3

91391

913910

SUPERVISOR'S USE ONLY

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.

Excellence

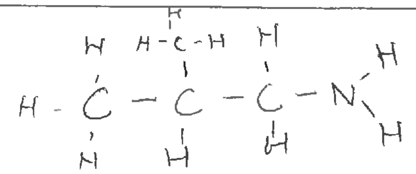
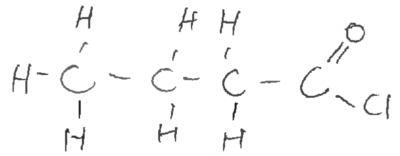
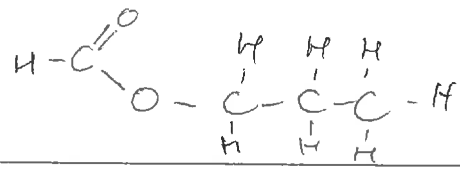
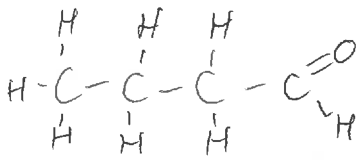
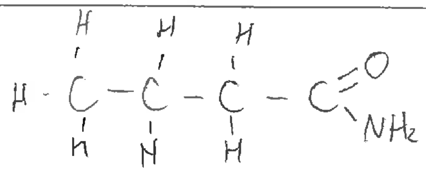
TOTAL 21

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

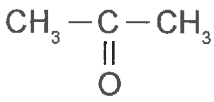
(a) Complete the table below to indicate the IUPAC name, functional group, and / or the structural formula for organic compounds that contain **only four carbon atoms**. The first row has been completed for you.

Functional group	Structural formula	IUPAC (systematic) name
Alkene	$CH_3CH_2CH{=}CH_2$	but-1-ene
Amine		2-methylpropan-1-amine
Acyl chloride		butanoyl chloride
Ester		propyl methanoate
Keytone	$CH_3CH_2-\underset{\underset{O}{\Vert}}{C}-CH_3$	butan-2-one
Aldehyde		butanal
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**.

ASSESSOR'S USE ONLY

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

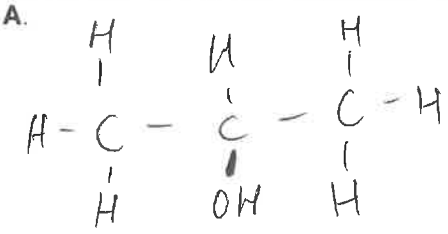


Propanone

Type of reaction: Reduction

Reagent 1: $NaBH_4$

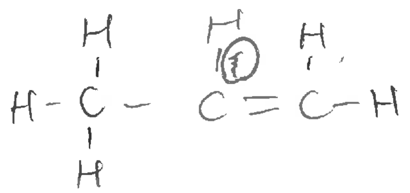
A.



Type of reaction: elimination/dehydration

Reagent 2: conc H_2SO_4

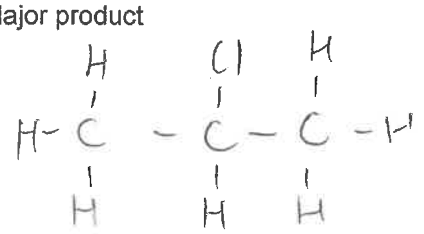
B.



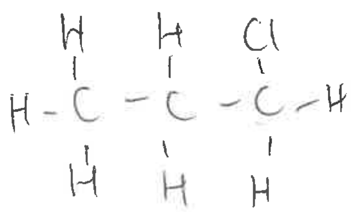
Type of reaction: addition

Reagent 3: HCl

C. Major product



D. Minor product

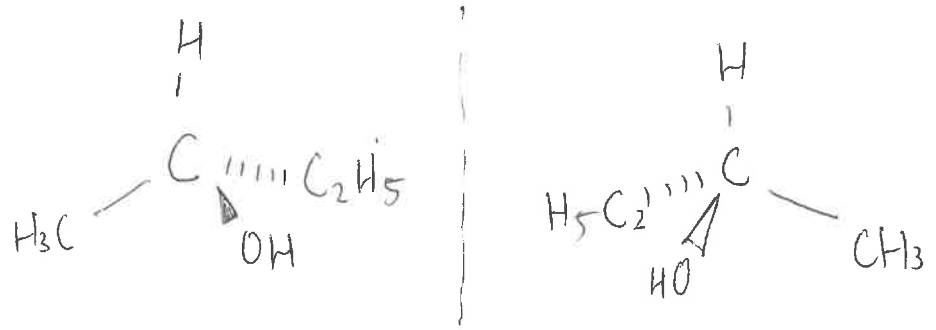


(c) Some organic compounds can exist as enantiomers (optical isomers).

