

91391



NEW ZEALAND QUALIFICATIONS AUTHORITY
 MANA TOHU MĀTAURANGA O AOTEAROA

3

SUPERVISOR'S USE ONLY

Level 3 Chemistry, 2014

91391 Demonstrate understanding of the properties of organic compounds

2.00pm Tuesday 11 November 2014
 Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of organic compounds.	Demonstrate in-depth understanding of the properties of organic compounds.	Demonstrate comprehensive understanding of the properties of organic compounds.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L3-CHEMR.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement

TOTAL

10

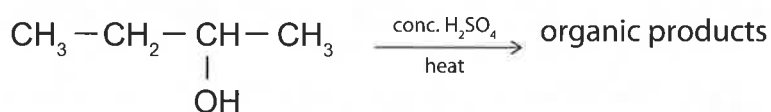
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QUESTION ONE

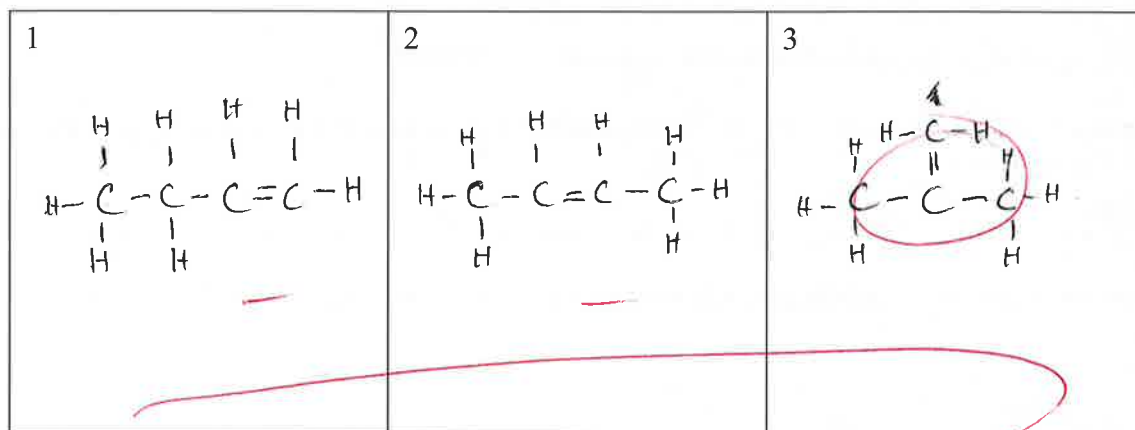
- (a) Complete the table below giving the IUPAC systematic name or the structural formula for each compound.

Structural formula	IUPAC systematic name
$\begin{array}{c} \text{Cl} \quad \text{O} \\ \quad \\ \text{CH}_3 - \text{CH} - \text{C} - \text{CH}_3 \end{array}$	butan-2- <u>3-chloro butanone</u>
$\begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H} - \text{C} - \text{C} - \text{C} - \text{NH}_2 \\ \quad \\ \text{H} \quad \text{H} \end{array}$	propanamide
$\begin{array}{c} \text{CH}_3 - \text{O} - \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ \\ \text{O} \end{array}$	<u>methyl butanoate</u>

- (b) When butan-2-ol undergoes a reaction with concentrated H_2SO_4 , three possible organic products form, which are isomers of each other.



- (i) In the boxes below, draw the three isomers formed during this reaction.

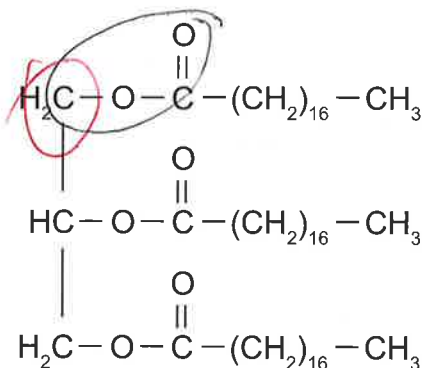


- (ii) Which of the three isomers from part (i) will be formed in the smallest amount?

Explain your answer.

Number ① will be formed in the smallest amount because it is a primary alkene, and the dehydration reaction occurring favours the formation of secondary and tertiary alkenes (2 and 3 are secondary alkenes).

(c) The triglyceride below is shown in condensed form.



