3

SUPERVISOR'S USE ONLY

91391

913910

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 3 Chemistry, 2017

91391 Demonstrate understanding of the properties of organic compounds

2.00 p.m. Wednesday 15 November 2017
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 room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 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.

Merit

TOTAL 15

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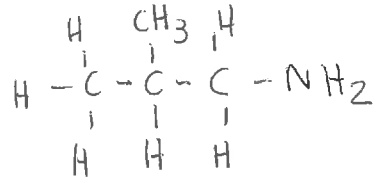
2 

QUESTION ONE

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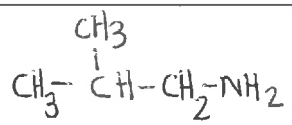
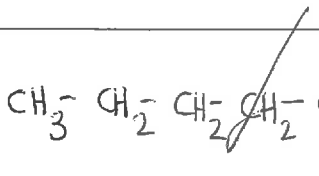
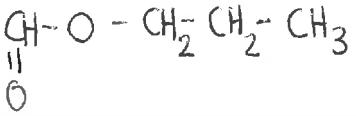
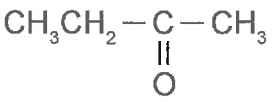
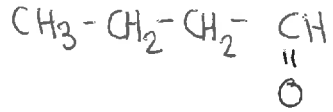
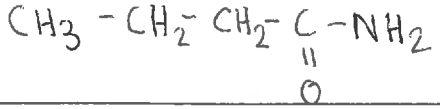
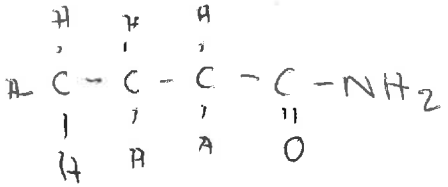
(a) Complete the table below to indicate the IUPAC name, functional group, and/or the structural formula for organic compounds that contain **only four carbon atoms**. The first row has been completed for you.

Functional group	Structural formula	IUPAC (systematic) name
Alkene	$CH_3CH_2CH=CH_2$	but-1-ene
Amine		2-methylpropan-1-amine
Acyl chloride		propanoylchloride
ester		propyl methanoate
ketone		propan-1-one propanone
Aldehyde		butanal ~~propanal~~
Amide		butanamide



(b) Complete the following reaction scheme by drawing the structural formulae of both organic compounds **A** and **B**, as well as the major and minor products **C** and **D**.

