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قسم الادلة الجنائية

المحاضرة السابعة

Saturated Hydrocarbons(Alkanes)

المادة : عضوية
المرحلة : الاولى
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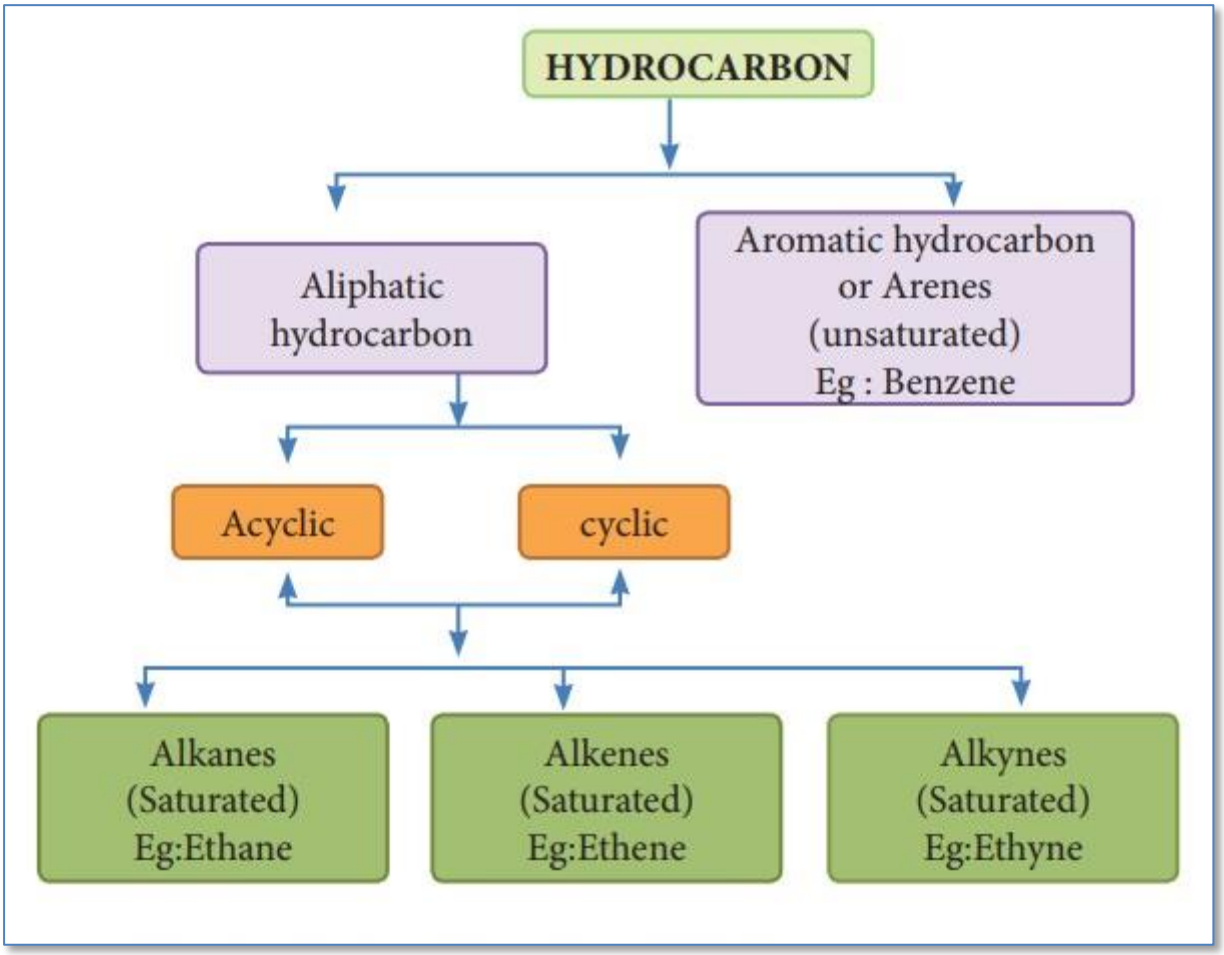
Alkane

A hydrocarbon is a compound composed of only carbon and hydrogen. Figure1 shows the four classes of hydrocarbons, along with the characteristic type of bonding between carbon atoms in each class.



