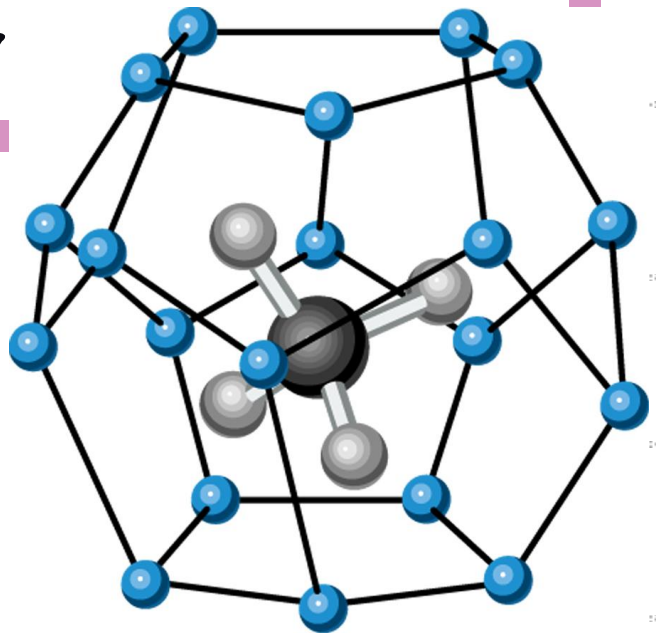
Introduction To Organic Chemistry



Learning Outcomes:

At the end of the lesson the students should be able to :

1. List the elements that made up organic compounds C, H, O, N, P, S and halogens.
2. State the ability of carbon to form 4 covalent bonds with other carbons or elements.
3. Differentiate between saturated and unsaturated organic compounds.
4. Give examples of organic compounds used in medicine, engineering, biotechnology and agriculture.

WHAT IS ORGANIC CHEMISTRY?

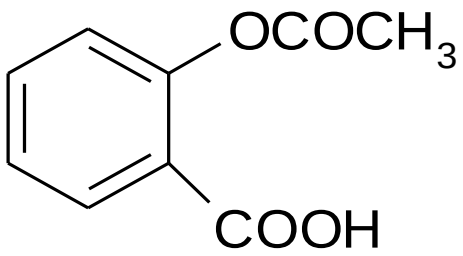
- Organic chemistry is the chemistry of carbon compounds.
- Organic compounds contain H as well as C, while other common elements are O, N, the halogens, S and P.
- There are many varieties of organic compounds

  (more than 10 millions!!!)
- They may exist as simple or complex molecules; as gases, liquids or solid and coloured or colourless.

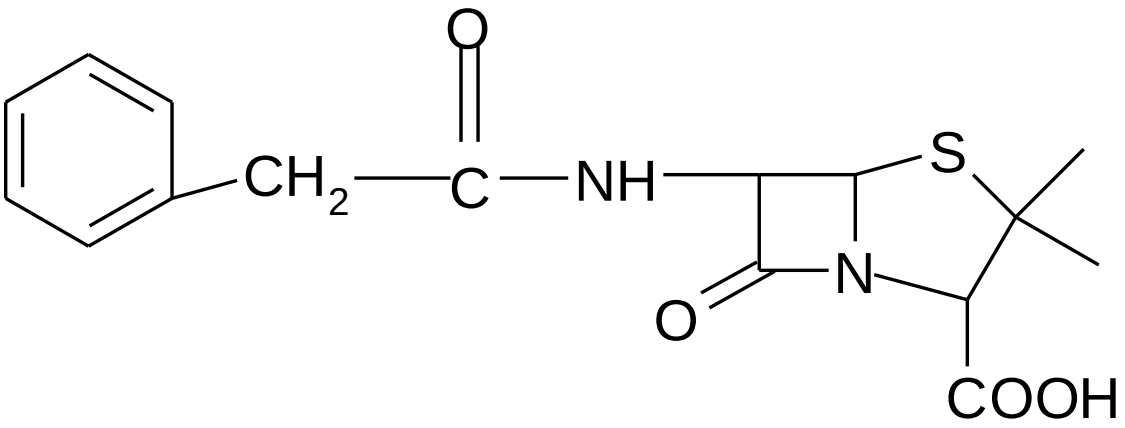
- Examples :-

CH_4

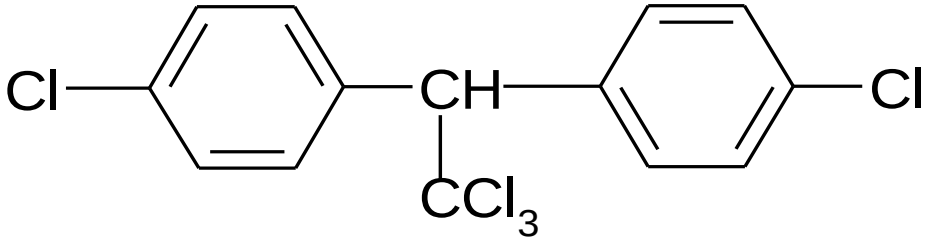
methane (a component of natural gas)



methyl salicylic acid (aspirin-a drug)



penicillin (an antibiotic)