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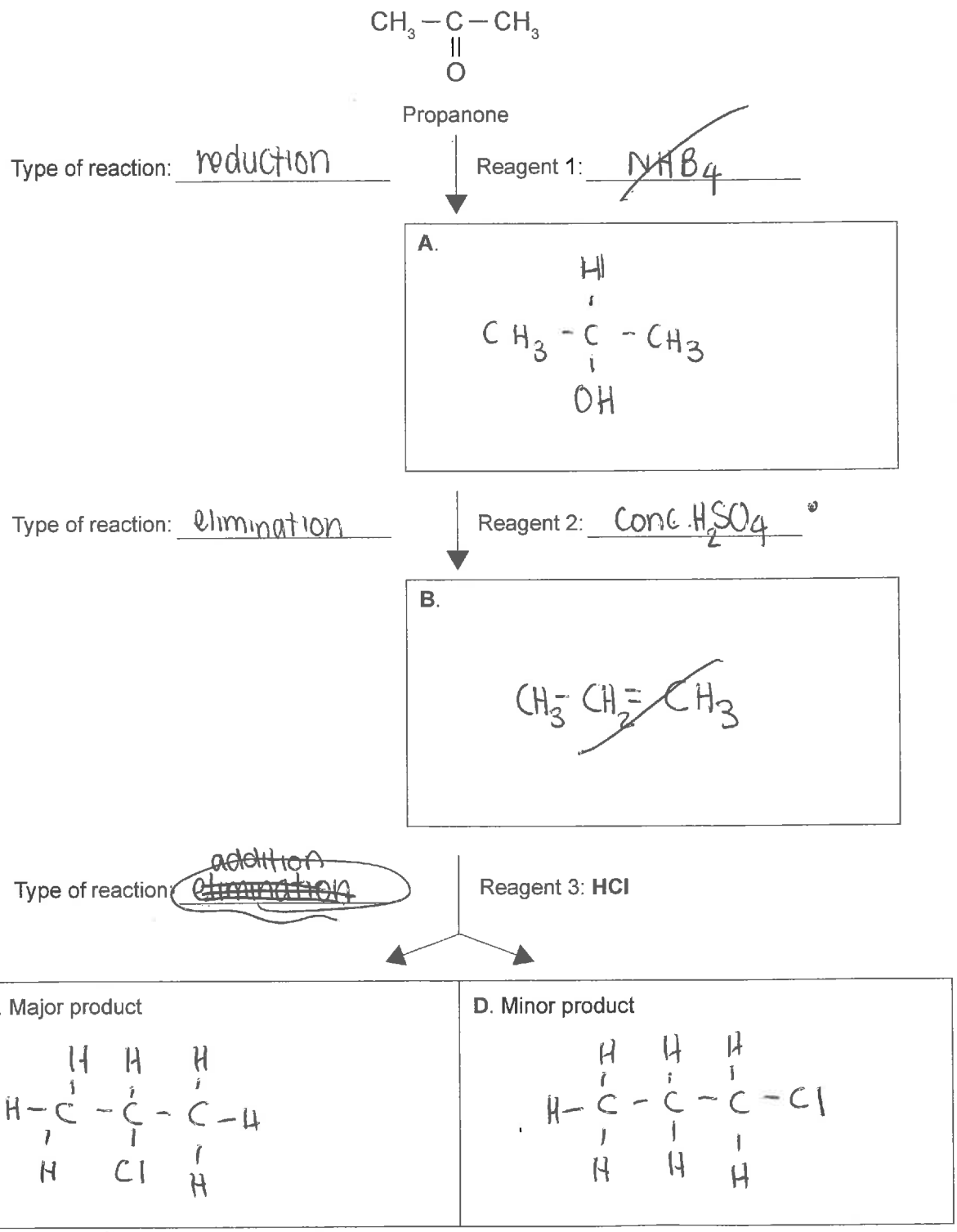
Identify both reagents 1 and 2, and indicate the type of reaction occurring at each step.



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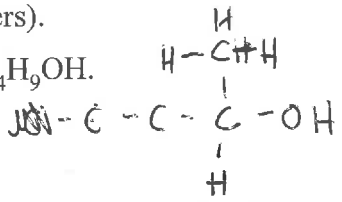
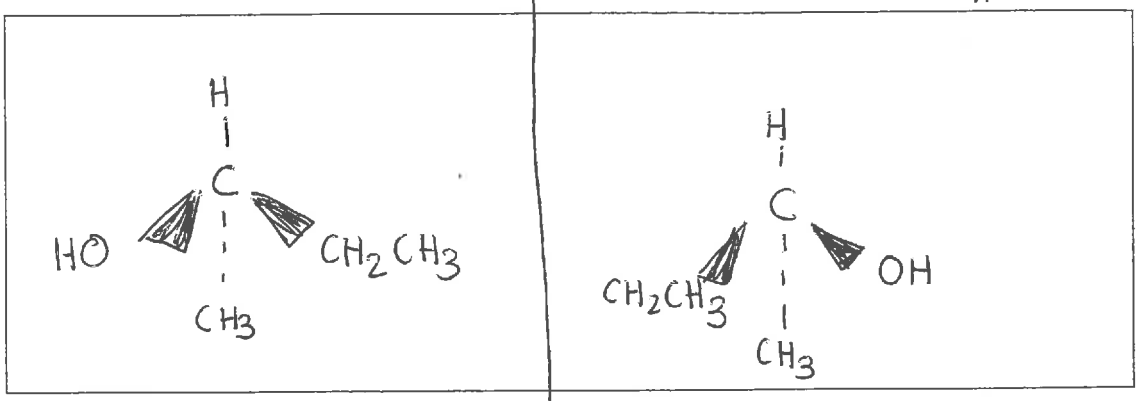
(c) Some organic compounds can exist as enantiomers (optical isomers).