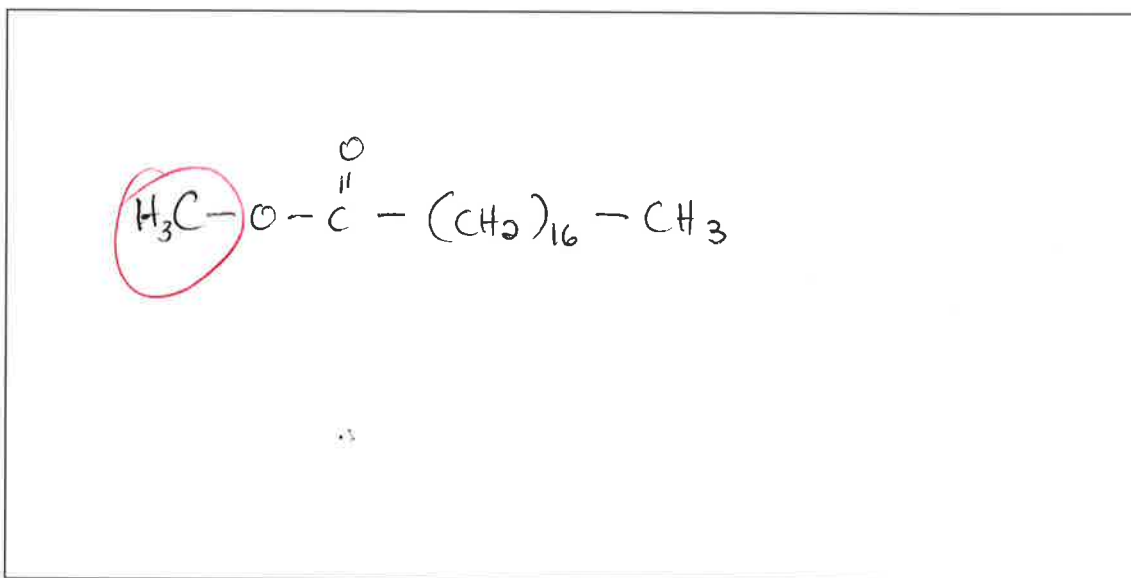
(i) Circle a functional group on the diagram above and give its name.

Functional group name: ester.

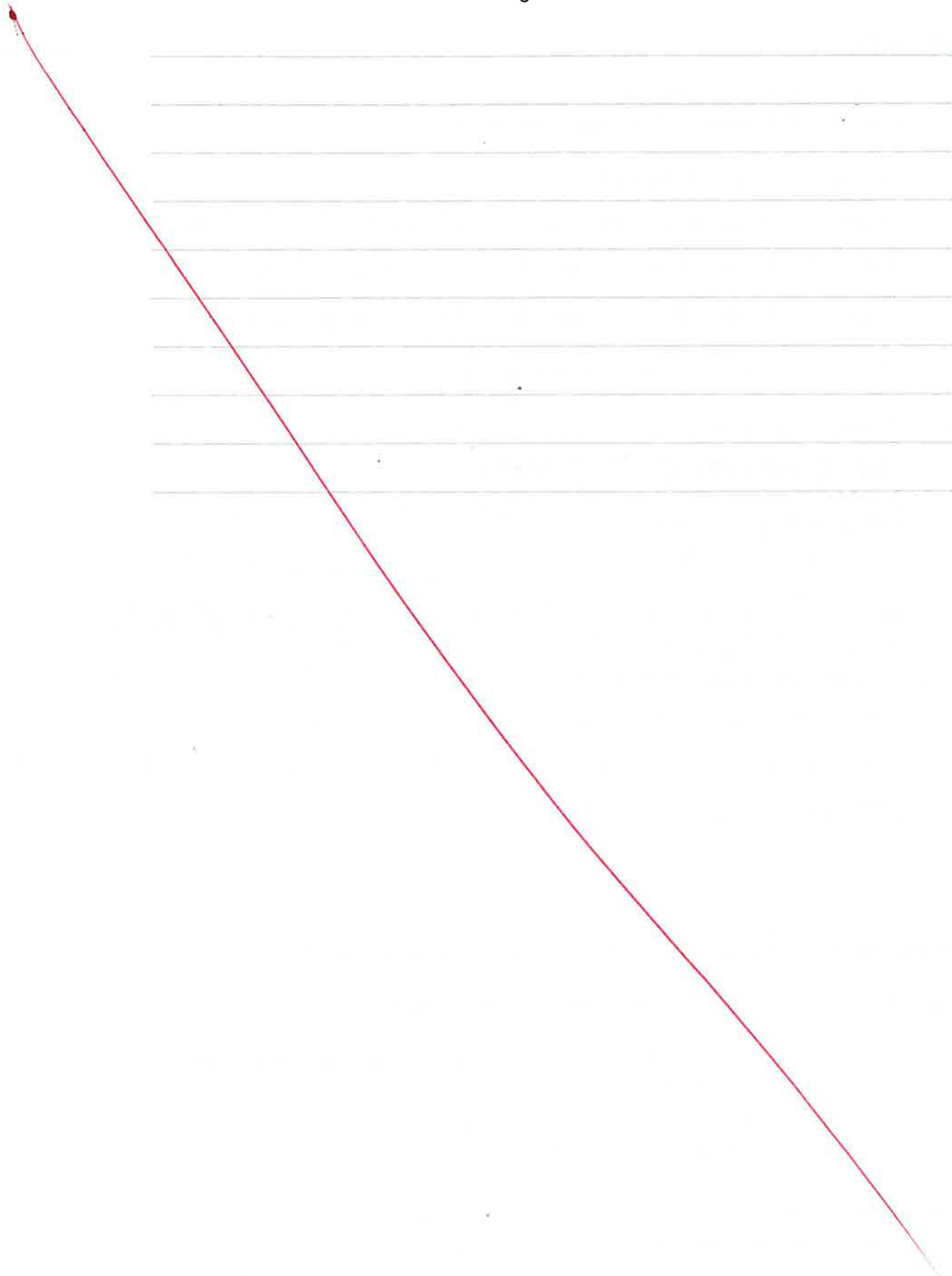
(ii) Compare and contrast the reaction of the above triglyceride when it undergoes both acidic and basic hydrolysis.

