EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Level: CIE AS and A Level (9701)
Subject: Chemistry
Topic: CIE Chemistry
Type: Topic Question

Chemistry CIE AS & A Level
To be used for all exam preparation for 2025+

CHEMISTRY AS and A

This to be used by all students studying CIE AS and A level Chemistry (9701) But students of other boards may find it useful

Question 1.

(a) State the reactants that can be oxidised to give an aldehyde and a ketone as products.

_____

_____

(2 marks)

(b) State the oxidation products, where appropriate, of an aldehyde and a ketone.

_____

_____

(2 marks)

(c) Describe how you could use 2,4-DNPH and melting point data to determine the identity of an unknown compound.

_____

_____

_____

(3 marks)

EXAM PAPERS PRACTICE

Copyright
© 2024 Exam Papers Practice

Question 2.

(a) Butanone can react with HCN.

Complete the reaction mechanism shown in Fig. 2.1 by drawing four curly arrows.

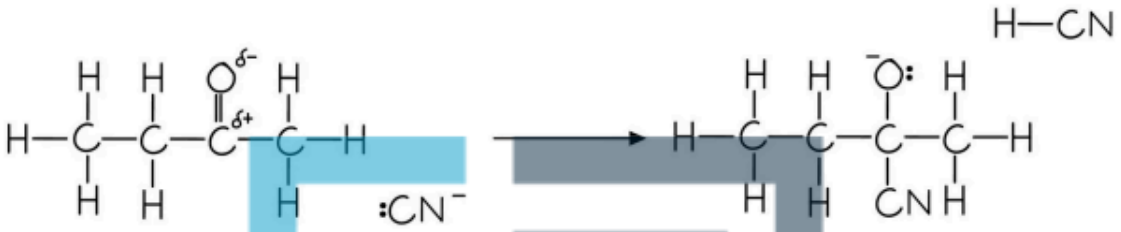


Fig. 2.1

(4 marks)

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

(b) Name the organic produced in part **(a)**.

(1 mark)

(c) Explain why butanone has no positional isomers.

(1 mark)

Question 3.

(a) Table 3.1 shows the initial observations for the reaction for Tollens' reagent with aldehydes and ketones.

Table 3.1

Ketone		Aldehyde	
Initial observation	**Final observation**	**Initial observation**	**Final observation**
Colourless solution		Colourless solution	

Complete the final observations for aldehydes and ketones.

(2 marks)

(b) Table 3.2 shows the initial observations for the reaction for Fehling's with aldehydes and ketones.

EXAM PAPERS PRACTICE

Copyright
© 2024 Exam Papers Practice

Table 3.2

Ketone		Aldehyde	
Initial observation	**Final observation**	**Initial observation**	**Final observation**
Blue solution		Blue solution	

Complete the final observations for aldehydes and ketones.

(2 marks)

(c) Ethanal and propanal are reacted separately heated with an alkaline solution of iodine.

i) State which aldehyde will give a yellow precipitate for this reaction.

[1]

ii) Explain your answer to part **(c)(i)**.

[1]

(2 marks)

Question 4.

(a) Calcium and its compounds have a large variety of applications.

Calcium metal reacts readily with most acids.

When calcium metal is placed in dilute sulfuric acid, it reacts vigorously at first.

After a short time, a layer of calcium sulfate forms on the calcium metal and the reaction stops. Some of the calcium metal and dilute sulfuric acid remain unreacted.

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

Suggest an explanation for these observations.

(1 mark)

(b) Calcium ethanedioate is formed when calcium reacts with ethanedioic acid, HOOCCOOH.

Calcium ethanedioate contains one cation and one anion.

i) State the full electronic configuration of the cation in calcium ethanedioate.

[1]

ii) Deduce the charge on the cation.

[1]

iii) Draw the fully displayed formula of ethanedioic acid.

[1]

(3 marks)

EXAM PAPERS PRACTICE

(c) Calcium chlorate(I), $Ca(ClO)_2$, is used as an alternative to sodium chlorate(I), NaClO, in some household products.

Copyright
© 2024 Exam Papers Practice

i) The chlorate(I) ion is formed when cold aqueous sodium hydroxide reacts with chlorine.

Write an ionic equation for this reaction. State symbols are **not** required.