An example is a secondary alcohol with the molecular formula C_4H_9OH.



(i) Draw the enantiomers of C_4H_9OH in the box below.



(ii) Explain what is meant by the term enantiomers (optical isomers).

In your answer, you should:

- identify the structural requirement for a molecule, such as C_4H_9OH, to exist as enantiomers
- explain how enantiomers can be distinguished from each other.

For C_4H_9OH to exist as an enatiomer, it needs a chiral carbon. A chiral carbon is a carbon that is attached to four different groups. In this case C_4H_9OH can form OH, H, CH_2CH_3 & CH_3 attached to a carbon (C). Enatiomers ~~move~~ rotate planes of polarised light ~~that~~ in different/opposite directions that ~~disting~~ can be used to distinguish from each other.

M5

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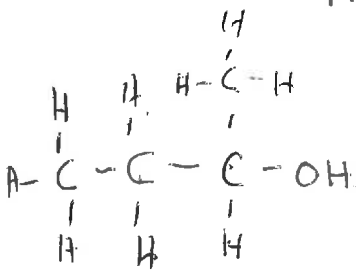
The examination continues on the following page.

C_4H_9OH



QUESTION TWO

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(a) Compound **P** and compound **Q** are straight-chain constitutional (structural) isomers with the molecular formula $C_5H_{12}O$. Compound **P** can form optical isomers, whereas compound **Q** cannot.

When reacted with concentrated sulfuric acid, compound **P** forms two products, compounds **R** and **S**; compound **Q** forms only one product, compound **S**.

When compound **Q** is reacted with *Reagent 1*, it forms a chloroalkane, compound **T**.

