



Rewarding Learning

ADVANCED
General Certificate of Education

Centre Number

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Candidate Number

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Life and Health Sciences

Assessment Unit A2 2
assessing
Organic Chemistry



AZ021

[AZ021] Assessment

TIME

1 hour 45 minutes.

Assessment Level of Control:

Tick the relevant box (✓)

Controlled Conditions	
Other	

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all six** questions.

Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Your attention is drawn to the Data leaflet which is used with the question paper.

You may use an electronic calculator.

Quality of written communication will be assessed in Question **3(e)**.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	

Total Marks	
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1 Ethanol is widely used as a solvent and in alcoholic drinks.

(a) Ethanol may be produced industrially from sugar.

(i) Name the industrial process by which ethanol is produced from sugar.

_____ [1]

(ii) State the conditions required to convert sugar to ethanol in this industrial process.

 _____ [3]

(iii) Apart from ethanol, name the other product in the process.

_____ [1]

(iv) State **one** beneficial health effect and **one** harmful health effect of the consumption of alcoholic drinks.

Beneficial effect: _____

Harmful effect: _____
 _____ [2]

Examiner Only	
Marks	Remark

(b) Ethanol may also be produced industrially from ethene.

(i) Write a balanced symbol equation for this reaction.

_____ [1]

(ii) Name the catalyst used in this reaction.

_____ [1]

(iii) Name the type of reaction occurring when ethene is converted into ethanol.

_____ [1]

(c) Ethanol may be used as an alternative fuel as it can be produced from renewable sources such as plants.

(i) Name another alternative fuel produced from renewable sources.

_____ [1]

(ii) What is meant by the term renewable?

_____ [1]

(iii) Suggest one reason why alternative fuels produced from renewable sources are better for the environment.

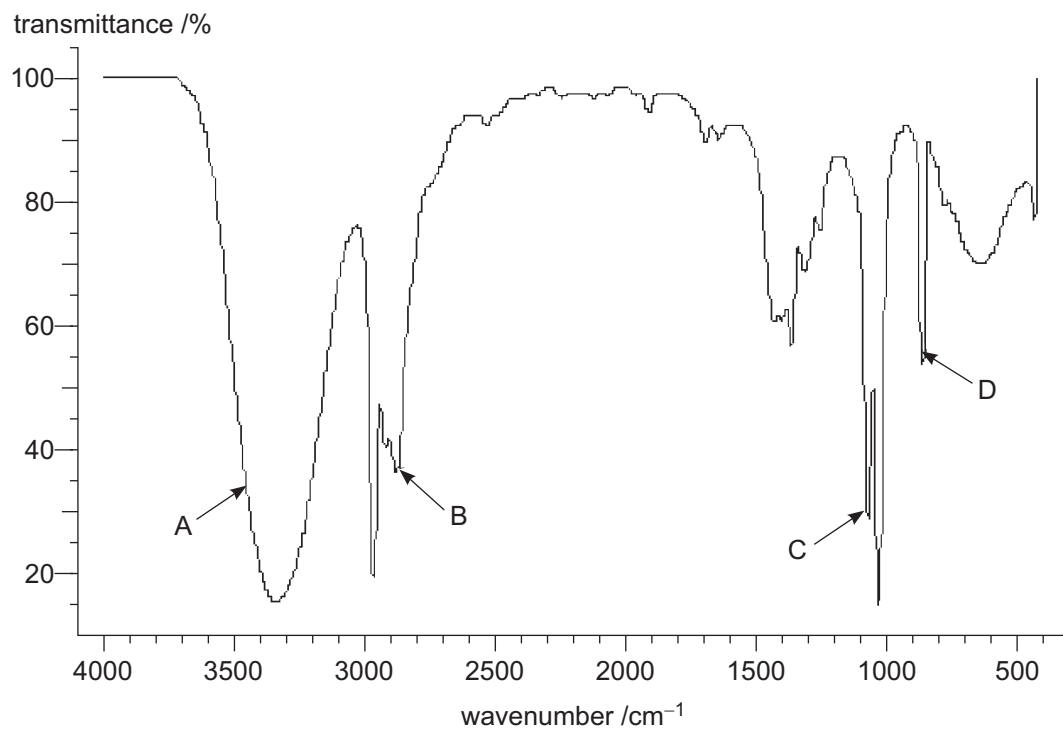
_____ [1]

Examiner Only

Marks

Remark

(d) The infrared spectrum below is for ethanol.



The table below gives some information on the infrared absorption of common bonds in organic compounds.