[1]

ii) The chlorate(I) ion is unstable and decomposes when heated as shown.

$$3ClO^- \rightarrow 2Cl^- + ClO_3^-$$

This reaction can be described as a disproportionation reaction.

Describe what is meant by disproportionation reaction.

[1]

iii) Deduce the oxidation number of chlorine in each species for the equation in **(c)(ii).**

Complete the boxes.

$3ClO^- \rightarrow 2Cl^- + ClO_3^-$

oxidation number of chlorine	+1		

[1]

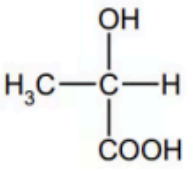
EXAM PAPERS PRACTICE

Copyright
© 2024 Exam Papers Practice

(3 marks)

(d) Calcium carbonate reacts with 2-hydroxypropanoic acid to form product Y.

2-hydroxypropanoic acid



Y

$Ca(CH_3CH(OH)COO)_2$

Fig. 1.1

i) Identify the **two** other products of the reaction of 2-hydroxypropanoic acid with calcium carbonate.

[1]

Two possible methods of making 2-hydroxypropanoic acid are shown in Fig. 1.2.

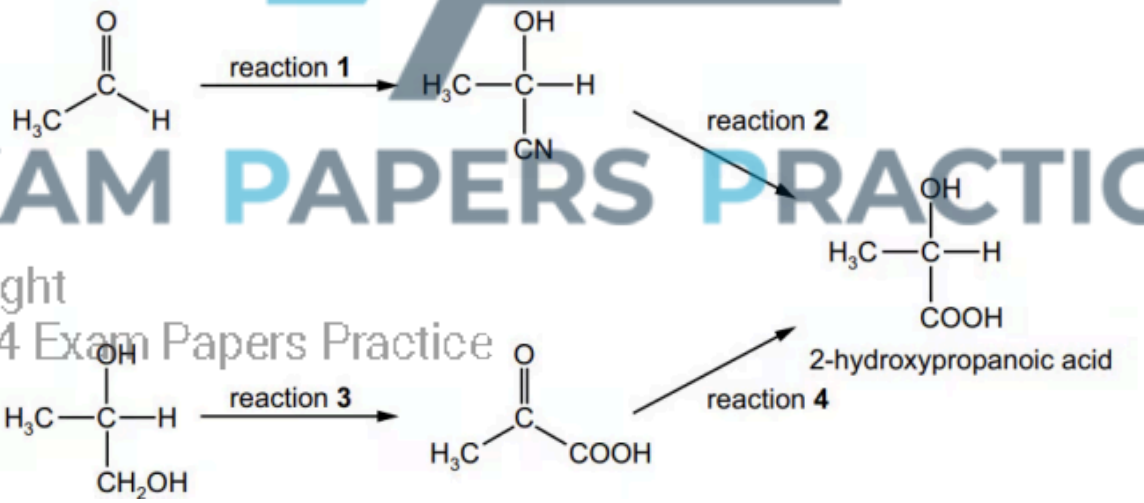


Fig. 1.2

ii) State suitable reagents and conditions for reactions **1** and **3.**

reaction **1** .....

reaction **3** .....

[4]

iii) Deduce the type of reaction that occurs in reaction **2**.

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

[1]

iv) The reagent for reaction **4** is $NaBH_4$.

Identify the role of $NaBH_4$ in this reaction.

[1]

v) 2-hydroxypropanoic acid has a chiral centre.

State what is meant by chiral centre.

[1]

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

(8 marks)

Question 5.

(a) Compound **W** can be converted into three different organic compounds as shown by the reaction scheme in Fig. 2.1.