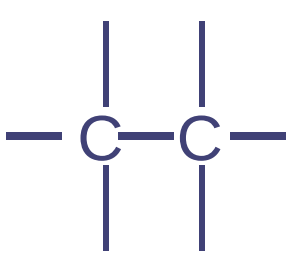


dichlorodiphenyltrichloroetane
(DDT- a pesticide component)

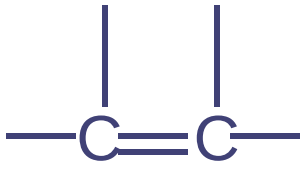
- All organic compounds consist of **carbon atom**.
- Properties of carbon atom:

  -has 4 valence electrons.

  -can form 4 covalent bonds.



Single bond



Double bond

Triple bond

Hydrocarbons

saturated

Contains only single bonds (-C-C-)

Examples: alkanes,

cycloalkanes

unsaturated

Contains at least one carbon-carbon double bond (-C=C-) or triple bond (-C≡C-).

Examples: alkenes,
alkynes.

Uses of organic compounds

Medicine	Antibiotics are used to fight bacterial and fungal infections
Engineering	Gasoline-as a fuel for internal combustion engines.
Biotechnology	Genetic information like DNA
Agriculture	DDT-as insectisides to kill harmful insects.

Molecular and Structural Formulae

Learning Outcomes:

At the end of the lesson the students should be able to :

- Define structural formula.
- Draw structural formula in the form of expanded, condensed and skeletal structures based on the molecular formula.
- Explain primary (1°), secondary (2°), tertiary (3°) and quaternary (4°) carbon.

- ***Structural formula*** shows how the atoms in a molecule are bonded to each other.
- 3 types of structural formula:
  - condensed structure
  - expanded structure
  - skeletal structure

2- Dimensional formula

Condensed Structure

- Does not show single bonds between carbon and hydrogen atoms, but double and triple bonds are shown.
- All atoms that are attached to a carbon are written immediately after that carbon.

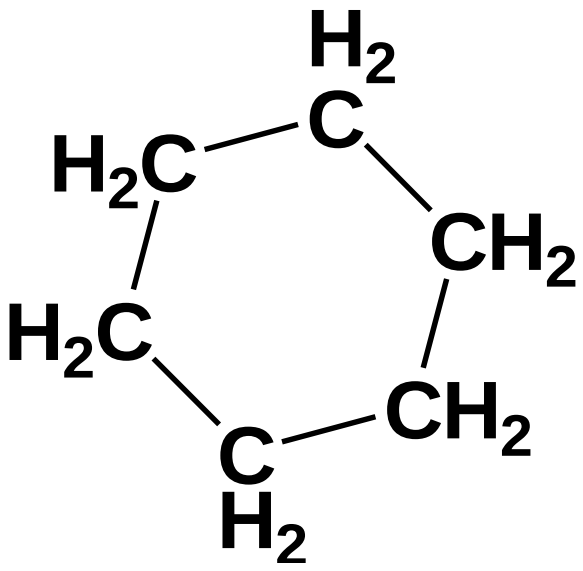
$C_4H_9Cl \longrightarrow CH_3CHCH_2CH_3$

(Condensed structure)

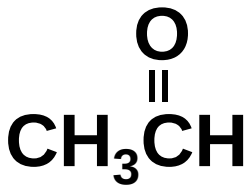
II

Examples:

ii) Cyclohexane, C_6H_{12}



iii) Aldehyde, CH_3CHO

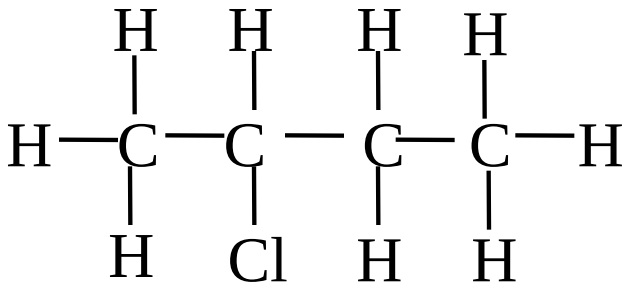


Expanded Structure

- Expanded structures indicate how atoms are attached to each other but are not representations of the actual shapes of the molecules.

