

Compounds of carbon

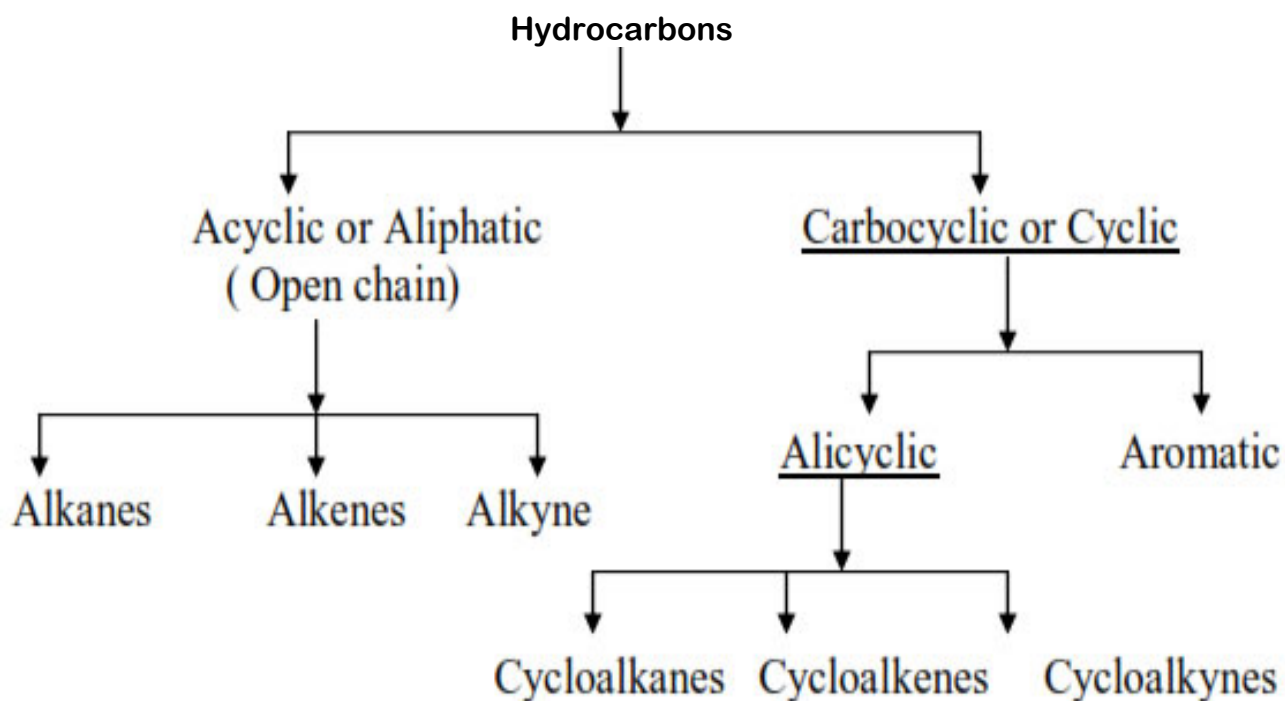
Why carbon can form large number of compound

- Carbon atom has four valence electrons and all available for bonding.
- Covalent bonds can form between carbon carbon atoms to form carbon chain.
- Bonds between carbon atoms can have multiple bonds.

The elements in organic compounds are C H O halogens, N and S

Electron configuration:

Hydrocarbons contain only carbon and hydrogen.



Hydrocarbons (Aliphatic)

	name	Formula	name	formula	name	formula
Number of Carbon	Alkane		Alkene		Alkyne	
1 Meth	Methane					
2						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Alkyl group (Branch)

Molecular formula ;

A formula that indicates the actual number of atoms and type of element in a molecule.

Empirical formula: The formula of a compound that indicates the simplest ratio of atoms of each element in the compound

Structural formula: A formula that represent three dimensional arrangements of atoms in a molecule.

Semi structural formula: A formula that represent the structural formula without giving three dimensional arrangement of atoms in a molecule

Functional group; Atoms or group of element in an organic molecule that largely determine properties and chemical reactions of the molecule

Homologous series: A series of organic compounds that have the same structural features and which the formula of each compound from previous and next differs by CH_2 group.

Homologous series have :

- Same functional group.
- Same general formula
- Similar chemical properties
- Different physical properties (a pattern to their physical properties)

Straight chain molecules

Branched chain molecules

Name of the group of compound	Name of the functional group	Suffix /Prefix	Functional group	Compound Eg:	Structure of the compound
Alkene					
Alkyne					
Alkanol					
Carboxylic acid					
Ester					
Chloroalkane					
Bromoalkane					
Amine					
Amide					
Ketone					
Aldehyde					
Ether					

Rules of IUPAC Naming

1. Select the longest continuous chain of the carbon chain and give the parent name for that carbon chain.
2. Number the carbons in the chain, from either end such that substituents given the lowest numbers possible.
- 3 The substituents are assigned the number of the carbon to which they are attached.
4. If substituent occurs more than once in the molecules, the prefix “di ,tri tetra” etc, are used to indicate the time it occurs.
5. If substituent occurs twice on the same carbon the number of substituent is repeated.
6. If any functional group is present give priority to the functional group when the compound is numbered and the naming.
7. The name of the parent chain preceded by the name and the number of the substituent, arranged in the alphabetic order.