Wavenumber (cm ⁻¹)	Bond
750–1100	C—C (any organic molecules)
1000–1300	C—O (alcohols, carboxylic acids)
1600–1700	C=C (alkenes)
1650–1800	C=O (carboxylic acids, aldehydes, ketones)
2500–3200	O—H (carboxylic acids)
2750–2850	C—H (aldehydes)
2850–3000	C—H (alkanes, alkenes, alcohols, carboxylic acids)
3200–3600	O—H (alcohols)

(i) Draw the structural formula of ethanol.

[1]

(ii) Suggest which bonds in ethanol are responsible for the major peaks in the infrared spectrum labelled A, B, C and D.

A _____

B _____

C _____

D _____ [4]

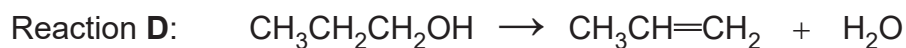
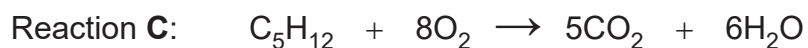
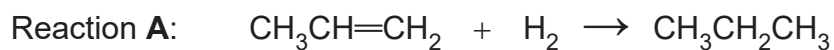
(iii) Name another analytical technique which could be used to identify ethanol.

_____ [1]

Examiner Only

Marks Remark

2 Some reactions of organic compounds are shown below.



(a) (i) State the IUPAC names of $\text{CH}_3\text{CH}=\text{CH}_2$ and $\text{CH}_3\text{CH}_2\text{CH}_3$ in Reaction A.

$\text{CH}_3\text{CH}=\text{CH}_2$ _____

$\text{CH}_3\text{CH}_2\text{CH}_3$ _____ [2]

(ii) Name the catalyst required in Reaction A.

_____ [1]

(iii) Name the type of reaction occurring in Reaction A.

_____ [1]

(iv) Name the **two** types of bond present in $\text{C}=\text{C}$.

_____ [2]

(v) $\text{CH}_3\text{CH}=\text{CH}_2$ reacts with bromine water. What colour change is observed during this reaction?

_____ [2]

Examiner Only

Marks Remark

(b) (i) Name the type of reaction occurring in Reaction **B**.

_____ [1]

(ii) State the IUPAC name of CH_3Cl in Reaction **B**.

_____ [1]

(iii) CH_3Cl can react with excess chlorine to form tetrachloromethane.
Write a balanced symbol equation for this reaction.

_____ [2]

Examiner Only

Marks Remark

(c) (i) Name the type of reaction occurring in Reaction C.

_____ [1]

(ii) Write the general formula for the homologous series to which C_5H_{12} belongs.

_____ [1]

(iii) Three different molecules have the molecular formula C_5H_{12} . Complete the table below, giving the structural formula and IUPAC names of the molecules.

IUPAC name	Structural formula
	$\begin{array}{ccccccccc} & H & & H & & H & & H & & H \\ & & & & & & & & & \\ H & -C & - & C & - & C & - & C & - & C & -H \\ & & & & & & & & & \\ & H & & H & & H & & H & & H \end{array}$
2-methylbutane	
	$\begin{array}{ccccccc} & H & & CH_3 & & H & \\ & & & & & & \\ H & -C & - & C & - & C & -H \\ & & & & & & \\ & H & & CH_3 & & H & \end{array}$

[3]

Examiner Only

Marks Remark

(d) (i) State the IUPAC name of $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ in Reaction D.

_____ [1]

(ii) Name the type of reaction occurring in Reaction D.

_____ [1]

(iii) Name the catalyst required in Reaction D.

_____ [2]

Examiner Only	
Marks	Remark

3 Crude oil is a non-renewable resource and a source of hydrocarbons.

(a) Name the process used to separate crude oil into simpler mixtures of hydrocarbons.

_____ [1]

(b) Many of the hydrocarbons produced from crude oil are used as fuels.

(i) What is meant by the term hydrocarbon?

_____ [1]

(ii) Suggest what is meant by the term fuel.

_____ [1]

(c) 1.29 g of a hydrocarbon obtained from crude oil contained 1.08 g of carbon. The relative molecular mass of the hydrocarbon is 86.

