

ORGANIC CHEMISTRY : INTRODUCTION

Homologous Series

A group of organic compounds that have...

1. the same general formula
2. they belong to the same functional group
3. they have the same chemical properties
4. their physical properties show a gradation as the carbons increase
5. Successive members differ by a CH_2 or Mr 14

Functional Group

- Is the reactive site of the molecule
- the chemical properties are determined by the functional group

Hydrocarbons

Compounds containing Carbon and Hydrogen only.

Non-Hydrocarbons

Compounds containing atoms in addition to carbon and hydrogen

HYDROCARBONS

Alkanes

Alkenes

Alkynes

NON-HYDROCARBONS

Alcohols $\text{R}-\text{OH}$

Carboxylic Acid $\text{R}-\text{COOH}$

Ester $\begin{matrix} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{O}-\text{R} \end{matrix}$

Aldehydes $\begin{matrix} \text{O} \\ \parallel \\ \text{R}-\text{C}-\text{H} \end{matrix}$

Ketones $\text{R}-\text{C}-\text{R}'$

Amine $\text{R}-\text{NH}_2$

Amino Acids $\text{H}_2\text{N}-\text{CH}-\text{COOH}$

l

R

Alkyl halides $\text{R}-\text{X}$

$\text{X} = \text{halide}$

FORMULAS:

Empirical formula

- Shows the simplest whole number ratio of atoms present in the molecule
- But it does not give the identity of the functional group

Molecular formula

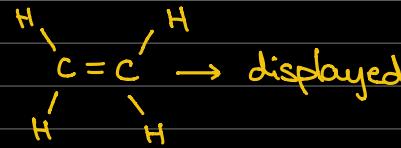
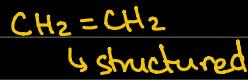
- Shows the actual (total) number of each type of atom present in the molecule
- Does not give the identity of the functional group

Structural formula

- Specifies exactly which atoms are bonded to each other
- i.e. $\text{CH}_3\text{CH}=\text{CH}-\text{CH}_3$

Displayed formula

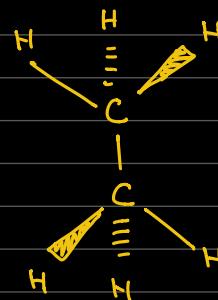
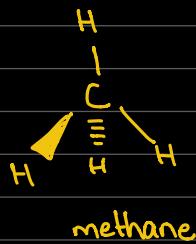
- Is a structural formula that displays / shows all the bonds between the atoms
- Usually drawn using 90° and 180° angles



3D formulae

- Gives a better picture of the shape of the molecule
- Utilizes the 3D bond notation.

i.e.



Skeletal formulas

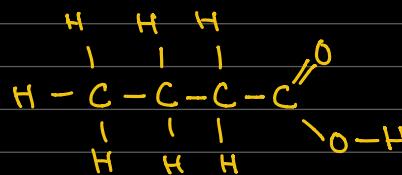
- Used to show structural formulae of large molecules that contain rings and/or long alkyl chains

Rules:

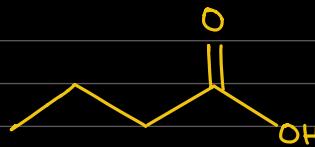
1. carbon and hydrogen are NOT written in the formula
2. each single line represents a single covalent bond between two C atoms
3. where the lines intersect / meet , that point is another carbon
4. where the line ends , there is also a carbon
5. the remaining valencies of C are assumed to be H , unless specified
6. all other atoms are shown with their symbols.



Structural

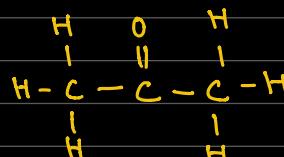
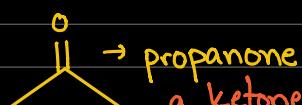
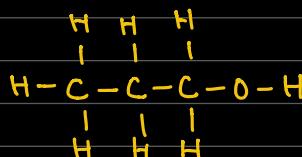


