Benha University Faculty of Science Chemistry Department	كلية العلوم	Date : 21 / 1 / 2020 Req. time part(II) : 1 hr.

Final Exam. Of General Chem 2 (105 CH) 1ST Term for 1st year students

Part (A) : (Organic chemistry): *(Prof. Dr. Wagdy I. El-Dougdoug)*

Answer The Following questions:

Q1: Select the more correct answer from the following: (11x 1= 11 Mark)

1. How many structural isomers does C_4H_8 have?

A. 3 C. 5

B. 4 D. 6

2. Which of the following compounds are structural isomers of C_5H_{10}?

(1) 2-methylbut-2-ene (2) 3-methylbut-1-ene (3) Pent-1-ene

A. (1) and (2) only C. (2) and (3) only

B. (1) and (3) only **D. (1), (2) and (3)**

3. Which of the following compounds are structural isomers of C_4H_8O?

(1) Butanal (2) 2-methylpropanal (3) Butanone

A. (1) and (2) only C. (2) and (3) only

B. (1) and (3) only **D. (1), (2) and (3)**

4. Which of the following compounds has/have a pair of geometrical isomers?

(1) $CH_3CH=CH_2$ (2) $CH_3OCCH=CHCOCH_3$ (3) $CH_2BrCH=CHCH_2Cl$

A. (1) only C. (1) and (3) only

B. (2) only **D. (2) and (3) only**

5. Which of the following compounds could exhibit geometrical isomerism?

(1) CHCl=CHBr (2) $(CH_3)_2C=CH_2$ (3) $CH_3CH=CHCH_3$

A. (1) and (2) only C. (2) and (3) only

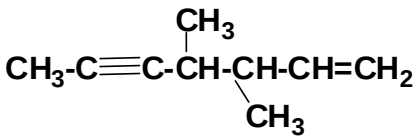
B. (1) and (3) only D. (1), (2) and (3)

6. Which of the following compounds is optically active?

A. $CH_3CH=CHCH_3$ C. $CH_3CH_2COCH_3$

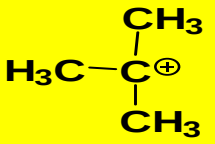
B. **$CH_2=CHCHBrCH_3$** D. $CH_3CH_2CHClCH_2CH_3$

7. What is the total number of sigma bonds result from linear overlapping between sp2 of carbon with sp2 hybrid orbital of another adjacent carbon the following compound?

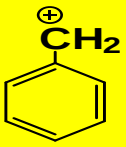


A. 3 B. 2 C. 1 D. 12

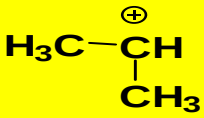
8. **Which of the following the correct arrangement for stabilized carbonium ions?**



(i)



(ii)

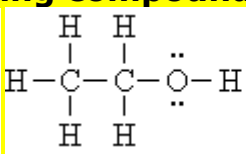


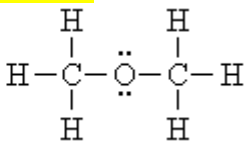
(iii)

(iv)

A. (i) > (ii) > (iii) > (iv)
B. (ii) > (i) > (iii) > (iv)
C. (ii) > (i) > (iv) > (iii)
D. (ii) > (iv) > (i) > (iii)

9. **How are the following compounds related?**





A. Isoelectronic species B. Isotopes C. Position isomers **D. Functional Isomers**

10. **Which of the following compounds is optically active?**

A. $CH_3CH=CHCH_3$
B. $CH_2=CHCHBrCH_3$
C. $CH_3CH_2COCH_3$
D. $CH_3CH_2CHClCH_2CH_3$

11. Which of the following has highest acidity?

A. Br- CH_2 COOH
B. F-CH_2COOH
C. I-CH_2COOH
D. Cl-CH_2 COOH

Q2: a. Write the short note on different types of isomers (14 marks).