	Class	Suffix Name
 increasing priority	Carboxylic acid	-oic acid
	Ester	-oate
	Amide	-amide
	Nitrile	-nitrile
	Aldehyde	-al
	Ketone	-one
	Alcohol	-ol
	Amine	-amine
	Alkene	-ene
	Alkyne	-yne
	Alkane	-ane
	Ether	—
	Alkyl halide	—

Naming organic compounds

Alkane

Alkene

Alcohol

Acid

Esters

Halogenoalkane

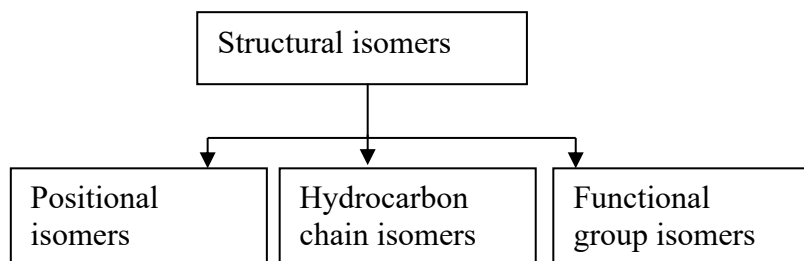
Amine

Ketone

Aldehyde

Isomers

The [molecules](#) with the same [molecular formula](#) but different arrangement of atoms



Positional isomers

Hydrocarbon chain isomers

Functional group isomers

Isomers of C_4H_{10}

Alkanol isomers of C_3H_8O

Alkanol isomers of $C_4H_{10}O$

Alkyl halide isomers of $\text{C}_4\text{H}_8\text{Cl}_2$

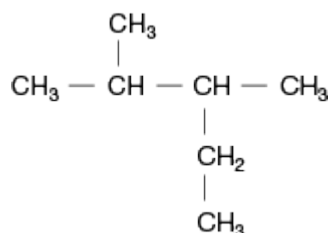
Draw two functional group isomers for the following molecular formulas.

1. $\text{C}_3\text{H}_8\text{O}$

2. $\text{C}_3\text{H}_6\text{O}_2$

3. $\text{C}_3\text{H}_6\text{O}$

1. The name of the organic compound shown is:



- A. 2-methyl-3-ethylbutane
 - B. 1,2-dimethylpentane
 - C. 2,3-dimethylheptane
 - D. 2,3-dimethylpentane.
2. Which of the following does *not* apply to alkanes?
- A. They have the general formula C_nH_{2n} .
 - B. They contain C and H.
 - C. Each has at least one C—C bond.
 - D. They are saturated hydrocarbons.
3. Which of the following compounds is not regarded as an organic compound?
- A. C_5H_{10}
 - B. H_2CO_3
 - C. $\text{C}_2\text{H}_5\text{OH}$
 - D. ClCH_3
4. Which of the following compounds is correctly classified as a tertiary alcohol?
- A. 3-methylbutan-1-ol
 - B. 2-methylbutan-1-ol
 - C. 3-methylbutan-2-ol
 - D. 2-methylbutan-2-ol
5. Which of the following apply to alkenes?
- A. They are saturated hydrocarbons.
 - B. They have the formula C_nH_{2n} .
 - C. Each has a saturated covalent bond.
 - D. They contain C, H and O.
6. The functional groups and suffixes for naming alcohols and carboxylic acids are respectively:
- A. OH, COOH, *-oate*, *-ol*
 - B. COOH, OH, *-ol*, *-oic*
 - C. OH, COOH, *-ol*, *-oic*
 - D. OH, COOH, *-ol*, *-oate*.

7. name of the compound $\text{CH}_3(\text{CH}_2)_5\text{COOH}$ is:

- A. hexanoic acid
- B. heptanoic acid
- C. hexanol
- D. heptanol.

