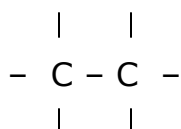


Unit 3 Chemistry – Structure & Naming of Alkanes [to C₁₀]

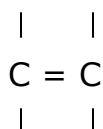
Most organic compounds contain carbon atoms covalently bonded to other carbon atoms [forming chains or rings] and hydrogen atoms, making hydrocarbon molecules. A few other elements [N, O, S, P, F, Cl, I ...] can be bonded to carbon and form part of a hydrocarbon molecule.

Bonding to Carbon

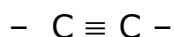
A carbon atom has the electronic configuration $1s^2 2s^2 2p^2$ and is a small atom with 4 outer-shell electrons. To gain stability [a filled 8 electron outer-shell], carbon atoms share these outer-shell electrons to form 4 strong covalent bonds. Sometimes a carbon atom shares 2 electrons with a particular atom to form a double covalent bond and occasionally shares 3 electrons to form a triple covalent bond.



single covalent



double covalent

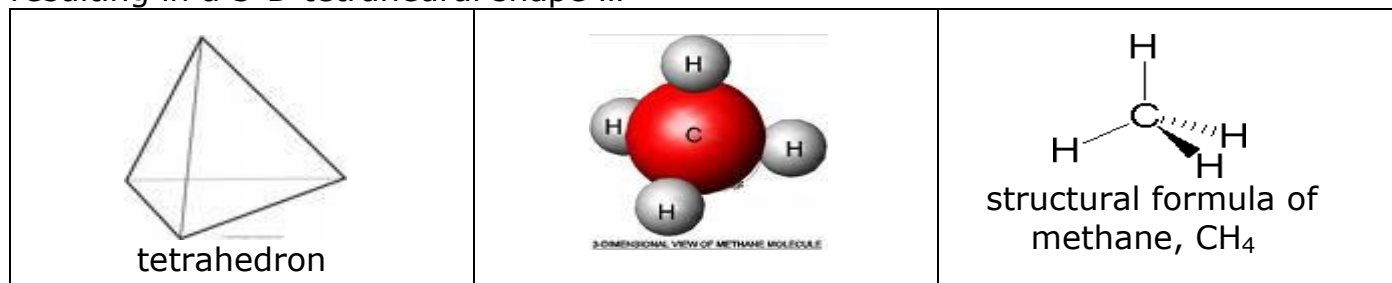


triple covalent

Note: every carbon atom has 4 covalent bonds or “sticks” around it

Shape of organic Molecules

When 4 single covalent bonds exist around a carbon atom, repulsion between the 4 bonding electron clouds, push the bonds as far away from each other as possible, resulting in a 3-D tetrahedral shape ...



The Alkanes

- the simplest hydrocarbons are the alkanes, which have only single covalent bonds and the general formula, C_nH_{2n+2}.
- The alkanes are a homologous series, starting with methane [CH₄], with each new member of the homologous series differing by -CH₂ [ie. CH₄, C₂H₆, C₃H₈ etc.]

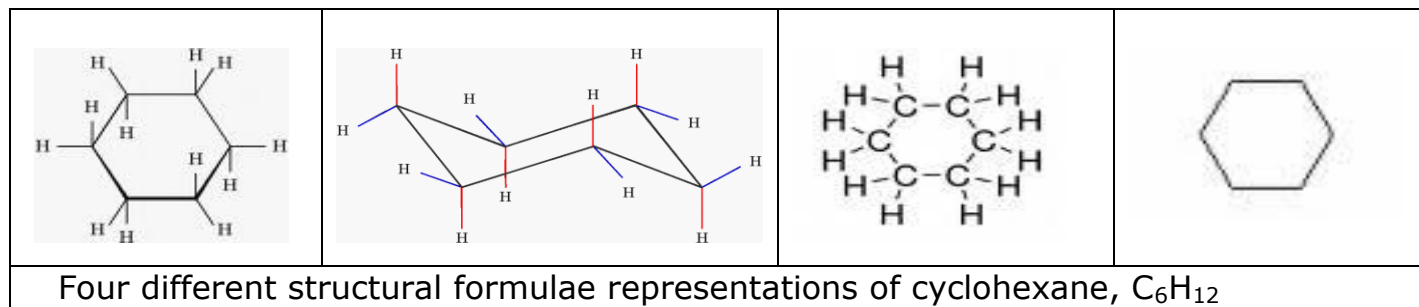
The alkanes = homologous series C _n H _{2n+2}		CH₄ = methane	C₂H₆ = ethane
C₃H₈ = propane	C₄H₁₀ = butane	C₅H₁₂ = pentane	C₆H₁₄ = hexane
C₇H₁₆ = heptane	C₈H₁₈ = octane	C₉H₂₀ = nonane	C₁₀H₂₂ = decane

Note: the alkane name ends in “ane” and the prefix gives the number of carbons in the alkane → prop = 3 carbons, hex = 6 carbons, oct = 8 carbons etc.