In your answer you should include:

- drawings of condensed structures of the organic products
- any reagents and conditions required for the reaction to proceed.



When the ~~above~~ above triglyceride undergoes hydrolysis and is added to an acid ^{conc. HCl}, the carboxylic acid it was made from and an alcohol is produced (methanol).
 When the triglyceride undergoes hydrolysis with a base ^{conc. NaOH}, the alcohol (methanol) is formed but so is a salt, in this case a sodium salt.



A3

QUESTION TWO

(a) Identify the reagents, conditions required, and observations linked to species, to enable the following pairs of chemicals to be distinguished from each other.

(i) Aqueous solutions of propanamine and propanamide.

Propanamine is basic and propanamide is a neutral solution.

Place a damp piece of red litmus in both solutions.

Propanamine should turn red litmus blue and propanamide will have no reaction with the litmus paper.

(ii) Propanone and propanal.

~~(Use Tollens' reagent, AgNO₃)~~

Use Beilings' reagent, copper(II) citrate. Propanone will have no reaction, as ketones don't oxidise. Propanal should turn the blue Ce^{2+} ions in the reagent to a brick red precipitate of Ce_2O_3 , because aldehydes can oxidise (to carboxylic acids).

(iii) Propanoyl chloride and propyl propanoate.

(an acid chloride)

Add water to both solutions. Propanoyl chloride reacts vigorously with water whereas propyl propanoate (an ester) will have no reaction with water.

(b) Instructions for the preparation of 2-chloro-2-methylpropane are given below.

Read the instructions carefully and answer the questions that follow.

1. Shake 10 mL of 2-methylpropan-2-ol with 30 mL of concentrated hydrochloric acid in a separating funnel for 10 minutes.
2. Run off the bottom acid layer and discard it. Add saturated sodium hydrogen carbonate to the organic product. Shake, releasing the tap every few seconds to relieve the pressure.
3. Run off the bottom aqueous layer and discard it. Transfer into a conical flask and add some anhydrous sodium sulfate, and stir thoroughly.
4. Transfer the organic product into a round-bottom flask, and collect the fraction boiling within $2^{\circ}C$ of the boiling point of 2-chloro-2-methylpropane.

- (i) Explain why the solution of sodium hydrogen carbonate is added in instruction 2.

Name the gas produced in this step.

Name of gas formed: CO₂, carbon dioxide gas.

Explanation: The sodium hydrogen carbonate is added to neutralise ~~the~~ any left over HCl, causing CO₂ gas to be formed.

- (ii) Explain why anhydrous sodium sulfate is added in instruction 3.

