A LEVEL CHEMISTRY

TOPIC 16 – ALDEHYDES, KETONES AND OPTICAL ISOMERISM

TEST

Answer all questions

Max 50 marks

Name ……..
Mark ……../50 ……....% Grade ……

SECTION A

1. (a) (i) Give a suitable reagent and state the necessary conditions for the conversion of propan-2-ol into propanone. Name the type of reaction.

Reagent .....

Conditions .....

Type of reaction .....

(ii) Propanone can be converted back into propan-2-ol. Give a suitable reagent and write an equation for this reaction.
(Use [H] to represent the reagent in your equation.)

Reagent .....

Equation

.....

(5)

(b) Propanal is an isomer of propanone.

(i) Draw the structure of propanal.

(ii) A chemical test can be used to distinguish between separate samples of propanone and propanal. Give a suitable reagent for the test and describe what you would observe with propanone and with propanal.

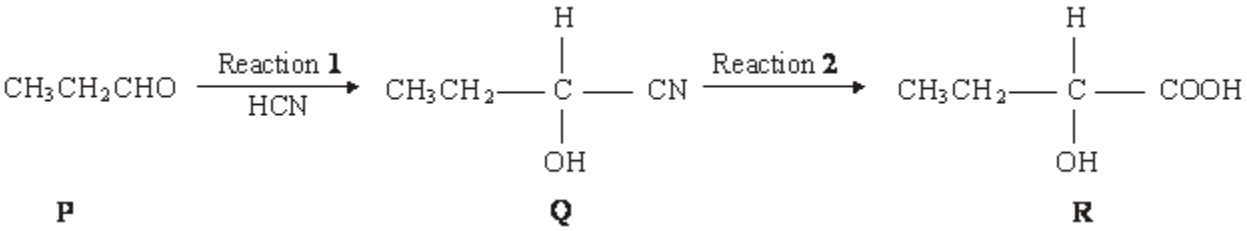
Test reagent .....

Observation with propanone .....

Observation with propanone .....

(4)
(Total 9 marks)

2. Consider the sequence of reactions below.



P **Q** **R**

(a) Name and outline a mechanism for Reaction **1**.

Name of mechanism .....

Mechanism

(5)

(b) Name compound **Q**

.....

(1)

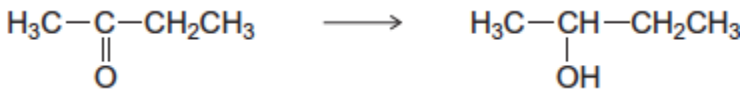
(c) Draw the structure of the main organic product formed in each case when **R** reacts separately with the following substances:

(ii) acidified potassium dichromate(VI);

(iii) concentrated sulphuric acid in an elimination reaction.

(2)
(Total 8 marks)

3. The reducing agent in the following conversion is $NaBH_4$



(i) Name and outline a mechanism for the reaction.

Name of mechanism .....

Mechanism

(5)

(ii) By considering the mechanism of this reaction, explain why the product formed is optically inactive.

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(3)
(Total 8 marks)

4. (a) **P**, **Q** and **R** have the molecular formula C_6H_{12}

All three are branched-chain molecules and none is cyclic.
P can represent a pair of optical isomers.
Q can represent a pair of geometrical isomers.
R can represent another pair of geometrical isomers different from **Q**.

Draw one possible structure for one of the isomers of each of **P**, **Q** and **R**.

*Structure of **P***

*Structure of **Q***

*Structure of **R***

(3)

(b) Butanone reacts with reagent **S** to form compound **T** which exists as a racemic mixture. Dehydration of **T** forms **U**, C_5H_7N, which can represent a pair of geometrical isomers.

(i) State the meaning of the term *racemic mixture* and suggest why such a mixture is formed in this reaction.

Racemic mixture .....

.....

Explanation.....

.....

.....

(ii) Identify reagent **S**, and draw a structural formula for each of **T** and **U**.

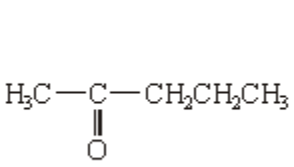
*Reagent **S*** .....

*Compound **T***

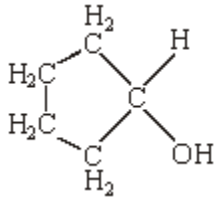
*Compound **U***

(6)
(Total 9 marks)

5. Compounds **C** and **D**, shown below, are isomers of $C_5H_{10}O$



C



D

(a) Name compound **C**.

.....

(1)

(b) Use **Table 2** on the Data Sheet to help you to answer this question.

(i) Suggest the wavenumber of an absorption which is present in the infra-red spectrum of **C** but not in that of **D**.

.....