(i) Calculate the mass of hydrogen in this sample of the hydrocarbon.

mass of hydrogen = _____ g [1]

(ii) Determine the empirical formula of the hydrocarbon.

empirical formula = _____ [3]

Examiner Only

Marks Remark

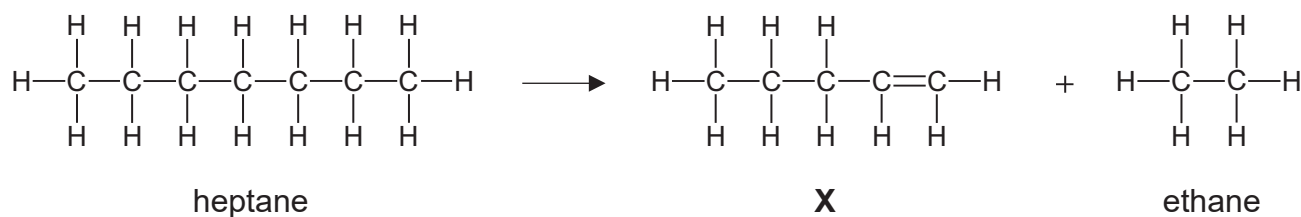
(iii) Determine the molecular formula of the hydrocarbon.

molecular formula = _____ [1]

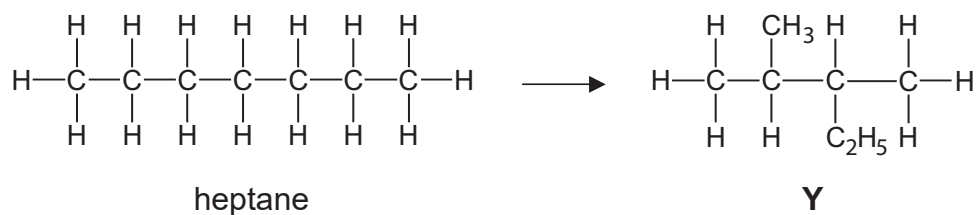
Examiner Only	
Marks	Remark

(d) Heptane, C_7H_{16} , is a hydrocarbon fuel obtained from crude oil. It can undergo two further processes as shown in the structural equations below. The products are labelled **X** and **Y**.

Process A



Process B



(i) Name **Process A** and **Process B**.

Process A _____

Process B _____ [2]

(ii) State the IUPAC names of products **X** and **Y**.

X _____

Y _____ [2]

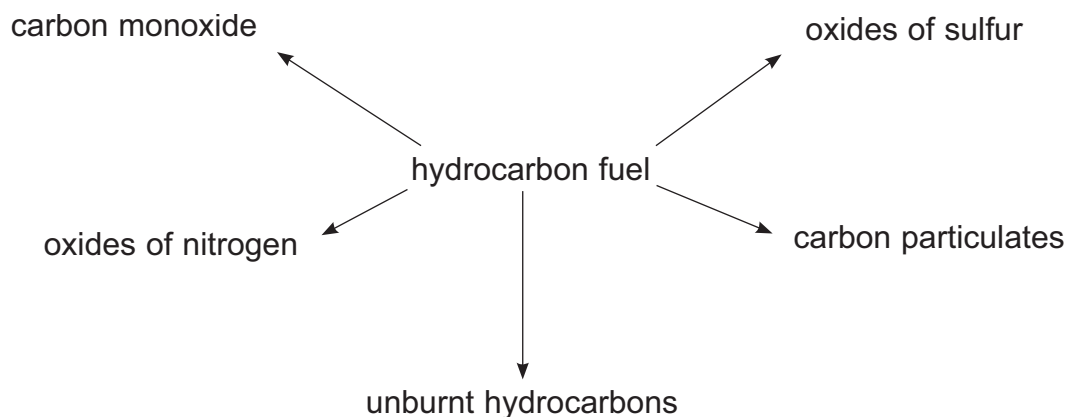
(iii) Draw the skeletal formula for **X** and **Y**.

X

Y

Examiner Only	
Marks	Remark

(e) The diagram below shows some of the polluting products formed from the use of hydrocarbons as fuels.



Discuss the environmental impact of these products and explain how catalytic converters are helping reduce the impact.

Quality of written communication will be assessed in this question.

[6]

Examiner Only	
Marks	Remark

4 Alcohols contain the –OH functional group and aldehydes contain the –CHO functional group.

(a) What is the name of the –OH functional group?

_____ [1]

(b) The general formula for the alcohols homologous series is $C_nH_{2n+1}OH$.

(i) Apart from having the same general formula, state what you understand by a homologous series.

_____ [3]

(ii) Write the molecular formula of an alcohol with 6 carbon atoms.