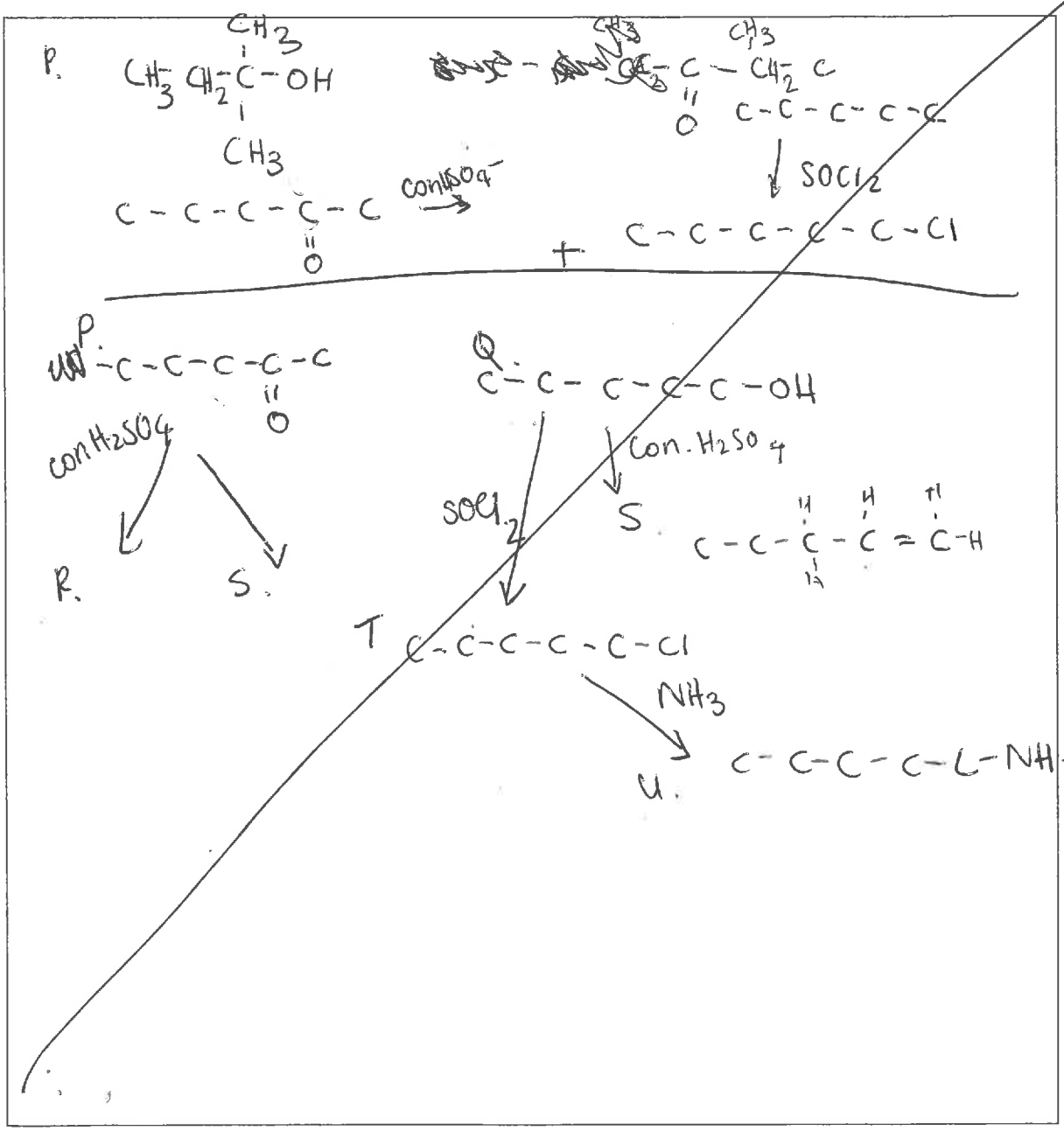
Compound **T** reacts with concentrated NH_3 to form compound **U**.

Compound **Q** can also be oxidised to form compound **V**, which will turn moist blue litmus paper red.

Compound **V** can also be reacted with compound **Q** and *Reagent 2*, to form a sweet-smelling liquid, compound **W**.

Use the information above to identify compounds **P** to **W**, and *reagents* **1** and **2**.

Space for planning/working is provided in the box below.



Complete the following tables using the information found on the previous page.

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Compound	Structure
P	$CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$ ketone
Q	$CH_3-CH_2-CH_2-CH_2-OH$ alcohol ~~aldehyde~~
R	$CH_3-CH_2-CH_2-CH_2-CH_3$ alkane ~~alk~~
S	$CH_3-CH_2-CH_2-CH=CH_2$ alkene
T	$CH_3-CH_2-CH_2-CH_2-CH_2-Cl$ chloroalkane bad
U	$CH_3-CH_2-CH_2-CH_2-CH_2-NH_2$ amide.
V	$CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-OH$ carboxylic acid
W	$CH_3-CH_2-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_2-CH_2-CH_2-CH_3$ ester

Reagent 1	$SOCl_2$
Reagent 2	conc. H_2SO_4

green > orange

$Cr_2O_7^-/H^+$

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(b) (i) Adding an acidified potassium dichromate solution to propan-1-ol can produce either propanal or propanoic acid.

distillation reflux.

Explain the laboratory procedure used to convert propan-1-ol to **propanal**.

primalc. aldehyde.

In your answer, you should:

- outline the procedure for the conversion, and describe any colour changes linked to the species involved
- state the type of reaction occurring
- explain how the procedure ensures only **propanal** is collected.

oxidation.

Propan-1-ol can be oxidised to form either propanal or propanoic acid using $Cr_2O_7^-/H^+$. To ensure that propanal is only collected, we use the procedure called distillation. $Cr_2O_7^-/H^+$ and reflux will produce propanoic acid. The colour of the solution will change from green to orange when propan-1-ol is oxidised. When propanal is formed $Cr_2O_7^-/H^+$ will turn into Cr^{3+} ions.