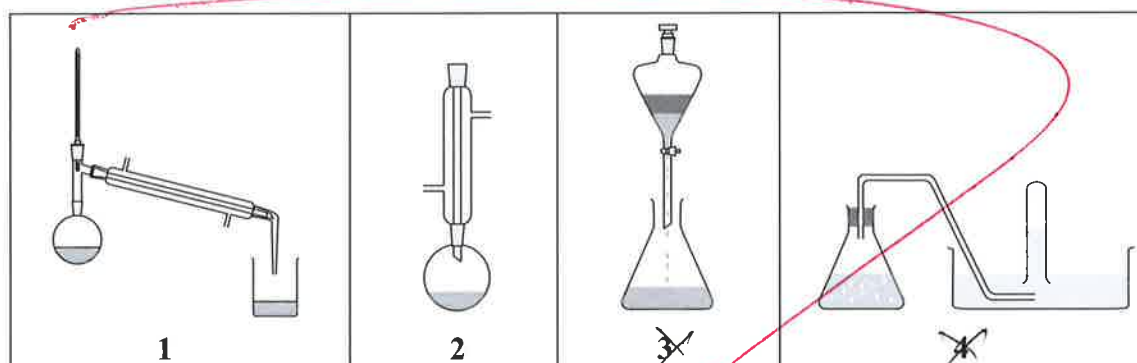
Anhydrous so that any left over water in the flask is removed.

- (iii) Name the process used in instruction 4 to purify the organic product.

Process used: Reflux

Write the number of the equipment that a student would use to perform this process from the diagrams below.

Diagram no: 2



(iv) Discuss the process carried out in instruction 4 on page 6.

Include in your answer:

- the purpose of this process
- an explanation of how it works.

Purpose of this process is to heat the reaction for longer, to ensure completion of the reaction. The equipment collects any evaporated substance and condenses it back to liquid state, so that the reaction can be heated for longer.

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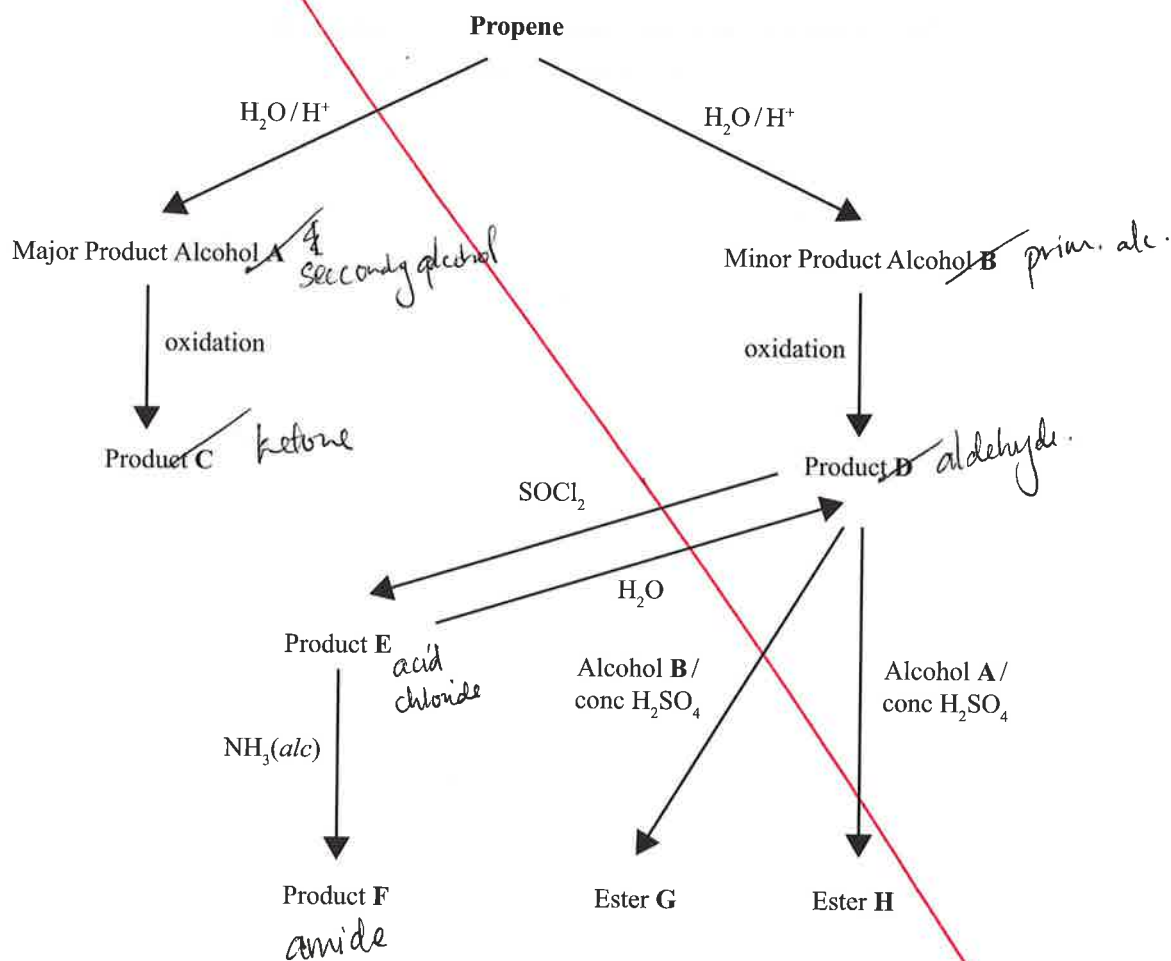
A3



