

Topic 10 Organic chemistry(SL)

Syllabus:

10.1 Fundamental of organic chemistry

A homologous series is a series of compounds of the same family, with the same general formula, which differ from each other by a common structural unit.

Full and condensed structural formula

Definition of structural formula

Functional groups are the reactive parts of molecules

The difference between saturated and unsaturated compounds

Benzene is an aromatic, unsaturated hydrocarbon

10.2 Fundamental of group chemistry

Alkanes have low reactivity and undergo free-radical substitution reactions

Alkenes are more reactive than alkanes and undergo addition reactions

Bromine water can be used to distinguish between alkenes and alkanes

Alcohols undergo nucleophilic substitution reactions with acids and some undergo oxidation reactions

Halogenoalkanes are more reactive than alkanes. They can undergo nucleophilic substitution reactions.

A nucleophilic is an electron-rich species containing a lone pair that it donates to an electron-deficient carbon.

10.1 Fundamental of organic chemistry

(A) Homologous series

Organic compounds are classified into “families” of compounds known as **homologous series**.

The followings are the main features of homologous series.

- Same general formula
- Successive members differ by a $-\text{CH}_2-$ group
- Similar chemical properties
- Gradual change in physical properties

Alkane		Boiling point / °C
Methane	CH ₄	-160
Ethane	C ₂ H ₆	-89
Propane	C ₃ H ₈	-41
Butane	C ₄ H ₁₀	-1
Pentane	C ₅ H ₁₂	35

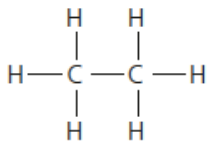
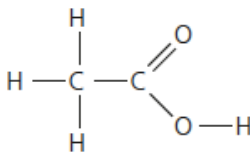
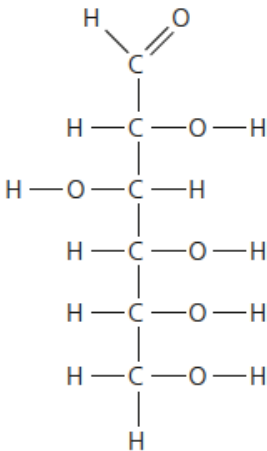
(B) Empirical, molecular and structural formulas for organic compounds

Empirical formula of a compound is the simplest whole number ratio of the atoms it contains.

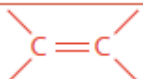
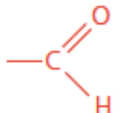
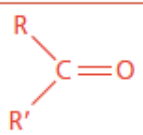
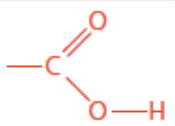
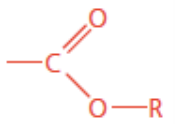
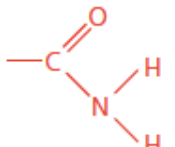
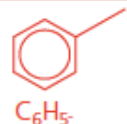
Molecular formula of a compound is the actual number of atoms of each element present in a molecule.

For Glucose, C₆H₁₂O₆ is the molecular formula and CH₂O is the empirical formula.

Structural formula is a representation of the molecule showing how the atoms are bonded to each other.

Compound	Ethane	Ethanoic acid	Glucose
Empirical formula	CH ₃	CH ₂ O	CH ₂ O
Molecular formula	C ₂ H ₆	C ₂ H ₄ O ₂	C ₆ H ₁₂ O ₆
Full structural formula			
Condensed structural formula	CH ₃ CH ₃	CH ₃ COOH	CHO(HCOH) ₄ CH ₂ OH

(C) Functional group

Class	Functional group	Name of functional group	Suffix in IUPAC name	Example of compound	General formula
alkane			-ane	C_2H_6 , ethane	C_nH_{2n+2}
alkene		alkenyl	-ene	$H_2C=CH_2$, ethene	C_nH_{2n}
alkyne	$—C\equiv C—$	alkynyl	-yne	$HC\equiv CH$, ethyne	C_nH_{2n-2}
alcohol	$—OH$	hydroxyl	-anol	C_2H_5OH , ethanol	$C_nH_{2n+1}OH$
ether	$R—O—R'$	ether	-oxyalkane	$H_3C—O—C_2H_5$, methoxyethane	$R—O—R'$
aldehyde		aldehyde (carbonyl)	-anal	C_2H_5CHO , propanal	$R—CHO$
ketone		carbonyl	-anone	CH_3COCH_3 , propanone	$R—CO—R'$
carboxylic acid		carboxyl	-anoic acid	C_2H_5COOH , propanoic acid	$C_nH_{2n+1}COOH$
ester*		ester	-anoate	$C_2H_5COOCH_3$, methyl propanoate	$R—COO—R'$
amide		carboxamide	-anamide	$C_2H_5CONH_2$, propanamide	
amine	$—NH_2$	amine	-anamine	$C_2H_5NH_2$, ethanamine	
nitrile	$—C\equiv N$	nitrile	-anenitrile	C_2H_5CN , propanenitrile	
arene	 C_6H_5-	phenyl	benzene	$C_6H_5CH_3$, methyl benzene	

MCQ

1. Which properties are features of a homologous series?

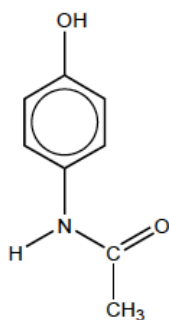
- I. Same general formula
- II. Similar chemical properties
- III. Graduated change in physical properties

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

2. What is the general formula of the alkyne series?

- A. C_nH_n
- B. C_nH_{2n-2}
- C. C_nH_{2n}
- D. C_nH_{2n+2}

3. Which functional group is present in paracetamol?



- A. Carboxyl
- B. Amino
- C. Nitrile
- D. Hydroxyl

4. Which statement is correct for members of the same homologous series?
- A. They have the same empirical formula and a gradual change in chemical properties.
 - B. They have the same empirical formula and a gradual change in physical properties.
 - C. They have the same general formula and a gradual change in chemical properties.
 - D. They have the same general formula and a gradual change in physical properties.
5. Which compound is an amide?
- A. $\text{CH}_3\text{COOCH}_3$
 - B. CH_3CONH_2
 - C. CH_3NH_2
 - D. $\text{CH}_2(\text{NH}_2)\text{COOH}$
6. Which of the following pairs are members of the same homologous series?
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{CHO}$
 - B. $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
 - C. CH_3COCH_3 and $\text{CH}_3\text{CH}_2\text{COOH}$
 - D. $\text{CH}_3\text{COCH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CHO}$
7. Which of the structures below is an aldehyde?
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
 - B. $\text{CH}_3\text{CH}_2\text{COCH}_3$
 - C. $\text{CH}_3\text{CH}_2\text{COOCH}_3$
 - D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$