(ii) Explain how Benedict's solution can be used to distinguish between propanone and propanal.

ketone

aldehyde.

$Cu^{2+} + 2e^- \rightarrow Cu$

In your answer, you should include:

- any observations made linked to the organic compounds involved
- the type of reaction occurring
- relevant equations showing any organic reactants and products involved.

Benedict's solution is an oxidant. When benedict's solution is added to propanone and propanal, only propanal will react to the solution because ketones can't be oxidised. The type of reaction occurring is redox reaction ~~oxidation~~ propanal gets oxidised to propanoic acid. The colour of this solution changes from blue to a reddy brown precipitate. Cu^{2+}

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

M5

QUESTION THREE

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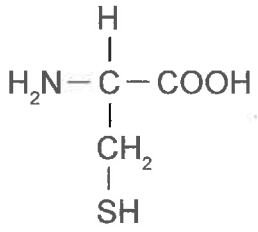
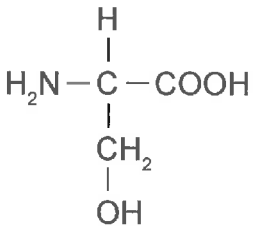
Peptides are molecules that form when amino acids combine.

The following structures show the amino acids cysteine and serine.



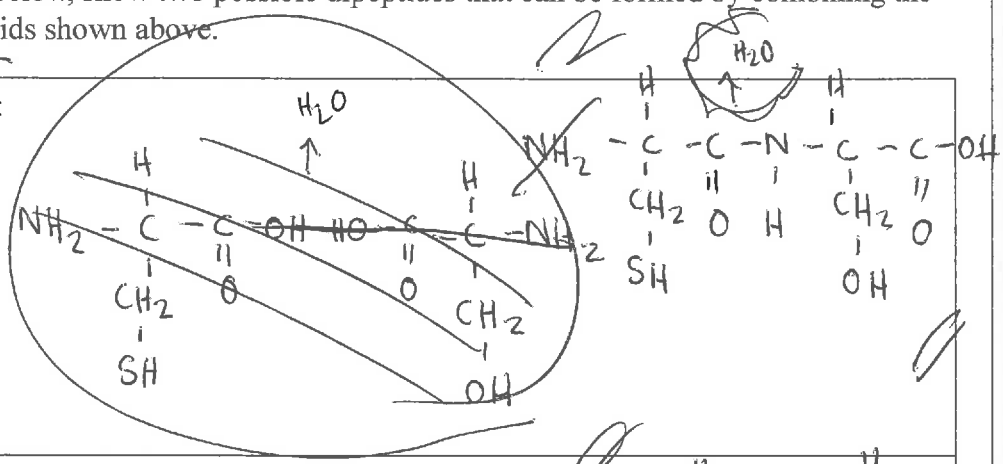
cysteine



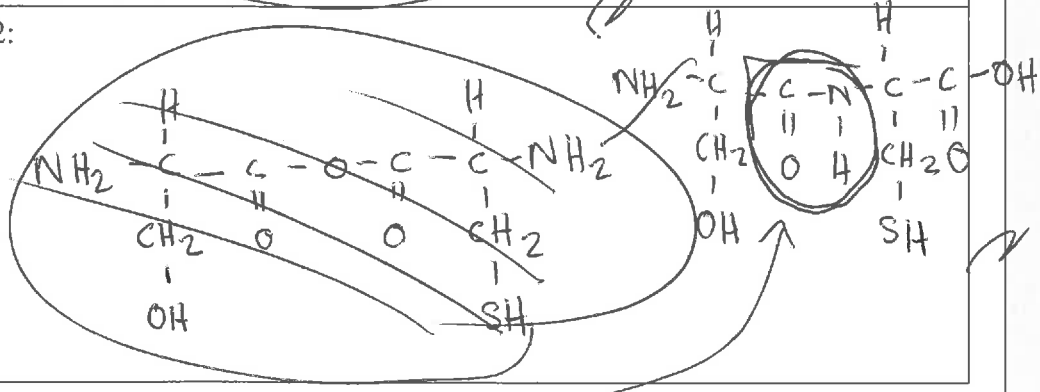
serine

(a) (i) In the boxes below, show two possible dipeptides that can be formed by combining the two amino acids shown above.

