



Term 2 2020

Basic organic molecules

WORKSHEET 1 Grade 12



TECHNICAL SCIENCES

NAME:
SCHOOL:
TEACHER:
BASIC ORGANIC MOLECULES: WORKSHEET 1
BACKGROUND INFORMATION
CONCEPTS
Organic molecules as molecules containing carbon atoms.
Hydrocarbons are organic compounds that consist of hydrogen and carbon only
Homologous series: A series of organic compounds that can be described by the same general formula and where each member differs from the next by a CH₂ group .
Functional group: An atom or a group of atoms that determine the chemistry of a molecule OR An atom or a group of atoms that determine(s) the physical and chemical properties of a group of organic compounds.
Saturated hydrocarbons contain only single covalent bonds between carbon atoms .
Unsaturated compounds contain covalent double or triple bonds between the carbon atoms .
Structural isomers are organic molecules with the same molecular formula, but different structural formulae

Types of structural isomers are **chain isomers, positional isomers and functional isomers**

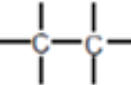

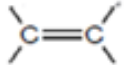
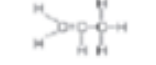
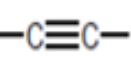

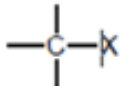

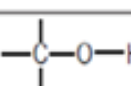

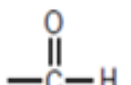

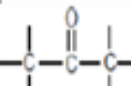

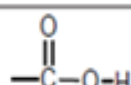

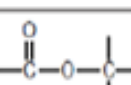

Chain isomers have the **same molecular formula**, but different types of **chains**.

Positional isomers have the same molecular formula, but **different positions** of the **side chain or substituents or functional groups** on the parent chain.

Functional isomers have the **same molecular formula**, but **different functional groups**

HOMOLOGOUS SERIES AND FUNCTIONAL GROUPS

Homologous series	Structure of functional group	
	Structure	Name/Description
Alkanes	$\begin{array}{c} & \\ -C & -C- \\ & \end{array}$	Only C-H and C-C single bonds
Alkenes	$\begin{array}{c} \diagdown & \diagup \\ C & =C \\ \diagup & \diagdown \end{array}$	Carbon-carbon double bond
Alkynes	$-C \equiv C-$	Carbon-carbon triple bond
Haloalkanes	$\begin{array}{c} \\ -C-X \\ \\ (X = F, Cl, Br, I) \end{array}$	Halogen atom bonded to a saturated C atom
Alcohols	$\begin{array}{c} \\ -C-O-H \\ \end{array}$	Hydroxyl group bonded to a saturated C atom
Aldehydes	$\begin{array}{c} O \\ \\ -C-H \end{array}$	Formyl group
Ketones	$\begin{array}{c} & O & \\ -C & -C & -C- \\ & & \end{array}$	Carbon=O group bonded to two C atoms
Carboxylic acids	$\begin{array}{c} O \\ \\ -C-O-H \end{array}$	Carboxyl group
Esters	$\begin{array}{c} O & \\ & \\ -C & -O-C- \\ & \end{array}$	-

Homologous series	General formula	Functional Group	Suffix	Example name	Structural formula	Molecular formula	
Hydrocarbons	Alkanes	C_nH_{2n+2}		-ane	propane		C_3H_8
	Alkenes	C_nH_{2n}		-ene	propene		C_3H_6
	Alkynes	C_nH_{2n-2}		-yne	propyne		C_3H_4
Haloalkanes/ alkyl halides	$C_nH_{2n+1}X$ (X = F, Cl, Br or I)		-ane	2-bromopropane		C_3H_7Br	
Alcohols	$C_nH_{2n+1}OH$		-ol	propan-2-ol		C_3H_7OH	
Aldehydes	$C_nH_{2n}O$ n = 1, 2, ...		-al	propanal		C_3H_6O	
Ketones	$C_nH_{2n}O$ n = 3, 4, ...		-one	propanone		C_3H_6O	
Carboxylic acids	$C_nH_{2n}O_2$ n = 1, 2, ...		-oic acid	propanoic acid		$C_3H_6O_2$	
Esters	$C_nH_{2n}O_2$ n = 2, 3, ...		-oate	ethyl methanoate		$C_3H_6O_2$	

IUPAC naming and formulae

- Write down the IUPAC name when given the structural formula for alkanes, alkenes, alkynes, alkylhalides (haloalkanes), aldehydes, ketones, alcohols, carboxylic acids and esters, restricted to one functional group per compound, except for haloalkanes. For haloalkanes, a maximum two functional groups per molecule.