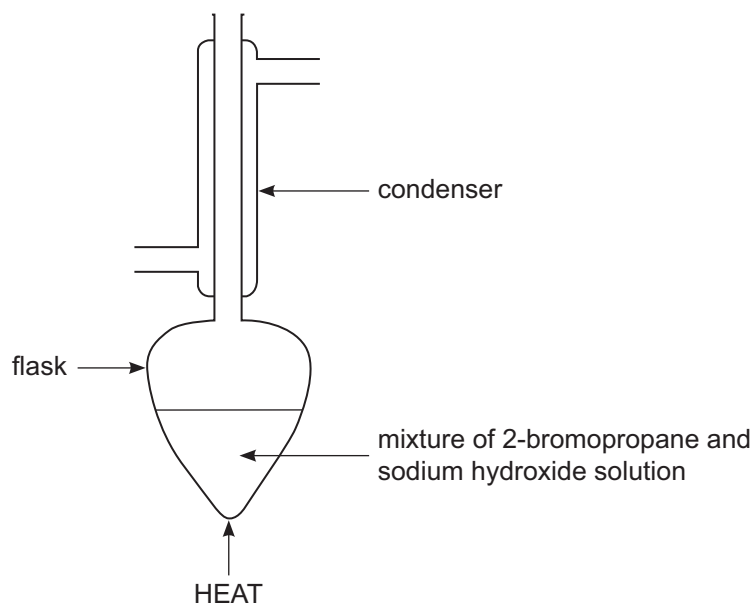
_____ [1]

Examiner Only

Marks

Remark

- (d) Propan-2-ol may be prepared from 2-bromopropane by heating under reflux with sodium hydroxide solution. The apparatus used is shown below.



- (i) What should be added to the flask to promote smooth boiling?

_____ [1]

- (ii) Label the positions of **water in** and **water out** on the condenser.

[1]

- (iii) Write a balanced symbol equation for the reaction of 2-bromopropane with sodium hydroxide.

_____ [2]

- (iv) Suggest why the condenser is left open at the top.

_____ [1]

Examiner Only

Marks Remark

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(Questions continue overleaf)

5 Alkenes undergo polymerisation reactions and they also react with hydrogen bromide.

(a) Draw the structure of a polymer formed from but-1-ene showing two repeating units.

[2]

(b) Polymers such as polythene and poly(but-1-ene) are non-biodegradable and require waste management strategies.

(i) Name two waste management strategies used to reduce the amount of polymers going to landfill.

1. _____

2. _____

_____ [2]

(ii) Why are polymers such as polythene described as non-biodegradable?

_____ [1]

Examiner Only	
Marks	Remark

(c) Alkenes such as but-2-ene and ethene react with hydrogen bromide in a similar way.

(i) Draw the structural formula of the product formed when but-2-ene reacts with hydrogen bromide and state its IUPAC name.

IUPAC name: _____ [2]

(ii) Name the mechanism by which but-2-ene reacts with hydrogen bromide.

_____ [1]

(d) Explain why but-1-ene cannot form cis–trans isomers.

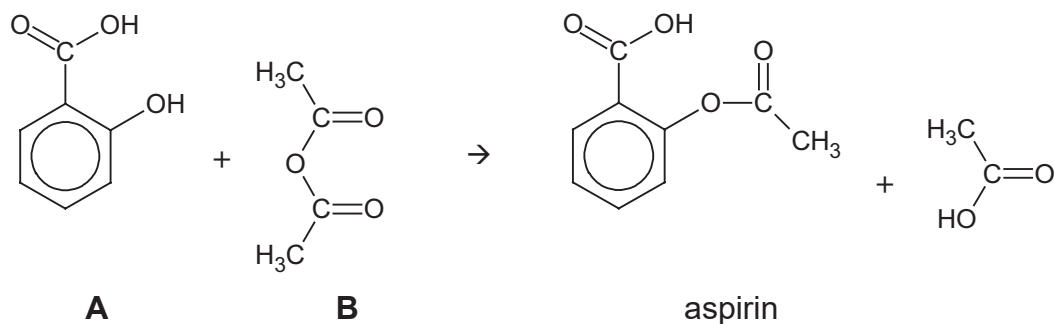
_____ [1]

Examiner Only

Marks

Remark

- 6 The equation below shows the formation of aspirin. The reactants are labelled **A** and **B**.



- (a) Name the reactants **A** and **B**.

A _____

B _____ [2]

- (b) On the structure of aspirin, circle the carboxylic acid group. [1]

- (c) The relative molecular masses of **A**, **B** and aspirin are given below.

Relative molecular mass of **A** = 138

Relative molecular mass of **B** = 102

Relative molecular mass of aspirin = 180

6.21 g of **A** were used to prepare aspirin using an excess of **B**.

6.30 g of aspirin were obtained.

- (i) Calculate the theoretical yield of aspirin, in grams, obtained from 6.21 g of **A**.

You are advised to show your working.

theoretical yield = _____ g [2]

Examiner Only

Marks Remark

- (ii) Calculate the percentage yield. Give your answer to 1 decimal place.

You are advised to show your working.

percentage yield = _____ % [2]

- (iii) Suggest two reasons why the percentage yield of aspirin is not 100%.

1. _____

2. _____

_____ [2]

- (d) Explain how iron(III) chloride (ferric chloride) is used to determine the purity of a sample of aspirin.

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

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Marks

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