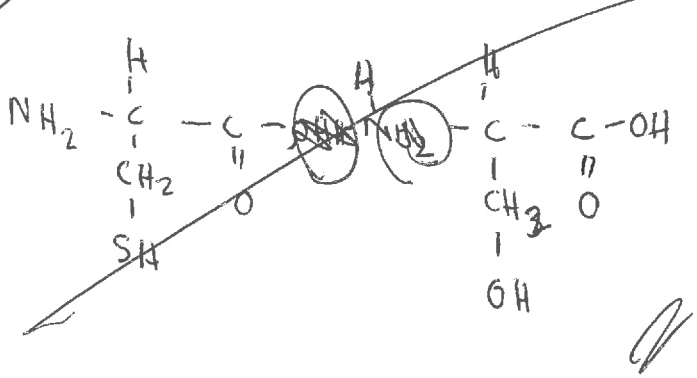
Dipeptide 1:



Dipeptide 2:



(ii) Circle the amide functional group on ONE of the dipeptides drawn in part (i).



(b) Nomex® is a polymer used in firefighters' suits. Nomex® is made up of two different monomers bonded together to form the polymer chain.

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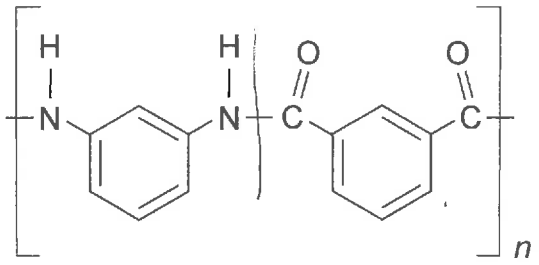
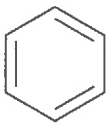
A small portion of the structure of Nomex® is shown below.

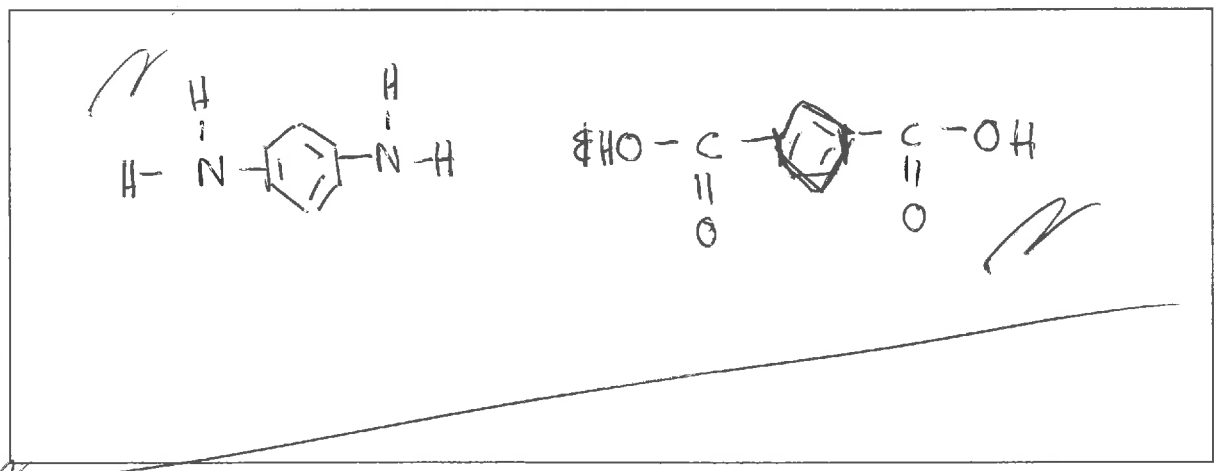


Note:  is a benzene ring and does not change when the monomers bond together to form the polymer.