Displayed

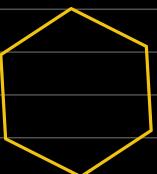
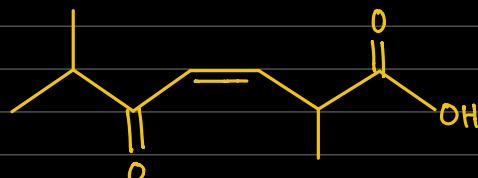
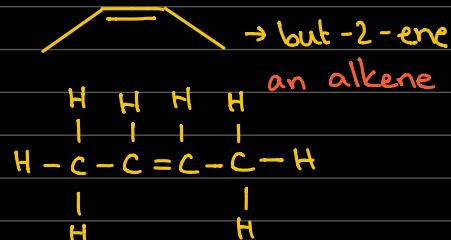
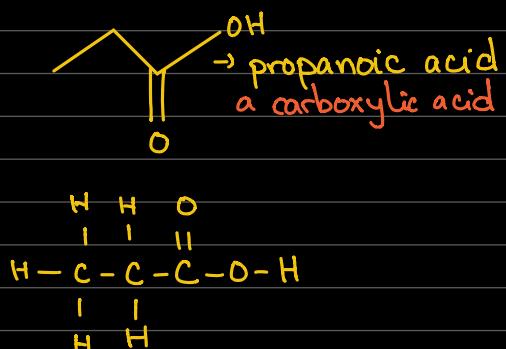
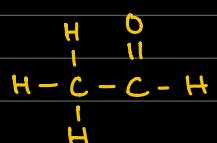
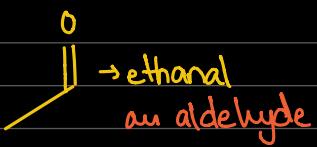


Skeletal

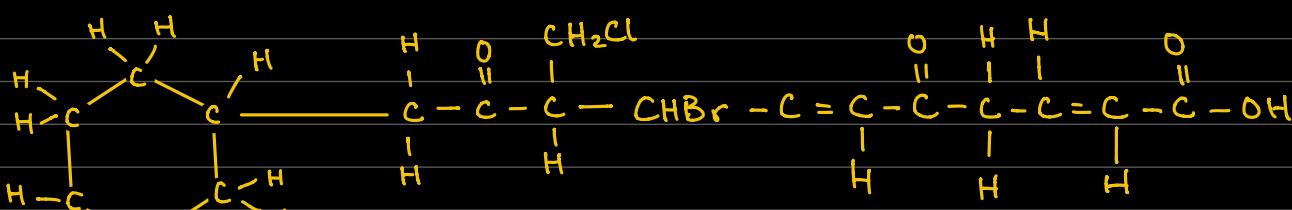
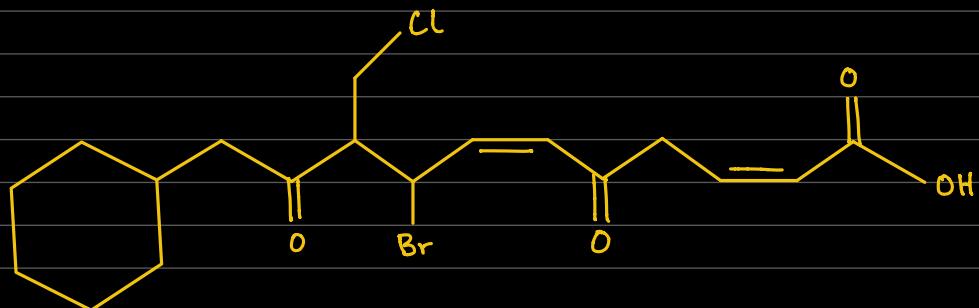
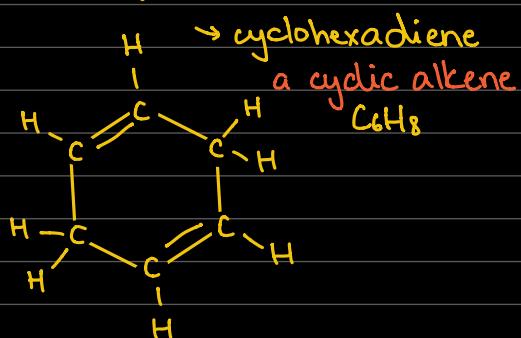
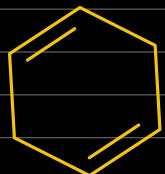
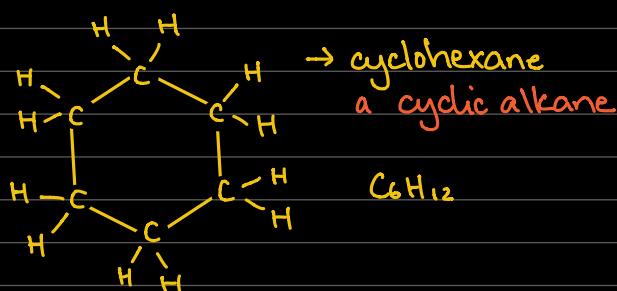
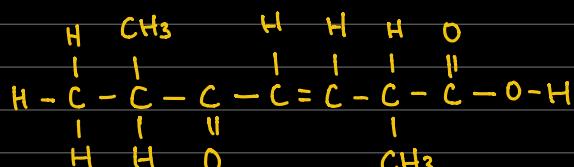
Common Skeletal Formulas (refer to screenshot)