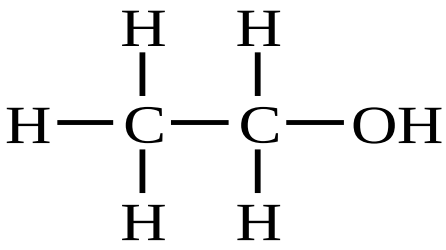
C_4H_9Cl

Molecular Formula

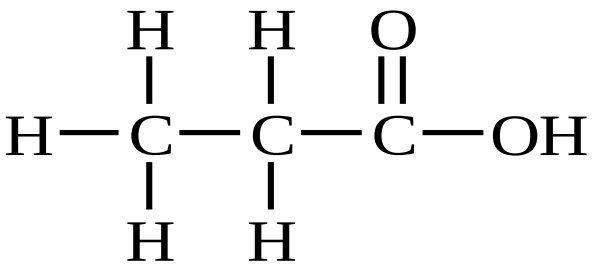


Expanded structure

- Examples:
- i) Alcohol (C_2H_6O)



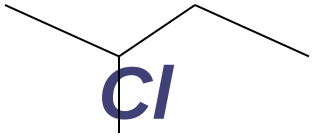
- ii) Carboxylic acid ($C_3H_6O_2$)



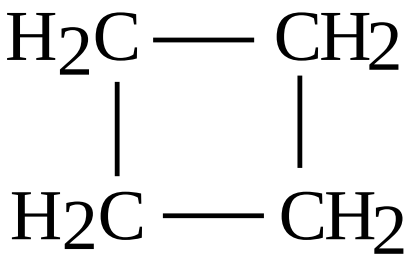
Skeletal Structure

- Shows only the carbon skeleton.
- Hydrogen atoms are not written.
- Other atoms such as O, Cl, N etc. are shown.

i) $CH_3CH(Cl)CH_2CH_3$ =



ii)



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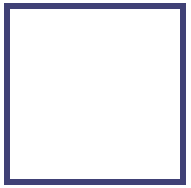
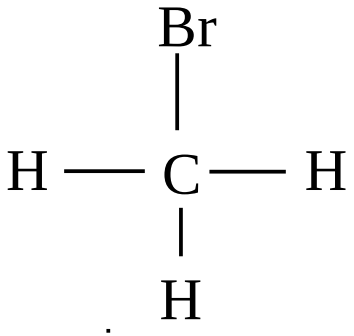
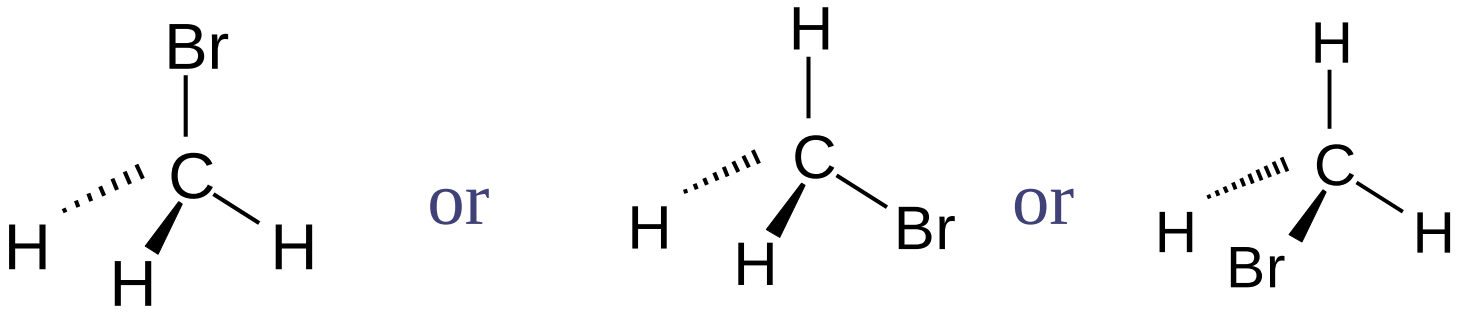


3- Dimensional formula
(wedge – dashed wedge – line formula)

- Describes how the atoms of a molecule are arranged in space.