(ii) Suggest the wavenumber of an absorption which is present in the infra-red spectrum of **D** but not in that of **C**.

.....

(2)

(c) Identify a reagent that you could use to distinguish between **C** and **D**. For each of **C** and **D**, state what you would observe when the compound is treated with this reagent.

Reagent .....

Observation with **C** .....

Observation with **D** .....

(3)

(d) Compound **E**, $CH_3CH_2CH_2CH_2CHO$, is also an isomer of $C_5H_{10}O$

Identify a reagent which will react with **E** but not with **C** or **D**. State what you would observe when **E** is treated with this reagent.

Reagent .....

Observation with **E** .....

(2)
(Total 8 marks)

SECTION B

6. Which one of the following reactions involves nucleophilic addition?

A $CH_3CH = CH_2 + HBr \rightarrow CH_3CHBrCH_3$

B $CH_3CH_2CH_3 + Cl_2 \rightarrow CH_3CHClCH_3 + HCl$

C $CH_3CH_2CH_2Br + NaOH \rightarrow CH_3CH_2CH_2OH + NaBr$

D $CH_3CH_2CHO + HCN \rightarrow CH_3CH_2CH(OH)CN$

(Total 1 mark)

7. Which one of the following isomers is not oxidised under mild reaction conditions?

A $(CH_3)_2CHCH(OH)COCH_3$

B $(CH_3)_2C(OH)CH_2COCH_3$

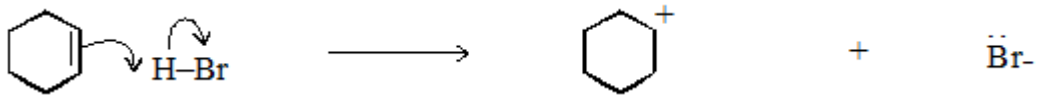
C $(CH_3)_2CHCH(OH)CH_2CHO$

D $(CH_3)_2C(OH)CH_2CH_2CHO$

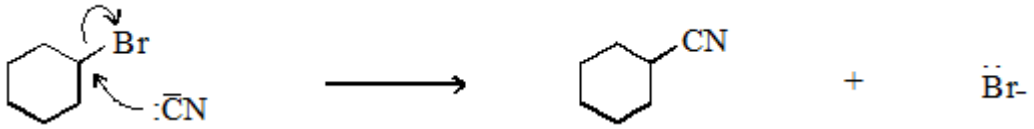
(Total 1 mark)

8. In which one of the following are the curly arrows **not** used correctly?

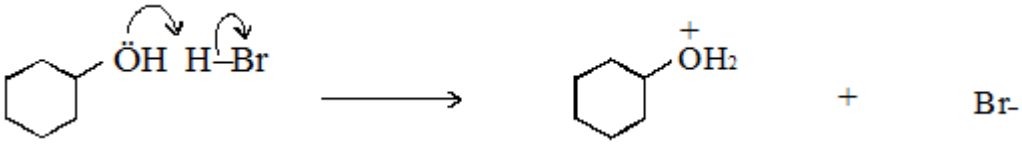
A



B



C



D



(Total 1 mark)

9. Which one of the following is **not** a suitable method for the preparation of ethanol?

A oxidation of ethane

B hydration of ethene

C reduction of ethanal

D hydrolysis of bromoethane

(Total 1 mark)

10. Which one of the following will undergo nucleophilic addition?

A hex-3-ene

B hexan-3-one

C 3-bromohexane

D hexan-3-ol

(Total 1 mark)

11. How many structural isomers, which are aldehydes, have the molecular formula $C_5H_{10}O$?

A 2

B 3

C 4

D 5

(Total 1 mark)

12. On reduction, a racemate can be formed by

A $CH_3CH_2CH_2CH_2CHO$

B $CH_3CH_2CH_2COCH_3$

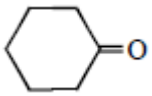
C $CH_3CH_2COCH_2CH_3$

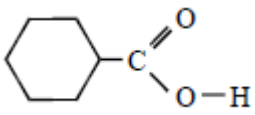
D $CH_3CH{=}CHCH_2CHO$

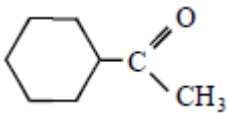
(Total 1 mark)

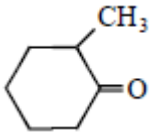
13. The compound lithium tetrahydridoaluminate(III), $LiAlH_4$, is a useful reducing agent. It behaves in a similar fashion to $NaBH_4$. Carbonyl compounds and carboxylic acids are reduced to alcohols. However, $LiAlH_4$ also reduces water in a violent reaction so that it must be used in an organic solvent.

Which one of the following can be reduced by $LiAlH_4$ to a primary alcohol?

A 

B 

C 

D 

(Total 1 mark)