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The examination continues on the following page.**

QUESTION THREE

- (a) Propene can be reacted with water in the presence of acid to form a major product (A) and a minor product (B).
- A is oxidised to form product C.
 - B is oxidised to form product D.
 - When D is reacted with SOCl_2 , it forms product E.
 - When D is reacted with alcohol B, it forms an ester G.
 - When D is reacted with alcohol A, it forms ester H, which is an isomer of G.
 - When E is reacted with alcoholic ammonia, it forms product F.
 - When E is reacted with water, it forms product D.



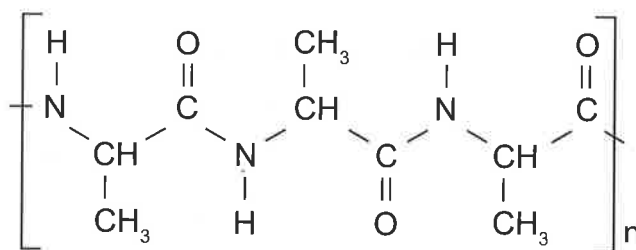
Name compounds A to G, and draw structural formulae for compounds A to H.

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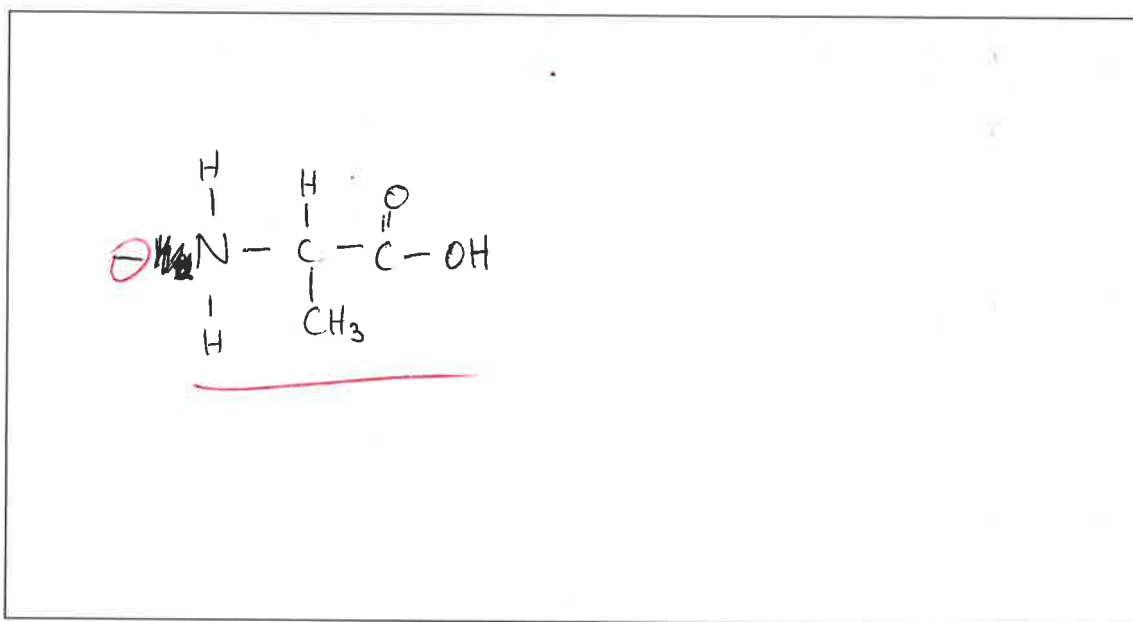
	Name	Structural Formula
A	propan-2-ol	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{OH} \quad \text{H} \end{array} $
B	propan-1-ol propan-1-ol	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{OH} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $
C	propanone	$ \begin{array}{c} \text{H} \quad \text{O} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array} $
D	propanal	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $
E	propanoyl propanoyl chloride	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{Cl} \\ \quad \\ \text{H} \quad \text{H} \end{array} $
F	propanamide	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{NH}_2 \\ \quad \\ \text{H} \quad \text{H} \end{array} $
G	methyl propanoate	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{O}-\text{CH}_3 \\ \quad \\ \text{H} \quad \text{H} \end{array} $
H		$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{O}-\text{CH}_2\text{CH}_3 \\ \quad \\ \text{H} \quad \text{H} \end{array} $