Example : Bromoethane





Indication :-

— **:bonds that lie in the plane**

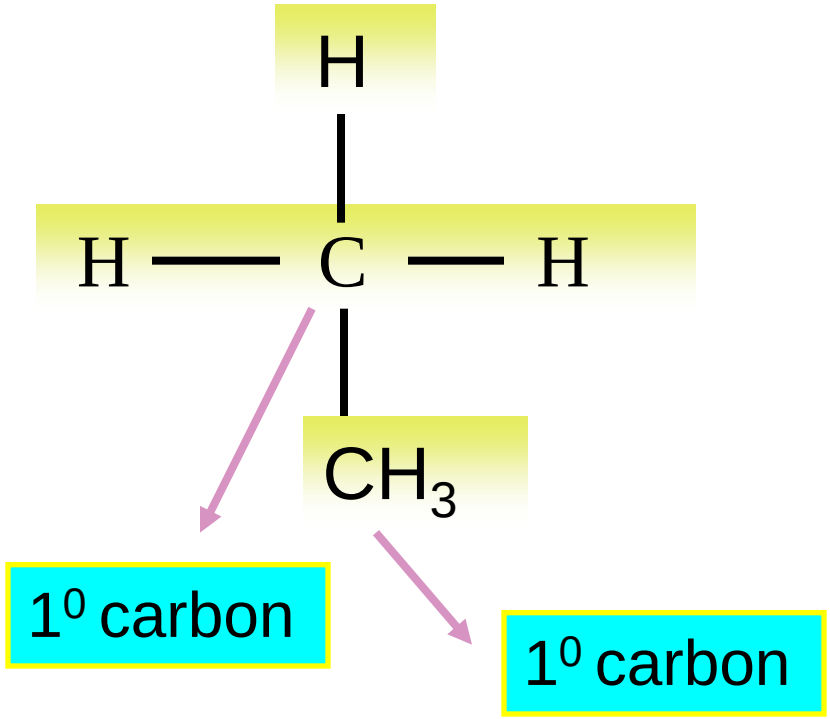
:bonds that lie behind the plane

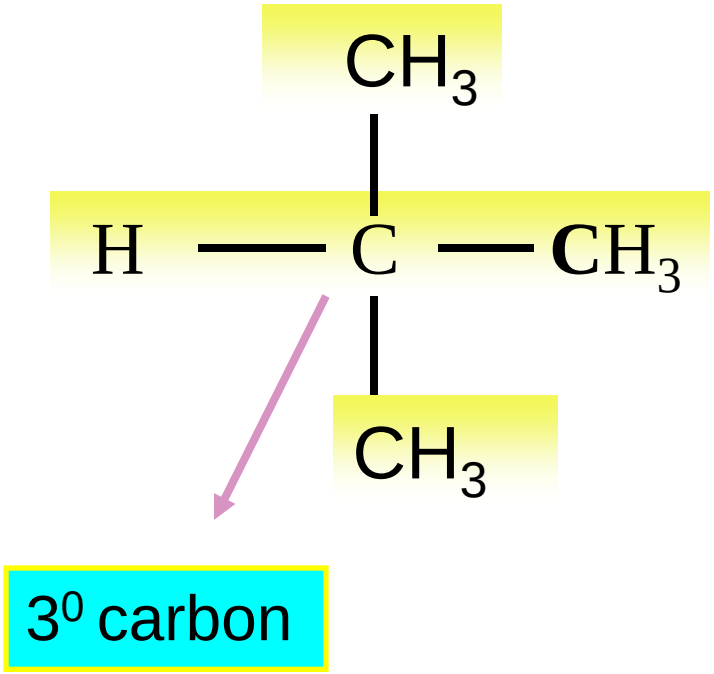
:bonds that project out of the plane

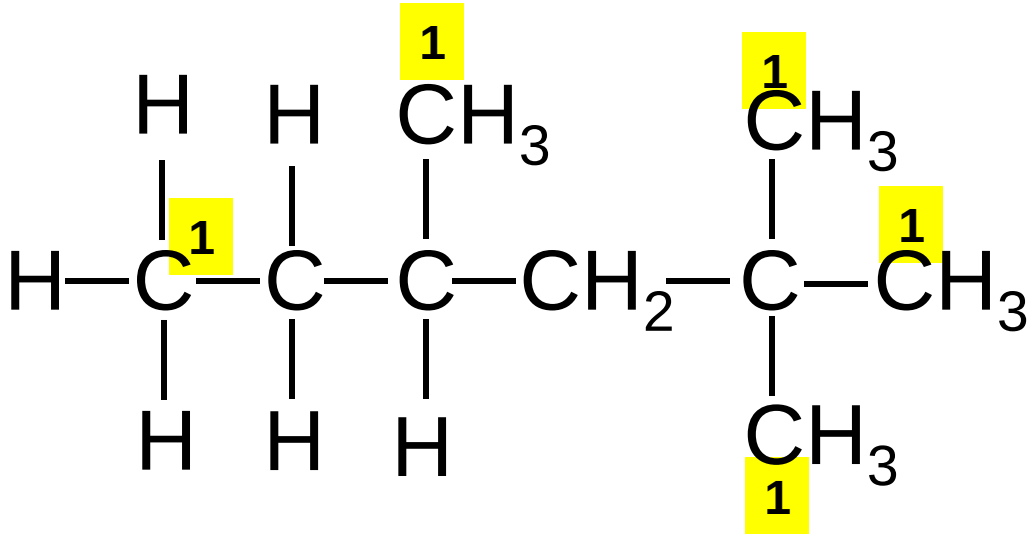
Classification of C atoms:

