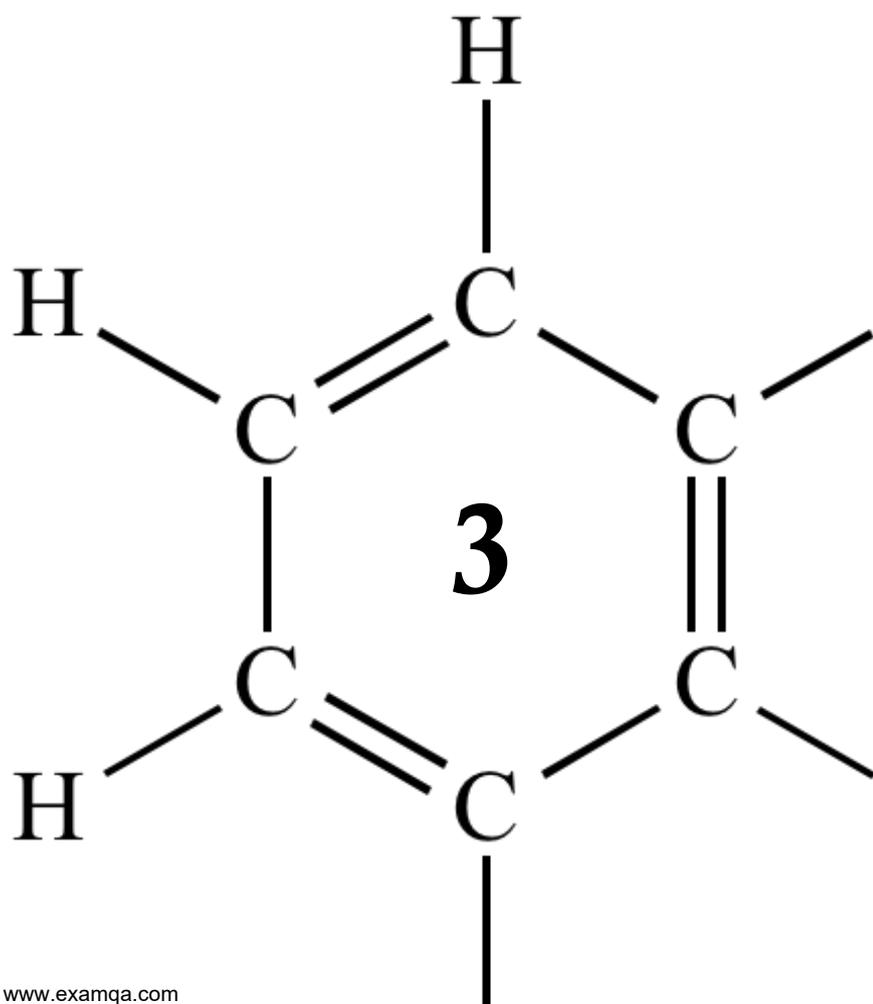


OCR A2 CHEMISTRY

MODULE 6.1

AROMATICS

CARBONYLS

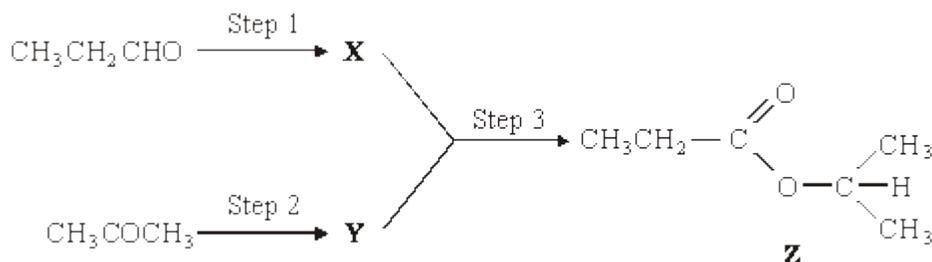


1

- (a) Describe how propanal, $\text{CH}_3\text{CH}_2\text{CHO}$, and propanone, CH_3COCH_3 , can be distinguished using
- a chemical test and
 - the number of peaks in their proton n.m.r. spectra.

(5)

- (b) Compound **Z** can be produced by the reaction of compound **X** with compound **Y** as shown in the synthesis outlined below.



Identify compounds **X** and **Y**.

For each of the three steps in the synthesis, name the type of reaction involved and give reagents and conditions. Equations are **not** required.

(10)**(Total 15 marks)****2**

- (a) Addition reactions to both alkenes and carbonyl compounds can result in the formation of isomeric compounds.
- Choose an alkene with molecular formula C_4H_8 which reacts with HBr to form two structural isomers. Give the structures of these two isomers and name the type of structural isomerism shown.

Outline a mechanism for the formation of the major product.
 - Using HCN and a suitable carbonyl compound with molecular formula $\text{C}_3\text{H}_6\text{O}$, outline a mechanism for an addition reaction in which two isomers are produced. Give the structures of the two isomers formed and state the type of isomerism shown.

(14)

- (b) Explain why ethanoyl chloride reacts readily with nucleophiles.
Write an equation for one nucleophilic addition–elimination reaction of ethanoyl chloride.
(A mechanism is not required.)

(4)
(Total 18 marks)

3

In which one of the following mixtures does a redox reaction occur?