- the alkanes are called **saturated hydrocarbons** because they have no C=C double bonds, are saturated with H atoms and therefore do not react with hydrogen

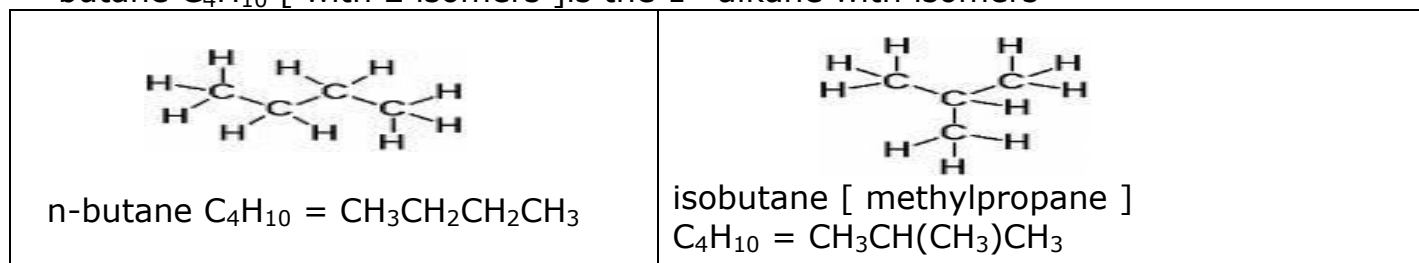
Cyclic Alkanes

- some alkanes have a chain of carbon atoms that form a **ring** shape and are known as cyclic alkanes eg. **cyclohexane** C_6H_{12}



Isomers

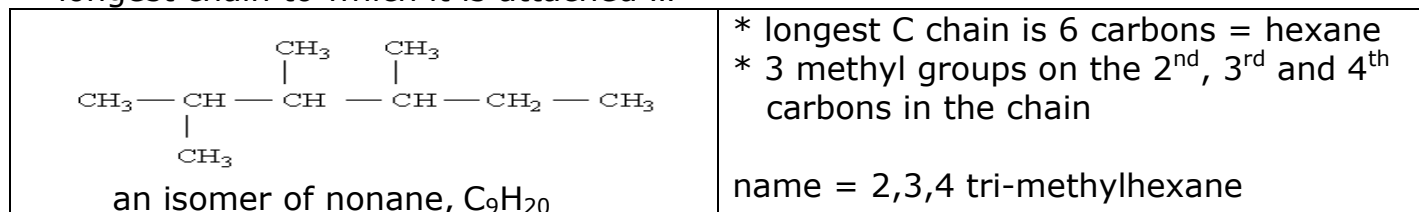
- molecules that have the same molecular formula, but a different structural formula are known as **isomers**.
- isomers have the same number and type of atoms in them, but the atoms are arranged in a different way
- isomers, even though they have the same molecular formula, are different compounds and have different physical and chemical properties
- butane C_4H_{10} [with 2 isomers] is the 1st alkane with isomers



- pentane has 3 isomers, hexane has 5, heptane 9 and decane, 75 structural isomers

Naming Alkane Isomers

- the longest carbon chain is identified, numbered and named eg. if the longest chain is 7 carbons long it is a "heptane"
- the number of carbons in the **alkyl side chain** determines its name eg. if the side chain is $-CH_3$ it is "methyl"; if the side chain is $-CH_2CH_2CH_3$ it is "propyl"
- the position of the side chain is determined from the numbered carbon in the longest chain to which it is attached ...



Examples involving the Structure and Naming of Alkanes

1. Which of the following organic compounds is an alkane?

- [i] C_3H_8 [ii] C_7H_{16} [iii] $CH_3CH_2CH_2CH_3$ [iv] C_2H_4
[v] C_2H_2 [vi] $C_{50}H_{102}$ [vii] CH_3CH_2OH [viii] $C_{10}H_{22}$
-

2. Copy and complete the following table...

Name	molecular formula	semi-structural formula	structural formula
propane			
hexane			
methylpropane			
3-ethylhexane			
2-methyl,3-ethyl heptane			

3. Draw structural formula and name the 5 structural isomers of pentane.

3. A saturated hydrocarbon molecule has the molecular formula, C_5H_{10} .

(a) sketch the structural formula of the molecule

(b) give the systematic name of the compound