8. The structural arrangement of 2,2-dimethylbutan-1-ol is:

- A.
$$\begin{array}{ccccccc} & \text{H} & & \text{CH}_3 & \text{CH}_3 & & \text{H} \\ & | & & | & | & & | \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{C} - \text{OH} \\ & | & & | & | & & | \\ & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & \text{H} & & \text{H} & & \text{CH}_3 & & \text{H} \\ & | & & | & & | & & | \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} - \text{OH} \\ & | & & | & & | & & | \\ & \text{H} & & \text{H} & & \text{CH}_3 & & \text{H} \end{array}$$
- B.
$$\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{CH}_3 & & \text{H} \\ & | & & | & & | & & | \\ \text{HO} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} - \text{H} \\ & | & & | & & | & & | \\ & \text{H} & & \text{H} & & \text{CH}_3 & & \text{H} \end{array}$$
- C.
$$\begin{array}{ccccccc} & \text{H} & & \text{H} & & & & \\ & | & & | & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{OH} \\ & | & & | & & & & \\ & \text{CH}_3 & & \text{CH}_3 & & & & \end{array}$$
- D.
$$\begin{array}{ccccccc} & \text{H} & & \text{CH}_3 & \text{CH}_3 & & \text{H} \\ & | & & | & | & & | \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{OH} \\ & | & & | & | & & | \\ & \text{H} & & \text{H} & & \text{CH}_3 & & \text{H} \end{array}$$

9. Cycloalkanes have the same molecular formula as:

- A. alkanes
- B. alkenes
- C. alkynes
- D. benzene.

10. Which group of compounds does benzene belong to?

- A. Alkanes
- B. Alkenes
- C. Alkynes
- D. Aromatics

11. In the IUPAC nomenclature system, the name of which of the following would end in -*al*?

- A. An alcohol
- B. An aldehyde
- C. An alkane
- D. A ketone

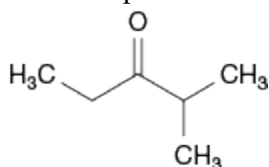
12. The correct name for HCHO is:

- A. methanal
- B. methaldehyde
- C. ethanal
- D. methanone.

13. The ester with the formula $\text{CH}_3\text{COOC}_2\text{H}_5$ is made from:

- A. ethanol and methanoate
- B. ethanol and methanoic acid
- C. ethanol and ethanoate
- D. ethanol and ethanoic acid.

14. This compound is:



- A. an ester
- B. an aldehyde
- C. a ketone
- D. a carboxylic acid.

15. Which type of compound does not contain a carbonyl group?

- A. Ester
- B. Aldehyde
- C. Alcohol
- D. Ketone

16. The common name for the compound $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ is:

- A. propanamine
- B. propylamide
- C. aminobutane
- D. propanamide.

17. The IUPAC name for the compound $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{NH}_2)\text{CH}_3$ is:

- A. 2-methylpentanamine
- B. 4-methylpentan-2-amine
- C. 2-methyl-4-pentanamine
- D. 4-methyl-2-pentanamine.

18. Which two functional groups are never found at the end of a carbon chain?

- A. Alcohol and aldehyde
- B. Ester and aldehyde
- C. Ketone and acid
- D. Ester and ketone

Primary alcohol

Secondary alcohol

Tertiary alcohol

Amines

Primary

Secondary

Tertiary

Draw the structures of the following alcohols, and explain whether they are primary, secondary or tertiary alcohols.

Pentan -2-ol

2-methyl hexan -2-ol

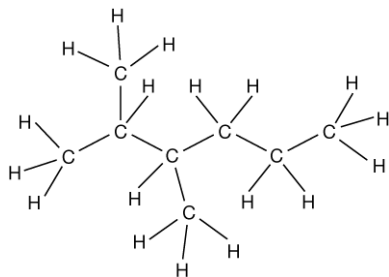
3,3-dimethyl butan -3ol.

Questions

1. Draw the structural formula of the heptane and 2,2,4-trimethylpentane molecules.
2. Identify the homologous series to which each of the following belongs:

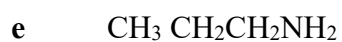
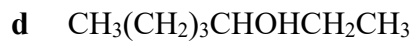
Formula	Homologous series	Name
$\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{Cl}$		
$\text{CH}_3(\text{CH}_2)_2\text{CHCl}(\text{CH}_2)_2\text{CH}_3$		
$\text{CH}_3\text{CHOH}(\text{CH}_2)_4\text{CH}_3$		
$\text{CH}_3(\text{CH}_2)_4\text{COOH}$		
$\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{NH}_2)\text{CH}_3$		
$(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$		
$(\text{CH}_3)_2\text{C}=\text{CHCH}_3$		

3. write the formula of the compound,

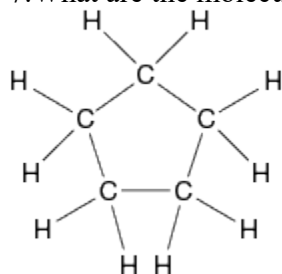


4. Explain why there is only one compound corresponding to the formula C_3H_8 while there are over 70 compounds corresponding to the molecular formula $\text{C}_{10}\text{H}_{22}$.

6. Write the systematic name of:

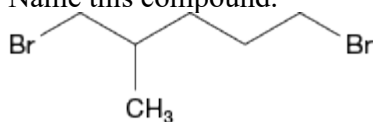


7. What are the molecular formula and name of this compound?



8. Draw the skeletal formula for the compound $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)_2$

9. Name this compound.



10. Draw the structures of cyclohexane and benzene. What are their similarities and differences?