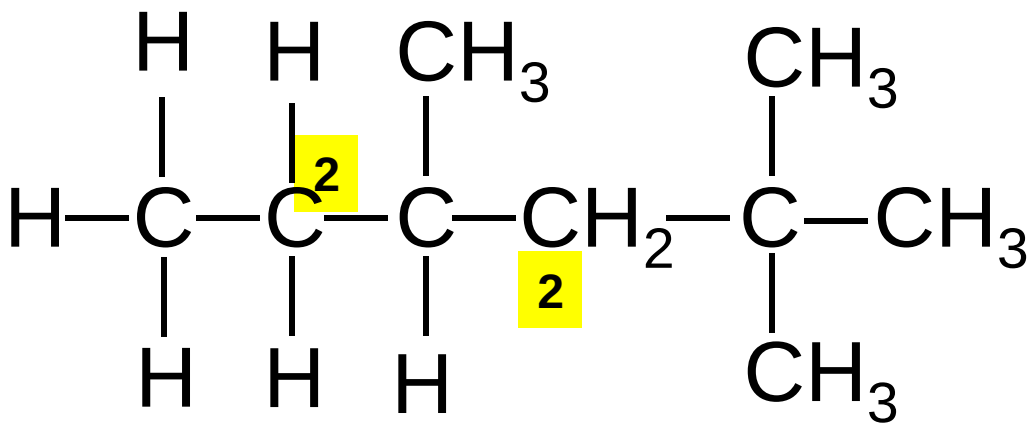
A carbon atom can be classified as

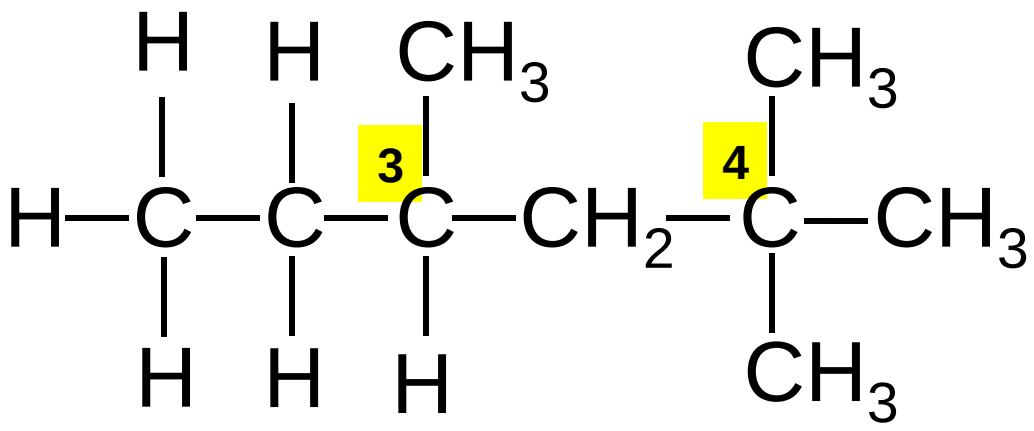
- ***primary carbon(1º)*** →bonded to *1 C*
- ***secondary carbon(2º)*** → bonded to *2* C
- ***tertiary carbon(3º)*** → bonded to *3* C
- ***quarternary carbon(4º)*** → bonded to 4 C


H
H — C — H
CH3
1⁰ carbon
1⁰ carbon


CH3
H
C
CH3
CH3
3⁰ carbon


1
1
1
1
1
H
H
CH3
CH3
H
C
C
C
CH2
C
CH3
H
H
H
CH3


H
H
CH3
CH3
2
H–C–C–C–CH2–C–CH3
2
H
H
H
CH3


H
H
CH3
CH3
3
4
H–C–C–C–CH2–C–CH3
H
H
H
CH3

Question

Expanded Structure	Condensed Structure	Skeletal Structure
	$CH_3(CH_2)CCl(CH_3)_2$