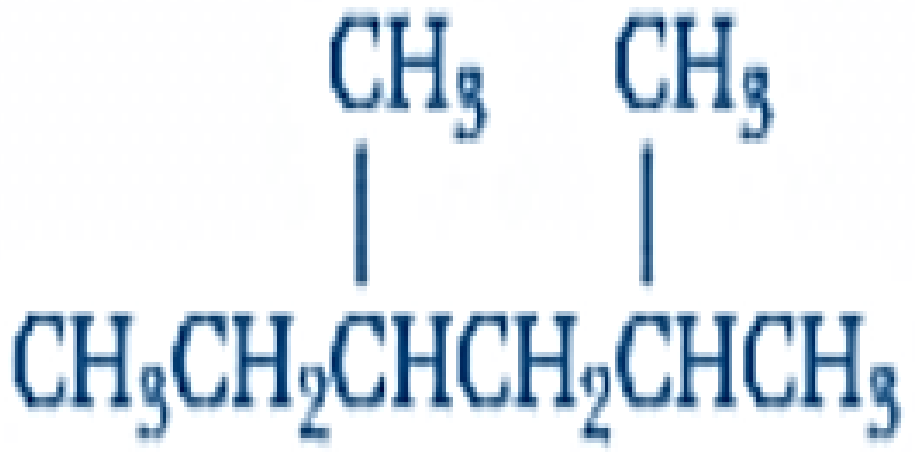
CH_3-	Methyl
CH_3-CH_2-	Ethyl
$CH_3-CH_2-CH_2-$	Propyl
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-$	iso-propyl
$CH_3-CH_2-CH_2-CH_2$	butyl
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-$	iso-butyl
$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\vert}{\underset{\vert}{C}}}}-$	tert - butyl

If there are two or more identical substituents, number the parent chain from the end that gives the lower number to the substituent encountered first. The number of times the substituent occurs is indicated by the prefix di-, tri-, tetra-

A comma is used to separate position numbers.



4-ethyl-3,3-dimethylheptane



2,4-Dimethylhexane (not 3,5-dimethylhexane)

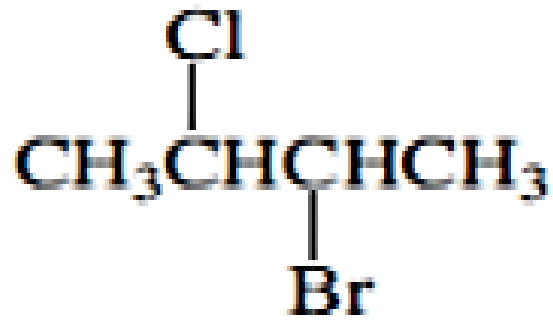
If there are two or more different substituents, list them in alphabetical order and number the chain from the end that gives the lower number to the substituent encountered first.

3-Ethyl-5-methylheptane (not 3-methyl-5-ethylheptane)

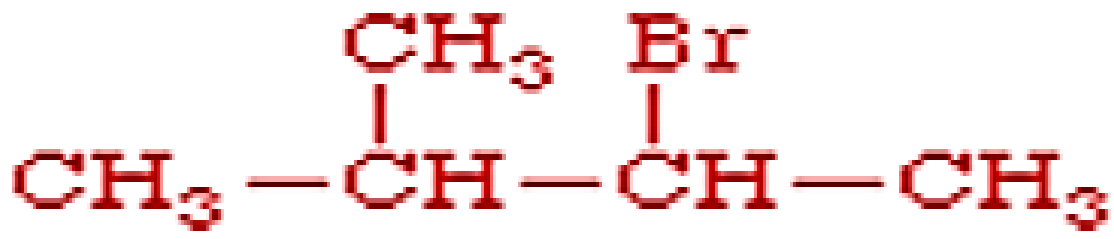
F-	Foloro
Br-	Bromo
I-	Iodo
NO_2 -	Nitro

methyl chloride
chloromethane

ethyl fluoride
fluoroethane



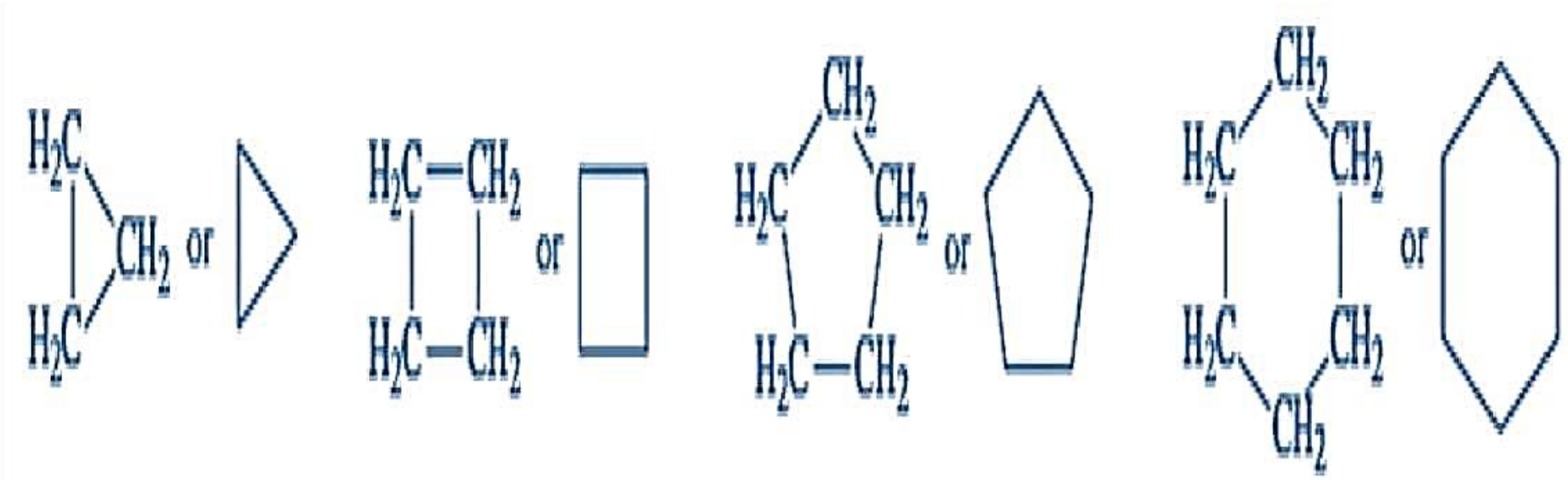
2-bromo-3-chlorobutane
not
3-bromo-2-chlorobutane



