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CHEMISTRY

ORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	OPTICAL ISOMERISM
PAPER TYPE:	SOLUTION - 4
TOTAL QUESTIONS	10
TOTAL MARKS	/40

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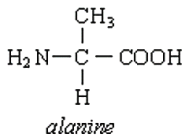
Optical Isomerism - 4

1.

(a)



alanine

Systematic name for alanine:

2-amino(e) propanoic acid

(1)

(b)

Stereoisomers are molecules with the same structural formula but with bonds, atoms, or groups arranged differently in three-dimensional space. They have identical connectivity of atoms but exhibit distinct spatial arrangements.

Stereoisomers have the same molecular formula and structural formula, but their spatial orientation in 3D space varies.

(2)

(c)

To distinguish between stereoisomers:

Plane-Polarized Light:

Measure the effect of each stereoisomer on plane-polarized light. Enantiomers rotate plane-polarized light equally but in opposite directions. This property, known as optical activity, can be observed using a polarimeter.

Opposite Rotations:

Enantiomers rotate plane-polarized light equally but in opposite directions. One enantiomer rotates light clockwise (dextrorotatory), while the other rotates it counterclockwise (levorotatory).

(2)

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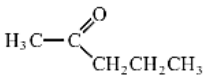
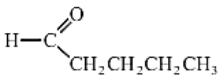
2. Consider the following pair of isomers



E

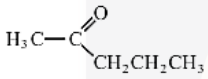


F

(a)

Name of compound E:

pentan-2-one or 2-pentanone



E

(1)

(b) I

Reagent:

Tollen's or Fehling's

Observation with E: (a ketone)

no reaction

Observation with F: (an aldehyde)

silver mirror or red ppt

Or

Reagent:

Fehlings or Benedicts

Observation with E: (a ketone)

no reaction

Observation with F: (an aldehyde)

red ppt

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(3)

3.

Optical isomerism a problem for the drug industry because sometimes, only one enantiomer is effective due to enzyme's active site/cell receptors being three dimension.

(2)

4.

(a)

A racemic mixture is a 1:1 mixture of two enantiomers, which are mirror images of each other. This mixture does not exhibit optical activity because the effects of the two enantiomers cancel each other out.

Why a Racemic Mixture is Formed in This Reaction

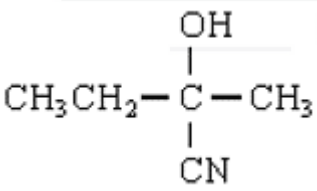
A racemic mixture is formed because the reaction creates a chiral center in compound T.
The intermediate formed during the reaction is planar, allowing the reagent to attack from either side with equal probability, resulting in equal amounts of both enantiomers.

(3)

(b)

Reagent S: HCN or (KCN / HCl or H_2SO_4)

Compound T:



Compound U:

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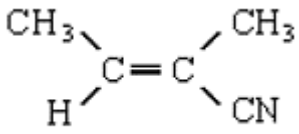
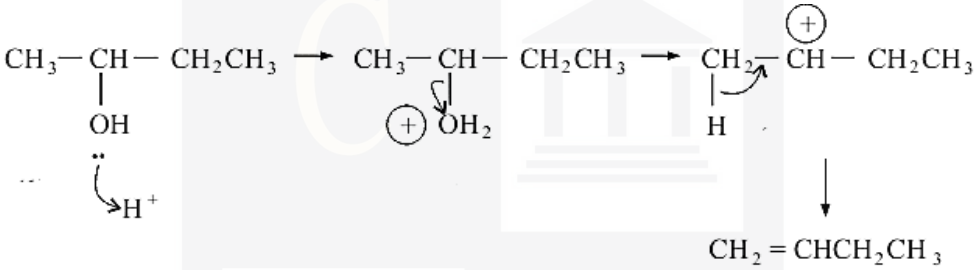


(3)

5.

(a)

Mechanism for the dehydration of butan-2-ol into but-1-ene:



(3)

(b)

But-1-ene does not show geometrical isomerism because one of the carbons in the double bond has two identical substituents (hydrogen atoms).

$CH_3–CH_2–CH=CH_2$

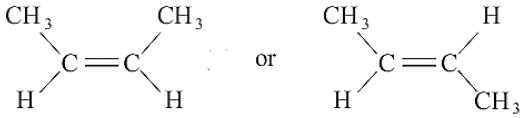
For geometrical isomerism to occur, each carbon in the double bond must have two different groups attached.

In but-1-ene, the second carbon (CH_2) has two hydrogen atoms, preventing the formation of cis and trans isomers.

(2)

(c)

Following is the structure of geometrical isomers and its full name:



cis but-2-ene trans but-2-ene

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(2)

6.

Polarimeters used to identify which enantiomer is present, the purity of the sample, the concentration of the sample etc by using a plane polarized light.

(2)

7. **B**

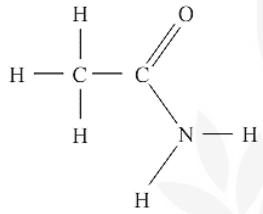
(1)

8.

Name of the C_2H_5ON:

Ethanamide

Graphical formula of the amide C_2H_5ON:



(2)

9.

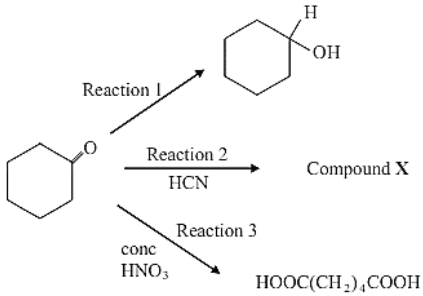
(a)

Suitable reagent for Reaction 1:

$NaBH_4$

(1)

(b)



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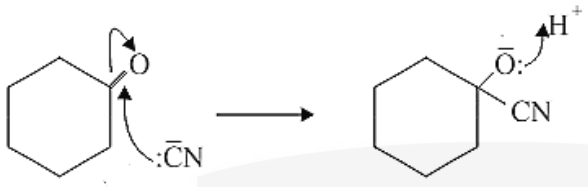
Name of mechanism:
Nucleophilic addition

Mechanism for Reaction 2:



(4)

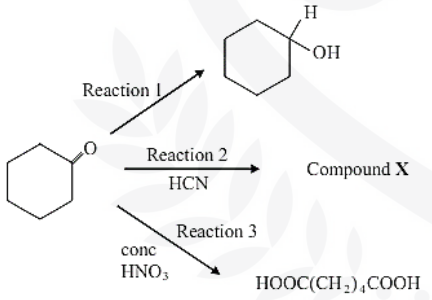
(c)

Name of the organic product of Reaction 3:

Hexanedioic acid

(1)

(d)



For reaction 3

$C_6H_{10}O \longrightarrow C_6H_{10}O_4$

Mr of $C_6H_{10}O$ = 98

Mr of $C_6H_{10}O_4$ = 146

Moles of cyclohexanone:

$\frac{2.40\text{ g}}{98\text{ g/mol}} = 0.0245\text{ mol}$

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Mass = 0.0245 mol × 146 = 3.58 g

(4)

10. D

(1)

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