Explain the structure of the polymer, Nomex®.

In your answer, you should include:

- the name of the functional group linking the monomers
- a drawing of both monomers
- a classification of the type of polymer formed, with an explanation to justify your choice.



The name of the functional group linking the monomers is called the amide link. The Nomex polymer is formed by the two moromers above with H_2O. H_2O attaches the moromers together ~~when they are~~ This is because when they are broken apart ~~through the~~ amide link, H_2O is condensated out. An OH is attached to the carbonyl group and an H is attached to the amino group.

(c) Polymers such as Nomex® can be hydrolysed by either aqueous acid or base.

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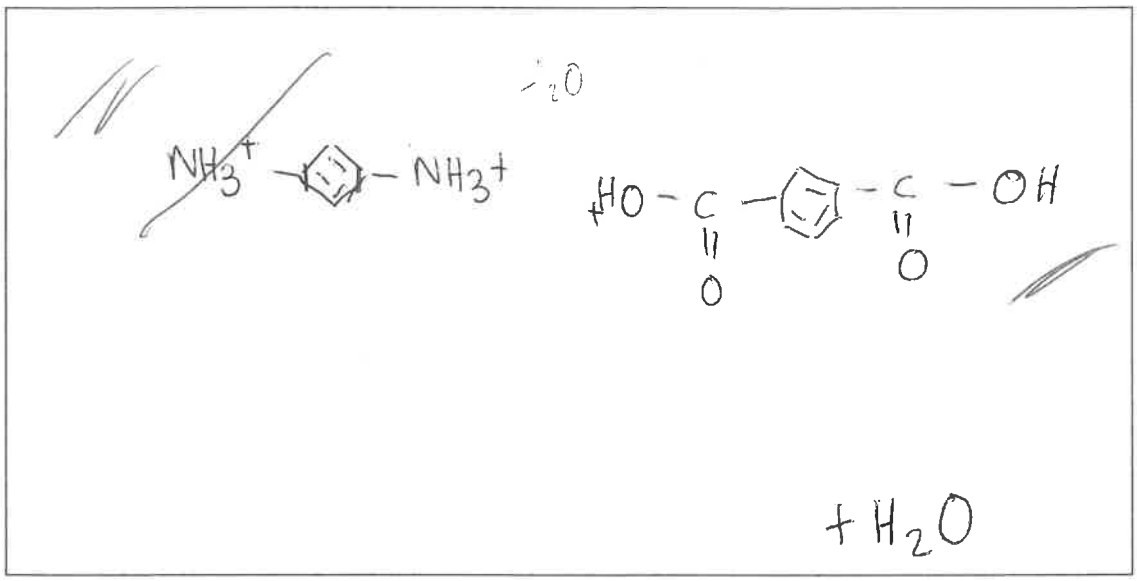
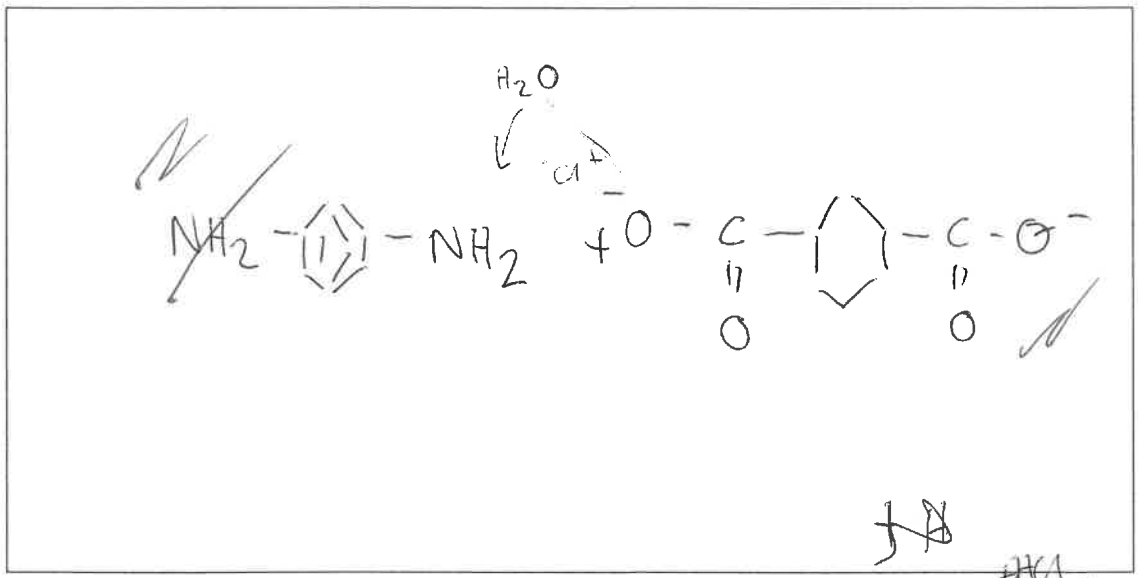
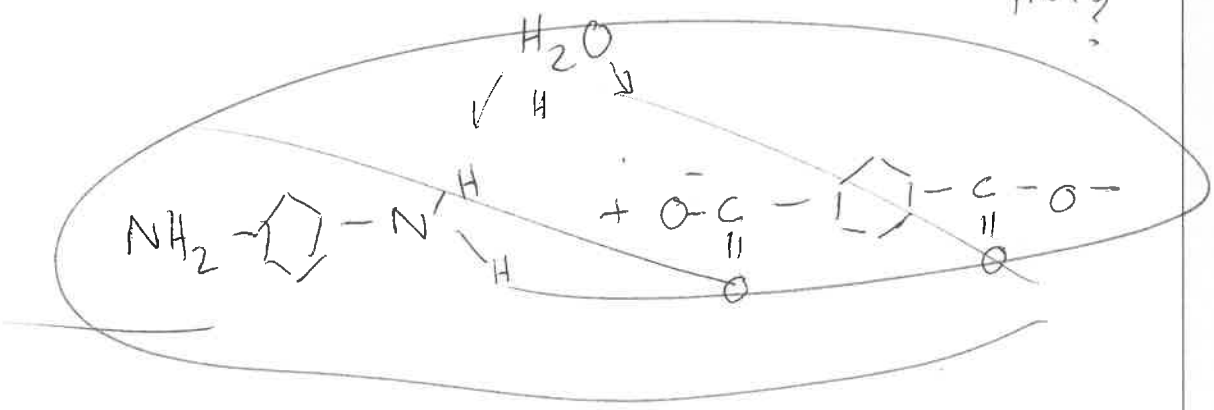
Show the products of the hydrolysis of Nomex® using:

(i) aqueous acid



(ii) aqueous base.





Subject:	Chemistry	Standard:	91391	Total score:	15

Q	Grade score	Annotation
1	M5	The candidate can draw most structures correctly, can follow a reaction scheme and understands optical isomers. Had the candidate eliminated errors with the drawing of structures in Q1(a), (b) or (c) they would have gained an M6 or higher.
2	M5	Again, errors drawing structures in Q2(a) have prevented a higher grade. Also, the answer to part (b)(i) lacks clarity. The colour change is reversed and there needs to be greater reference to the requirement to separate propanal the moment it is formed to prevent further oxidation to propanoic acid.
3	M5	Again, errors drawing structures have prevented a higher grade. When drawing functional groups such as NH_2 or OH of the left-hand side of a molecule they need to be drawn as they would connect, e.g. H_2N and HO. Also, the description of condensation polymerisation in part (b) is not clear enough for a higher grade.