- Write down the structural formula when given the IUPAC name for alkanes, alkenes, alkynes, alkylhalides (haloalkanes), aldehydes, ketones, alcohols, carboxylic acids and esters.
- Identify alkyl substituents (methyl- and ethyl-) in a chain to a maximum of TWO alkyl substituents on the parent chain.
- When naming haloalkanes, the halogen atoms do not get preference over alkyl groups – numbering should start from the end nearest to the first substituent, either the alkyl group or the halogen. In haloalkanes, where e.g. a Br and a Cl have the same number when numbered from different ends of chain, Br gets alphabetical preference. When an alkyl group is a substituent in a molecule, it should be treated as a substituent.

When writing IUPAC names, substituents appear as prefixes written alphabetically (bromo-, chloro-, ethyl-, methyl-), ignoring the prefixes di- and tri-.

ACTIVITIES		
Activity 1		
With the use of table below, for the following homologous series, write down the structural formulae for the functional group and general formulae of the following organic compounds		
Homologous series	Structural formula for the functional group	General formula
Alkanes	1.1	1.10
Alkenes	1.2	1.11
Alkynes	1.3	1.12
Alkyl halides	1.4	1.13
Aldehydes	1.5	1.14
Ketones	1.6	1.15

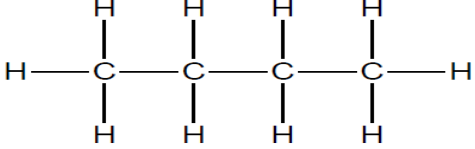
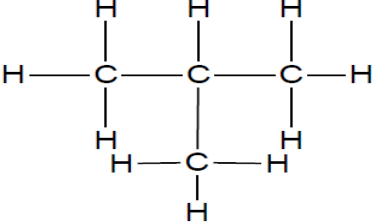
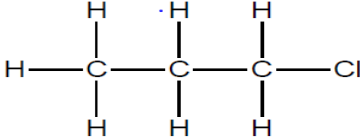
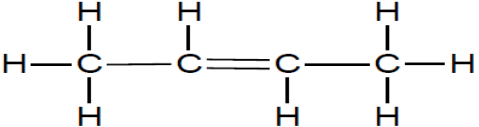
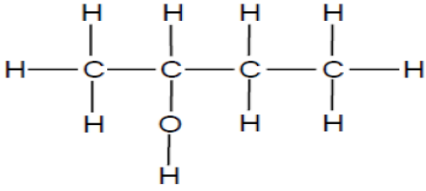
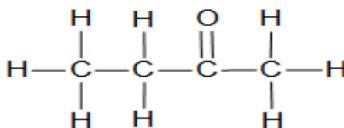
Alcohols	1.7	1.16
Carboxylic acids	1.8	1.17
Esters	1.9	1.18
Marks	2 x9 =18	1x9=9
[27]		

Activity 2			
Consider the organic compounds provided in the table, draw their structural and molecular formulae as well as homologous series to which they belong.			
Name of organic compound	Structural formula	Molecular formula	Homologous series
Butane	2.1	2.8	2.15
2-methylpropane	2.2	2.9	2.16
Hexane	2.3	2.10	2.17
Pentyne	2.4	2.11	2.18
Butylethanoate	2.5	2.12	2.19

Heptanal	2.6	2.13	2.20
2-methylpropan-ol	2.7	2.14	2.21
Marks	2x7 = 14	1x7=7	1x7=7
			[28]

Activity 3

The table shows structures of 6 organic organic compounds, study them and answer questions that follow.

A		D	
B		E	
C		F	

3.1	Write down the IUPAC names of all the compounds in the table. Write down A-F and next to each the IUPAC name of the compound.	(6)
3.2	From the table, write down the letter which represent the following:	
3.2.1	Chain isomer of compound A	(2)
3.2.2	Unsaturated Hydrocarbon	(1)

	3.2.3	The ketone	(1)
	3.2.4	The compound with hydroxyl group	(1)
	3.2.5	The compound with carbonyl group	(1)
3.3.	Draw the structures of the following compounds		
	3.3.1	The positional isomer of compound B	(2)
	3.3.2	The functional isomer of compound F	(2)
			[16]

ACTIVITY 4			
4.1	Define the following terms		
	4.1.1	Organic compound	(2)
	4.1.2	Hydrocarbon	(2)
	4.1.3	Homologous series	(2)
	4.1.5	Functional group	(2)
	4.1.6	Chain isomer	(2)

4.2	Distinguish between the following		
	4.2.1	Saturated and unsaturated hydrocarbons	(4)
	4.2.2	Positional and functional isomer	(4)
			[18]

TOTAL [89]

YOUR TOTAL