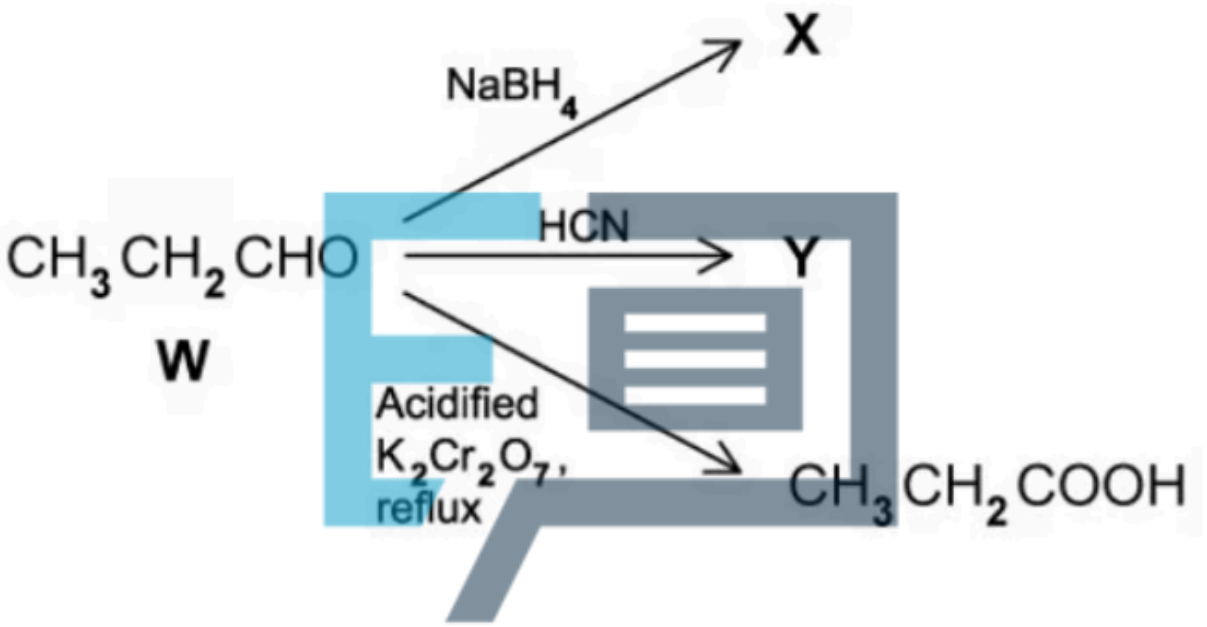


Fig. 2.1

EXAM PAPERS PRACTICE

Write an equation for the formation of **X**. Use [H] to represent the reagent in the equation.

Copyright
© 2024 Exam Papers Practice

(1 mark)

(b) Identify the specific type of isomerism shown by the product **Y**, in Fig. 2.1.

Draw the mechanism to show the formation **Y** and explain how this leads to the isomers of **Y**.

(5 marks)

(c) When 5.00 cm^3 of propanal (Mr = 58.0) were reacted with an excess of acidified potassium dichromate (VI) solution, 4.25 g of propanoic acid (Mr = 74.0) were obtained.

The density of propanal is 0.810 $g\,cm^{-3}$.

Calculate the percentage yield for this reaction.

(3 marks)

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

(d) A different carbonyl compound, **Q**, (M_r = 72) reacts with 2,4-dinitrophenylhydrazine but not with Tollens' reagent.

i) State what you would see when **Q** reacts with the 2,4-dinitrophenylhydrazine reagent

[1]

ii) State what functional group is present in **Q**.

[1]

iii) Identify **Q** either by name or by its structural formula.

[1]

(3 marks)

(e) **Q** can be reduced to compound **R**. For this reaction

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

i) State a suitable reducing agent

[1]

ii) Name the functional group in **R** (two words are required)

[1]

iii) Give the structural formula of **R**

[1]

(3 marks)

Question 6.

(a) 2-hydroxybutanoic acid can be made from propanal by via a reaction with hydrogen cyanide and the subsequent hydrolysis of 2-hyrdoxybutanenitrile. A possible pathway is shown in Fig. 3.1.The incomplete mechanism for reaction **2** is shown in Fig. 3.2.

Compound **A** —Reaction **1**→ Propanal —Reaction **2**→ 2-hydroxybutanenitrile —Reaction **3**→ 2-hydroxybutanoic acid