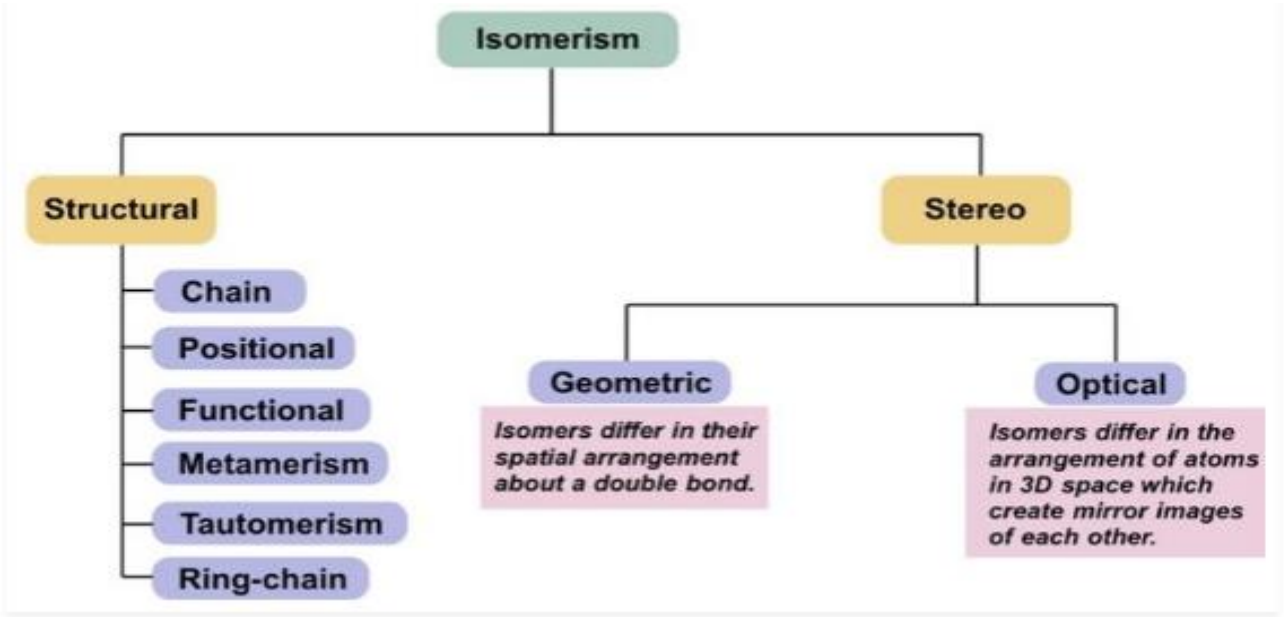
Isomerism

Isomerism is the phenomenon in which more than one compounds have the same chemical formula but different chemical structures. Chemical compounds that have identical chemical formulae but differ in properties and the arrangement of atoms in the molecule are called **isomers**. Therefore, the compounds that exhibit isomerism are known as isomers. The

word “isomer” is derived from the Greek words “isos” and “meros”, which mean “equal parts”. This term was coined by the Swedish chemist Jacob Berzelius in the year 1830.

Types

There are two primary types of isomerism, which can be further categorized into different subtypes. These primary types are **Structural Isomerism** and **Stereoisomerism**. The classification of different types of isomers is illustrated in the following:



（1） Structural isomerism

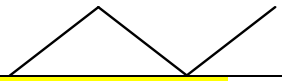
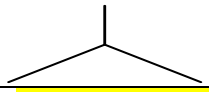
If the compounds with the **same molecular formula** have their atoms attached in different orders, they have **different structures** and are said to be **structural isomers** of each other.

1. Structural isomers containing the same functional group

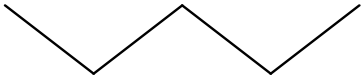
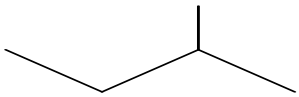
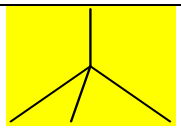
Chain isomerism

The structural isomers differ in the arrangement of the carbon atoms. In general, a branched chain isomer has a lower boiling point than a unbranched chain isomer; the more numerous the branches, the lower the boiling point. This is because with branching the shape of the molecule tends to approach that of a sphere; and as this happens the surface area decreases, with the result that the van der Waals' forces become weaker and are overcome at a lower temperature.

Example 1 : Structural isomers for C_4H_{10}

	
butane b.p. 0℃	***methylpropane b.p. -12℃***

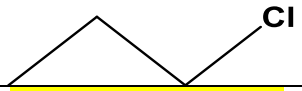
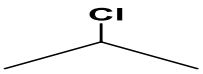
Example 2 : Structural isomers for C_5H_{12}

		
pentane b.p. 3℃	**methylbutane b.p. 28℃**	**dimethylpropane b.p. 9.5℃**

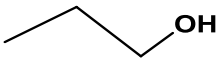
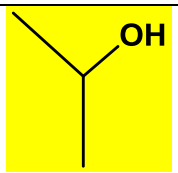
Position isomerism

Structural isomers have the same carbon skeleton and belong to the same homologous series, but differ in the position of the functional group.