2-bromo-3-methylbutane

Cyclo Alkanes

A hydrocarbon that contains carbon atoms joined to form a ring is called a cyclic hydrocarbon. When all carbons of the ring are saturated, the hydrocarbon is called a cycloalkane.



Cyclopropane Cyclobutane Cyclopentane Cyclohexane

Physical Properties of Alkanes

- The first four n-alkanes are gases, but, as a result of the rise in boiling point and melting point with increasing chain length, the next 13 (C5-C17) are liquids, and those- containing 18 carbons or more are solids physical constants for a number of the n-alkanes., the boiling points and melting points rise as the number of carbons increases.
- The processes of boiling and melting require overcoming the intermolecular forces of a liquid and a solid; the boiling points and melting points rise because these intermolecular forces increase as the molecules get larger.

- We see that in every case a branched-chain isomer has a lower boiling point than a straight-chain isomer, and further, that the more numerous the branches, the lower the boiling point.

Properties

Least Polar — Most Polar

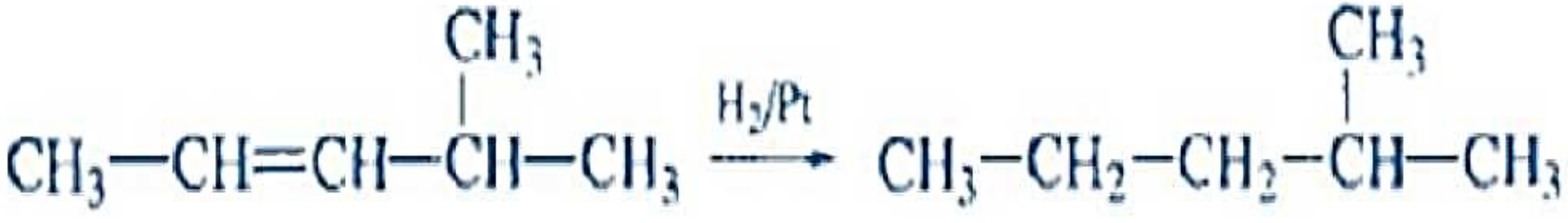
$$\left\{\begin{array}{c}\textit{alkane}\\ \textit{alkene}\\ \textit{alkyne}\end{array}\right\} < \text{ether} < \left\{\begin{array}{c}\textit{aldehyde}\\ \textit{ketone}\end{array}\right\} < \text{ester} < \text{amine} < \text{amide} < \left\{\begin{array}{c}\textit{alcohol}\\ \textit{phenol}\end{array}\right\} < \text{carboxylic acid}$$

Lowest b.p. — Highest b.p.

Lowest water solubility — Highest water solubility

Preparation of Alkane

1) Hydrogenation of Alkene



2) Reduction with Alkyl Halide

A)Hydrolysis with Grignard reagent.

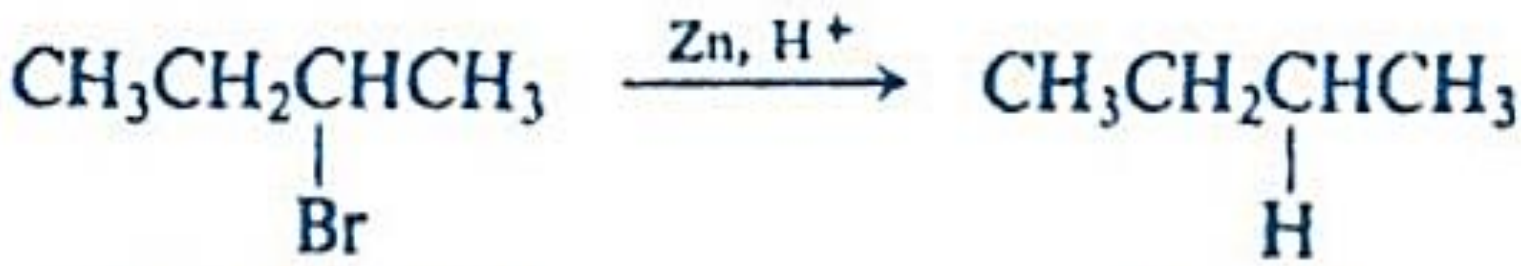
Example:

sec-Butyl bromide — *sec*-Butylmagnesium bromide — *n*-Butane

b) Reduction with Metal and Acid

$$RX + Zn + H^+ \longrightarrow RH + Zn^{++} + X^-$$

Example:



sec-Butyl bromide — *n*-Butane


Thank you