Fig. 3.1

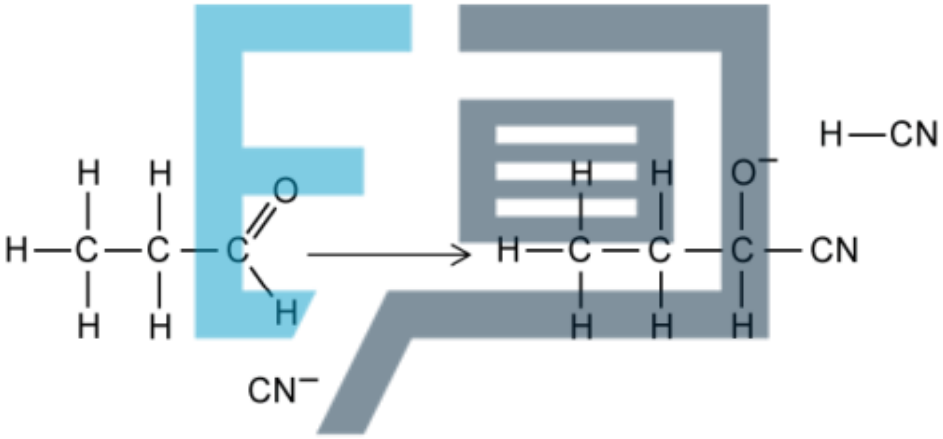


Fig. 3.2

EXAM PAPERS PRACTICE

i) State the reagents and conditions required for reaction **2**.

Copyright
© 2024 Exam Papers Practice

[3]

ii) Complete the mechanisim for this reaction.

[4]

(7 marks)

(b) 2-hydroxybutanenitrile contains a chiral centre. Draw the three-dimensional structures of the two optical isomers.

(2 marks)

(c) State the reagent(s) for reaction **3**.

(1 mark)

EXAM PAPERS PRACTICE

Copyright © 2024 Exam Papers Practice

(d) Compound **A** forms propanal when reacted with acidified potassium dichromate. Give the structural formula of compound **A**.

(1 mark)

(e) Compound **A** and propanal were tested using a series of reagents outlined in Table 3.1. For each of the tests listed:

- State the positive result
- Identify which compound(s) would give a positive result

Table 3.1

Reagent	Observation for positive result	Compounds that will give a positive result
I_2 / NaOH (aq)		
Na_2CO_3		
2,4-DNPH		

(6 marks)

EXAM PAPERS PRACTICE

Copyright
© 2024 Exam Papers Practice

Question 7.

(a) Aqueous sodium tetrahydridoborate, $NaBH_4$, is a common reducing agent.

Identify **two** isomers with the formula C_3H_6O that cannot be reduced by aqueous $NaBH_4$.

_____

_____

(2 marks)

(b) Identify the **two** isomers with the formula C_3H_6O that can be reduced by aqueous $NaBH_4$.

_____

_____

(2 marks)

(c) When $NaBH_4$ is used as a reducing agent followed by the addition of acid, the reduction products of ketones can exhibit optical isomerism, while the reduction products of aldehydes cannot.

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

i) Classify the reduction products of aldehydes and ketones.

[2]

ii) Explain why the reduction products of ketones can exhibit optical isomerism, while the reduction products of aldehydes cannot.

[2]

_____

_____

(4 marks)

(d) Explain why the reduction product of a carbonyl compound, by $NaBH_4$ and acid, cannot be a tertiary alcohol.

(2 marks)

Question 8.

(a) This question is about the reactions of an organic compound **R**.

Analysis of 15.0 g of an organic compound, **R**, showed it to contain 69.8% carbon, 2.79 g of oxygen and the remaining mass was hydrogen.

i) Calculate the empirical formula of the organic compound **R**.

ii) Compound **R** has a molecular mass of 86.0 g mol^{-1}, deduce the molecular formula of compound **R**.

EXAM PAPERS PRACTICE
Copyright
© 2024 Exam Papers Practice

(4 marks)

(b) Compound **R** is a straight chain organic compound. One isomer of compound **R** produces optical isomers of compound **S** when reacted with hydrogen cyanide followed by dilute acid.

Compounds **R** and **S** were tested with acidified potassium dichromate(VI) and Tollens reagent. The results are shown in **Table 2.1.**

Table 2.1

	R	S
Acidified potassium dichromate(VI)	Green solution	Green solution
Tollens reagent	Silver mirror formed	No visible change

Using this information and your answer from part **(a)**, identify compounds **R** and **S**. Justify your answer.

EXAM PAPERS PRACTICE

Copyright
© 2024 Exam Papers Practice

(4 marks)

(c) Draw 3D representations of the two optical isomers of compound **S**.

(1 mark)

(d) There are some isomers of compound **S** that do not display optical isomerism.

Draw the skeletal formula of these isomers.

(1 mark)

EXAM PAPERS PRACTICE

Copyright
© 2024 Exam Papers Practice