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 CnH_2n+2. we can determine the number of hydrogens in the molecule and its molecular formula. For example, decane, with ten carbon atoms, must have $(2\times10)+2=22$hydrogen atoms and a molecular formula of $C_{10}H_{22}$.

Nomenclature of Alkanes and the IUPAC System:

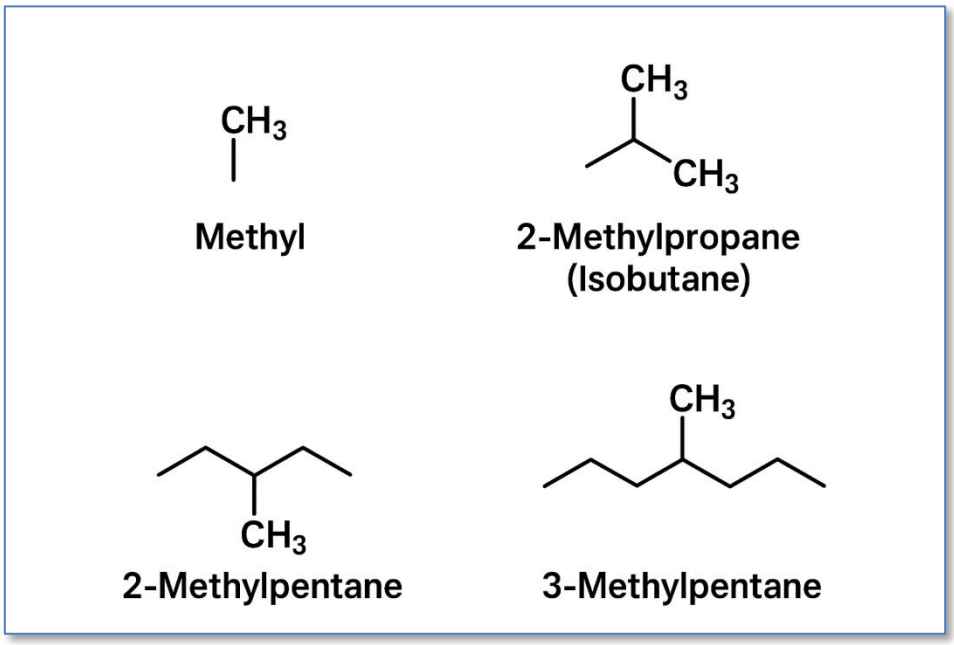
The rules of the IUPAC system for naming alkanes follow:

1. The name for an alkane with an unbranched 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

Name	Molecular Formula (C_nH_{2n+2})	Condensed Structural Formula	Number of Possible Isomers
methane	CH_4	CH_4	—
ethane	C_2H_6	CH_3CH_3	—
propane	C_3H_8	$CH_3CH_2CH_3$	—
butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$	2
pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$	3
hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$	5
heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	9
octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	18
nonane	C_9H_{20}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	35
decane	$C_{10}H_{22}$	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	75

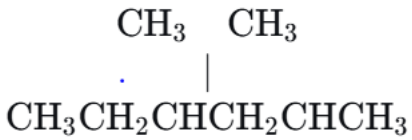
2. For branched-chain alkanes, select the longest chain of carbon atoms as the parent chain; its name becomes the root name. If there is one substituent, number the parent chain from the end that gives the substituent the lower number.

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.



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.

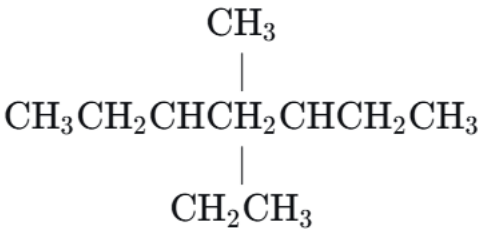
4-If there are two or more identical substituents, number the parent chain from the end that gives the lower number to the substituent encountered first. The number of times the substituent occurs is indicated by the prefix di-, tri-, tetra-, and so on. A comma is used to separate position numbers.