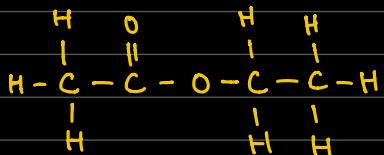
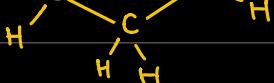


Note: When the H is bonded to a carbon, then we will not write the H symbol.
However, we will have to write the H symbol when it's bonded to a non-carbon atom.

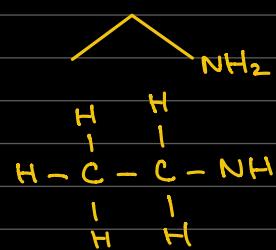


Notes : Cyclic alkanes are isomeric with alkenes
But they are NOT alkenes

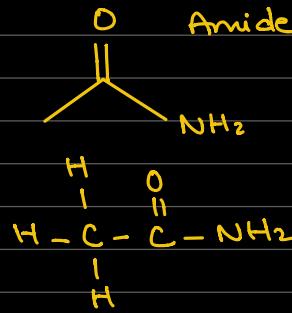




Amine



Amide



First 10 alkanes (general formula = $\text{C}_n\text{H}_{2n+2}$)

Name	Molecular Formula	Structural Formula	Alkyl Group
1. methane	CH_4	CH_4	methyl $- \text{CH}_3$
2. ethane	C_2H_6	CH_3CH_3	ethyl $- \text{CH}_2\text{CH}_3$
3. propane	C_3H_8	$\text{CH}_3\text{CH}_2\text{CH}_3$	propyl $- \text{CH}_2\text{CH}_2\text{CH}_3$
4. butane	C_4H_{10}	$\text{CH}_3(\text{CH}_2)_2\text{CH}_3$	butyl $- \text{CH}_2(\text{CH}_2)_2\text{CH}_3$
5. pentane	C_5H_{12}	$\text{CH}_3(\text{CH}_2)_3\text{CH}_3$	pentyl $- \text{CH}_2(\text{CH}_2)_3\text{CH}_3$
6. hexane	C_6H_{14}	$\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	hexyl $- \text{CH}_2(\text{CH}_2)_4\text{CH}_3$
7. heptane	C_7H_{16}	$\text{CH}_3(\text{CH}_2)_5\text{CH}_3$	heptyl $- \text{CH}_2(\text{CH}_2)_5\text{CH}_3$
8. octane	C_8H_{18}	$\text{CH}_3(\text{CH}_2)_6\text{CH}_3$	octyl $- \text{CH}_2(\text{CH}_2)_6\text{CH}_3$
9. nonane	C_9H_{20}	$\text{CH}_3(\text{CH}_2)_7\text{CH}_3$	nonyl $- \text{CH}_2(\text{CH}_2)_7\text{CH}_3$
10. decane	$\text{C}_{10}\text{H}_{22}$	$\text{CH}_3(\text{CH}_2)_8\text{CH}_3$	decyl $- \text{CH}_2(\text{CH}_2)_8\text{CH}_3$