- A ethanal and Tollens' reagent
- B ethanoyl chloride and ethanol
- C ethanal and hydrogen cyanide
- D ethanoic acid and sodium hydroxide

(Total 1 mark)

4

Propanone can be reduced to form an alcohol. A functional group isomer of the alcohol formed is

- A $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- B $\text{CH}_3\text{CH}_2\text{CHO}$
- C $\text{CH}_3\text{OCH}_2\text{CH}_3$
- D CH_3COCH_3

(Total 1 mark)

5

- (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

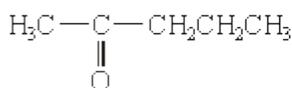
Observation with propanone

Observation with propanone

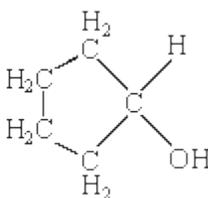
(4)
(Total 9 marks)

6

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) Deduce the number of peaks in the proton n.m.r. spectrum of **C**.

.....

(1)

- (d) 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)

- (e) Compound **E**, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$, is also an isomer of $\text{C}_5\text{H}_{10}\text{O}$

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 9 marks)

7

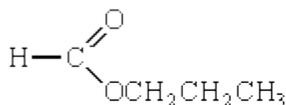
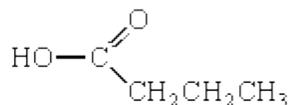
Which one of the following is **not** a correct general formula for the non-cyclic compounds listed?

- A** alcohols $\text{C}_n\text{H}_{2n+2}\text{O}$
B aldehydes $\text{C}_n\text{H}_{2n+1}\text{O}$
C esters $\text{C}_n\text{H}_{2n}\text{O}_2$
C primary amines $\text{C}_n\text{H}_{2n+3}\text{N}$

(Total 1 mark)

8

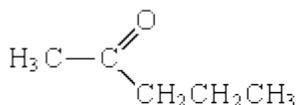
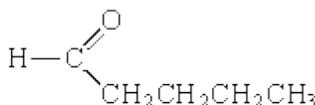
(a) Consider the following pair of isomers.

**C****D**(i) Name compound **C**.

.....

(ii) Identify a reagent which could be used in a test-tube reaction to distinguish between **C** and **D**. In each case, state what you would observe.*Reagent**Observation with C**Observation with D*.....**(4)**

(b) Consider the following pair of isomers.

**E****F**(i) Name compound **E**.

.....

(ii) Identify a reagent which could be used in a test-tube reaction to distinguish between **E** and **F**. In each case, state what you would observe.*Reagent**Observation with E**Observation with F*.....**(4)**(c) Draw the structure of the chain isomer of **F** which shows optical isomerism.**(1)****(Total 9 marks)**

9

The three compounds $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, $(\text{CH}_3)_3\text{COH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ can be distinguished by use of the following three reagents

1. potassium dichromate(VI) acidified with dilute sulphuric acid
2. Tollens' reagent
3. ethanoic acid, together with a small amount of concentrated sulphuric acid.

(a) Identify which of these three organic compounds would reduce acidified potassium dichromate(VI). Give the structures of the organic products formed. Write a half-equation for the reduction of dichromate(VI) ions in acidic solution.

(6)

(b) Identify which one of these three organic compounds would reduce Tollens' reagent. Give the structure of the organic product formed. Write a half-equation for the reduction of Tollens' reagent.

(3)

(c) Identify which of these three organic compounds would react with ethanoic acid in the presence of concentrated sulphuric acid. In each case, give the structure of the organic product formed.

(4)

(d) State the number of peaks in the proton n.m.r. spectra of $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ and of $(\text{CH}_3)_3\text{COH}$. (Analysis of peak splitting is not required.)

(2)**(Total 15 marks)****10**

(a) Outline a mechanism for the reaction of $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ with HCN and name the product.

Mechanism

Name of product

(5)

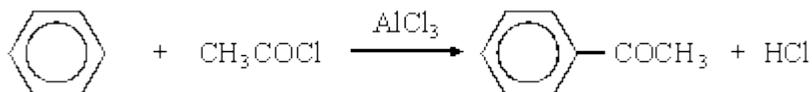
- (b) Outline a mechanism for the reaction of CH_3OH with $\text{CH}_3\text{CH}_2\text{COCl}$ and name the organic product.

Mechanism

Name of organic product

(5)

- (c) An equation for the formation of phenylethanone is shown below. In this reaction a reactive intermediate is formed from ethanoyl chloride. This intermediate then reacts with benzene.



- (i) Give the formula of the reactive intermediate.

.....

- (ii) Outline a mechanism for the reaction of this intermediate with benzene to form phenylethanone.

(4)

(Total 14 marks)

11

Which one of the following would **not** reduce an acidified aqueous solution of potassium dichromate(VI)?

- A CH_3COOH
- B Zn
- C CH_3CHO
- D $\text{Fe}^{2+}(\text{aq})$

(Total 1 mark)

12

Which one of the following statements about but-2-enal, $\text{CH}_3\text{CH}=\text{CHCHO}$, is **not** true?

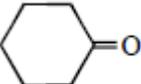
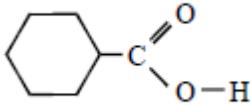
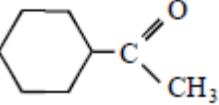
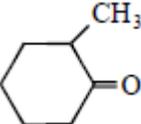
- A It has stereoisomers.
- B It shows a strong absorption in the infra-red at about 1700 cm^{-1} .
- C It will turn an acidified solution of potassium dichromate(VI) green.
- D It can be dehydrated by concentrated sulphuric acid.

(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)