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

5-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)



Symble	Name
F-	Fluoro
Cl-	Chloro
Br-	Bromo
I-	Iodo
NO_2-	Nitro

B. Common Names

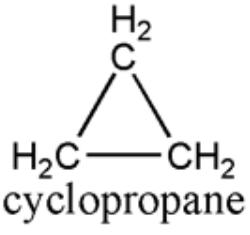
In an alternative system known as common nomenclature, the total number of carbon atoms in an alkane, regardless of their arrangement, determines the name. The first three alkanes are methane, ethane, and propane. All alkanes with the molecular formula C_4H_{10} are called butanes, all those with the molecular formula C_5H_{12} are called pentanes, all those with the molecular formula C_6H_{14} are called hexanes, The fact that an alkane chain is unbranched is sometimes indicated by the prefix n- (normal); an example is n-pentane for $CH_3CH_2CH_2CH_2CH_3$. For branched-chain alkanes beyond propane, iso- indicates that one end of an otherwise unbranched chain terminates in a $(CH_3)_2CH$- group and neo- indicates that it terminates in-$C(CH_3)_3$. Following are examples of common name.

IUPAC Name	Structural formula	Common name
Ethane	$CH_3 - CH_3$	Ethane
Propane	$CH_3 - CH_2 - CH_3$	n-Propane
Butane	$CH_3 - CH_2 - CH_2 - CH_3$	n-Butane
2-Methylpropane	$CH_3 - CH(CH_3) - CH_3$	Iso-Butane
2,2-Dimethylpropane	$CH_3 - C(CH_3)_2 - CH_3$	Neo-Pentane

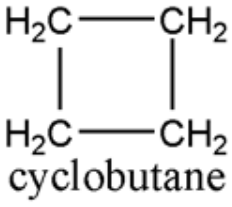
Cycloalkanes

A hydrocarbon that contains carbon atoms joined to form a ring is called a cyclic hydrocarbon.

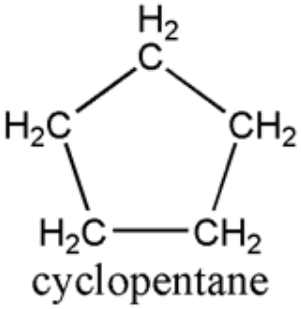
When all carbons of the ring are saturated, the hydrocarbon is called a cycloalkane



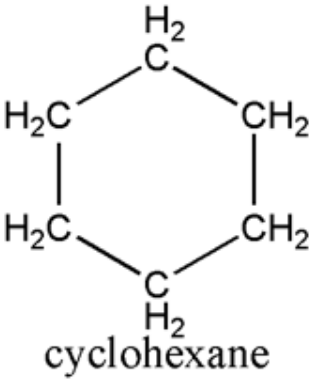
cyclopropane



cyclobutane



cyclopentane



cyclohexane

physical properties of alkanes:

1. State at Room Temperature

C1–C4 (Methane to Butane): Gases

C5–C17: Liquids

C18 and above: Solids

This is because as the carbon chain length increases, the van der Waals forces increase, leading to higher melting and boiling points.

2. Boiling and Melting Points

Trend: Both increase with increasing molecular weight (number of carbon atoms).

Reason: Larger molecules have stronger **London dispersion forces**, requiring more energy to separate.

Branching Effect: Branched alkanes have **lower boiling points** than straight-chain isomers due to less surface area, reducing van der Waals forces.

3. Density

Alkanes are **less dense than water** (≈0.6–0.8 g/cm³).

Density increases slightly with molecular weight.

4. Solubility

Alkanes are **nonpolar**, so they are:

Insoluble in water

Soluble in nonpolar solvents (like hexane, benzene)

5. Viscosity

Viscosity **increases with molecular weight**.

Long-chain alkanes flow more slowly than short-chain ones.

6. Color and Odor

Colorless in pure form.

Odorless for lower alkanes (methane, ethane), slight smell for higher ones.

7. Surface Tension

Increases slightly with molecular weight due to stronger intermolecular forces.