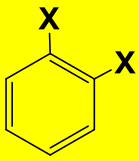
Example 1 : Structural isomers for chloropropane, C_3H_7Cl

	
1-chloropropane	***2-chloropropane***

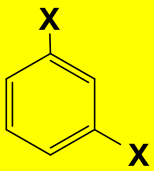
Example 2 : Structural isomers for propanol, C_3H_7OH

	
propan-1-ol	***propan-2-ol***

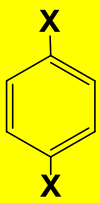
Example 3 : Structural isomers for disubstituted benzene, $C_6H_4X_2$



o- Dihalobenzene

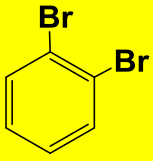


m- Dihalobenzene

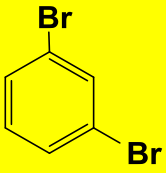


p- Dihalobenzene

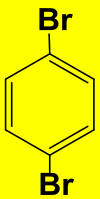
Example 4 : Structural isomers for trisubstituted benzene, e.g. $C_6H_3Br_3$



o- Dibromobenzene



m- Dibromobenzene



p- Dibromobenzene

2. Structural isomers containing different functional groups

Functional group isomerism

The structural isomers have the same molecular formula but belong to different homologous series, i.e. they differ in the nature of the functional group.

Example 1 : Alcohols and ethers

Two structural formulae can be written for the molecular formula **C_2H_6O**. Methoxymethane is an ether and exists as a gas that has been used as an aerosol propellant and a refrigerant. Ethanol is an alcohol and exist as a liquid that is used as a solvent and in alcoholic beverages.

CH_3-O-CH_3 **CH_3-CH_2-OH**

methoxymethane b.p. - 25 ℃ *ethanol b.p. 78 ℃*

Example 2 : Aldehydes and ketones, e.g. **C_3H_6O**

CH_3-CH_2- CHO **CH_3-CO-CH_3**

propanal (an aldehyde *propanone (a ketone)*

Example 3 : Carboxylic acids and esters, e.g. **$C_3H_6O_2$**

CH_3-CH_2 COOH **CH_3-COOCH_3** **HCOO CH_2-CH_3**

propanoic acid **methyl ethanoate (an ester)** **ethyl methanoate (an ester)**

Example 4 : Acyclic and cyclic hydrocarbons

All acyclic alkanes have the general formula C_nH_{2n+2} , where n = the number of carbon atoms in the molecule. The presence of a ring or a double bond

reduces the number of hydrogen in the formula by two for each double bond or ring; that is, a compound with the general formula C_nH_{2n} contains either one double bond or one ring. **For example**, structural isomers for C_4H_8 are :

- **CH_3-CH=CH-CH_3** - **CH_2=CH_2-CH_2-CH_3**

2） Stereoisomerism

In **stereoisomerism** the isomers have the same molecular formula and the same structural formula, but differ in the spatial arrangement of their groups. There are two kinds of stereoisomerism : geometrical isomerism and enantiomerism.

1. Geometrical isomerism

Geometrical isomers are compounds with the same molecular and structural formula, but differ in the spatial arrangement of their groups. They are not mirror images and usually arise from the rigidity of C=C bond in organic compounds.

Rigidity of C=C bond leading to cis/trans isomers

In a molecule of ethene, the two carbon atoms are linked by a σ bond and a π bond.

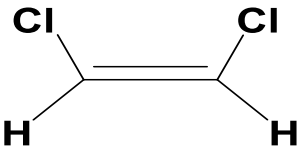
The shape of the π orbital ensures that:

(i) all six atoms in the molecule lie in one plane,

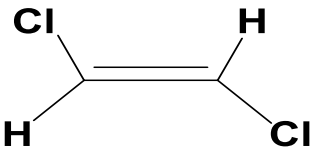
(ii) the carbon atoms cannot be rotated relative to one another about the bond axis without breaking the π bond. This would require energy (about 250 $kJmol^{-1}$) in the form of heat or radiation.

Because of this restriction, an alkene substituted on different sides of the double bond do not interconvert, but may have two possible structures differing in the spatial arrangement of the substituted atoms or groups.

Example 1 : Geometrical isomers for 1,2-dichloroethene



Cis- 1,2-Dichloroethene



Trans-1,2-Dichloroethene

(*geometrical isomers*)

In the cis form, the two chlorine atoms lie on the same side of the C=C axis; in the trans form they lie on opposite sides. They differ only in the spatial arrangement of the atoms around C=C bond.

2. Enantiomerism

Enantiomers are compounds with the same molecular and structural formula, but differ in the spatial arrangement of their groups. They are **non-superimposable mirror images** and usually arise from the presence of chiral carbon atom in organic compounds.

Chiral carbon atom is a saturated carbon atom with four different attached atoms or groups.

b. Define chemical reaction and write short note on the different types of reactions in organic chemistry? (15 mark)

substances, the reactants, are converted to one or more different substances, the products. Substances are either **chemical** elements or compounds. A **chemical reaction** rearranges the constituent atoms of the reactants to create different substances as products

The basic organic chemistry reaction types are:

1-addition reactions,

2-elimination reactions,

3- substitution reactions,

4-pericyclic reactions,

5- rearrangement reactions,

6- photochemical reactions and

7-redox reactions. In organic synthesis

مع خالص تمنياتى بالتوفيق والنجاح.