(b) The following polymer will, under the correct conditions, hydrolyse.

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(i) Draw the monomer(s) from which this polymer is formed.

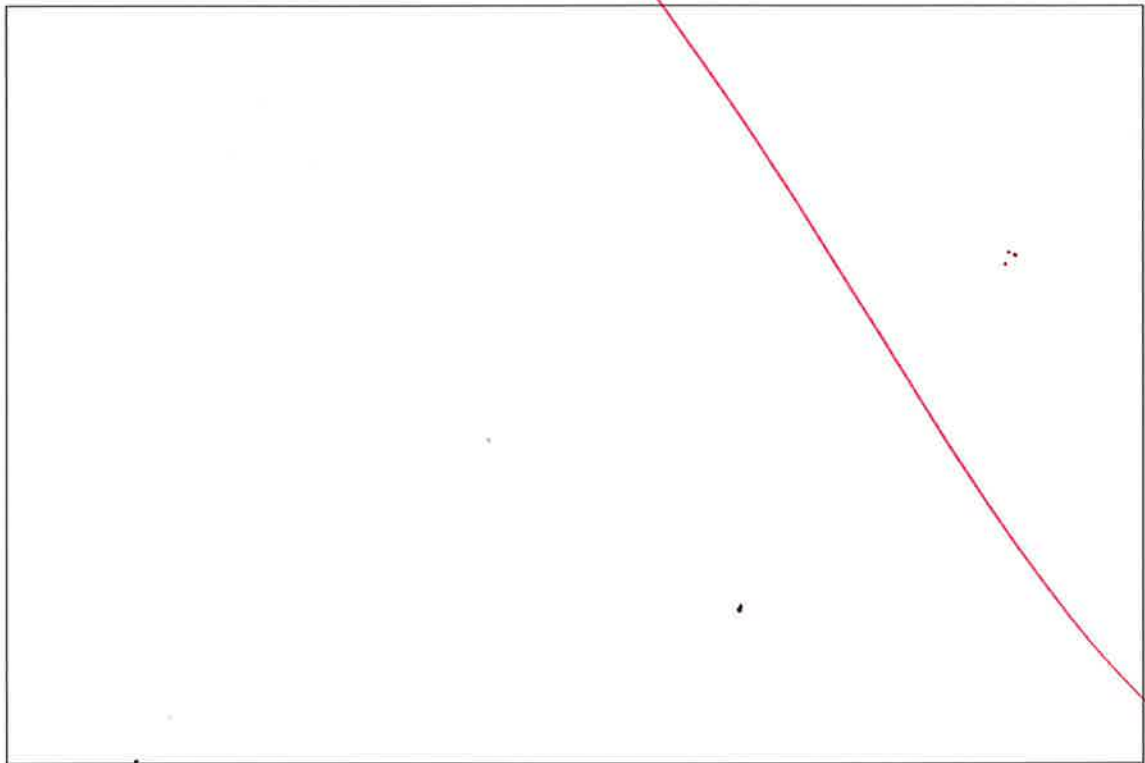
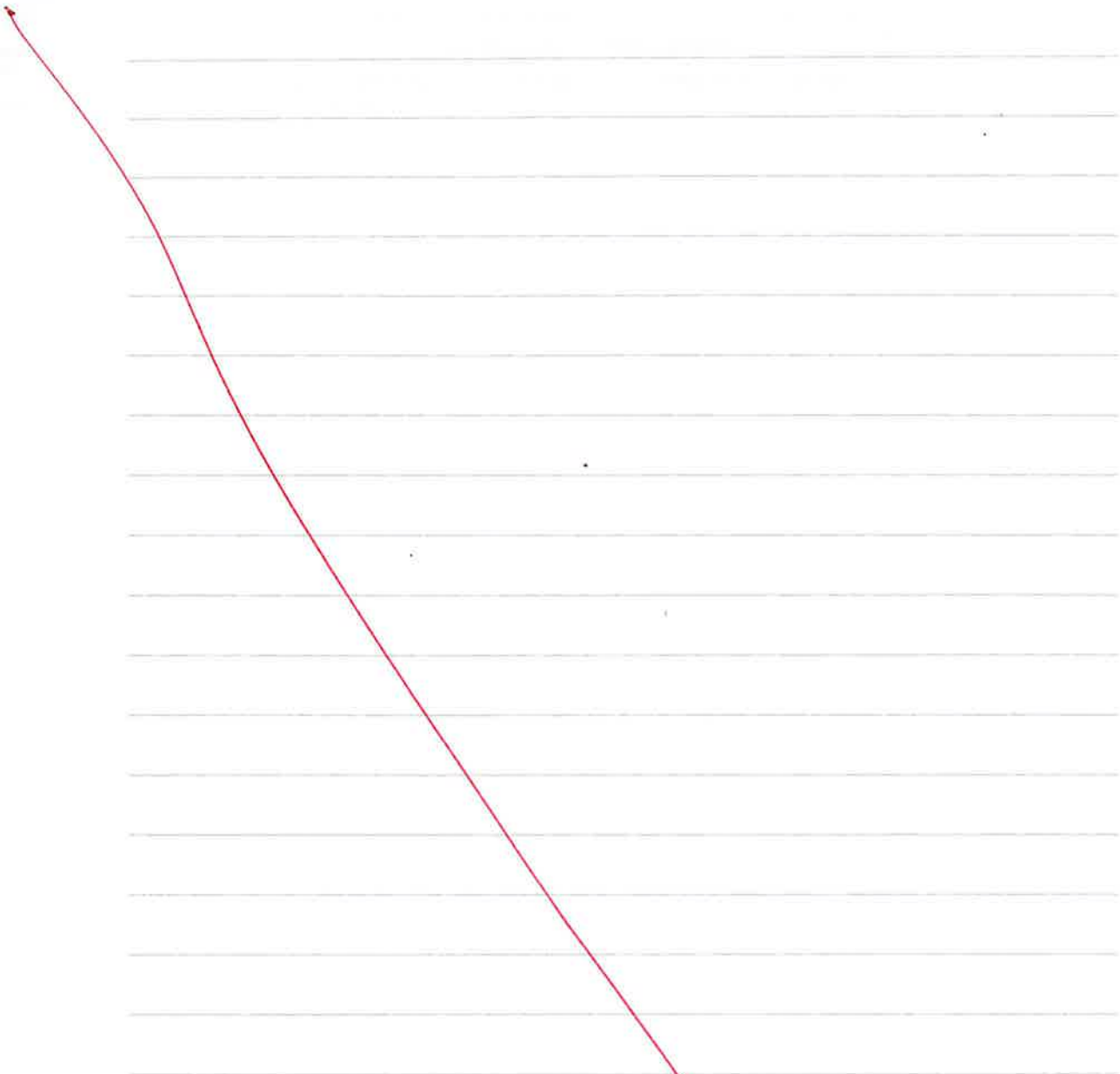


(ii) Discuss the hydrolysis of the polymer.

In your answer you should include:

- the conditions under which it can be hydrolysed
- structures of the organic products formed as a result of hydrolysis.

The polymer will hydrolyse to form an amino acid, under alcoholic and heated conditions.



A4

Achievement

Q 1

(b)(i) only two structures correct

(b)(ii) explanation incomplete

(c)(i) ester functional group incorrectly circled in red

(c)(ii) structure incorrect, however explanation shows partial understanding

Q2

(a)(ii) Fehlings reagent requires heat

(b)(iii) incorrect process and explanation

(b)(iv) Incomplete discussion of the purpose and explanation of how distillation occurs

Q3

(a) D should have produced a carboxylic acid not an aldehyde

(b)(i) correct monomer, no penalty for crossed out part