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

ASSESSOR'S USE ONLY

(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.

In order to be an enantiomer the molecule must contain a chiral carbon atom. A chiral carbon atom is a carbon atom in which is bonded to 4 ~~other~~ ~~carbon~~ different groups of atoms: e.g in C_4H_9OH the central C atom is bonded to a H atom, a CH_3 group, a ~~a~~ C_2H_5 group and an OH group To distinugish between the different enantiomers shine plane polarised light through the solutions and each enantiomer will ~~a~~ rodate the plane polarised light in opposite directions

E7

This page has been deliberately left blank.

The examination continues on the following page.

QUESTION TWO

ASSESSOR'S USE ONLY

(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**.

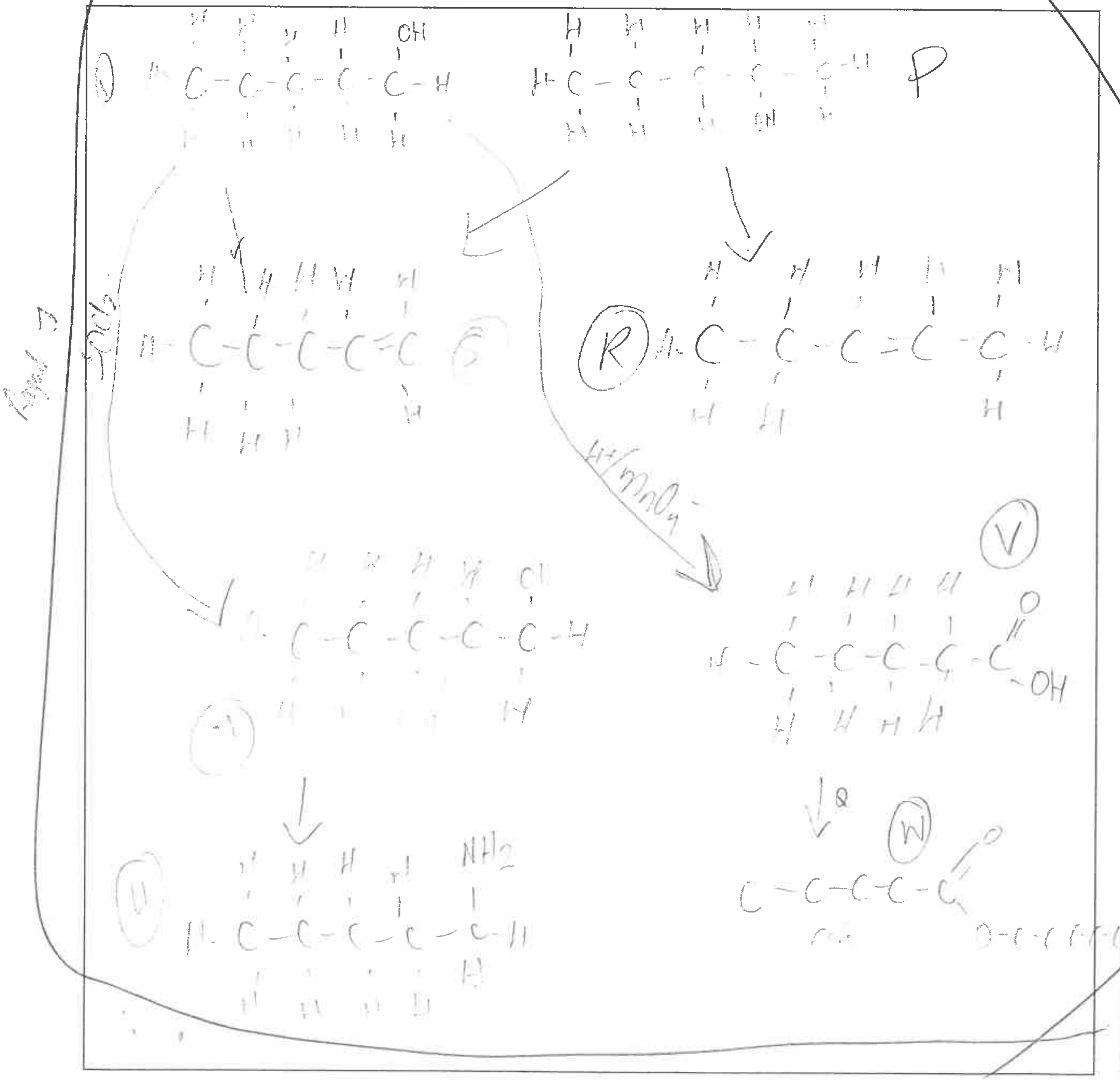
Compound **Q** can also be oxidised to form compound **V**, which will turn moist blue litmus paper red.

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**.

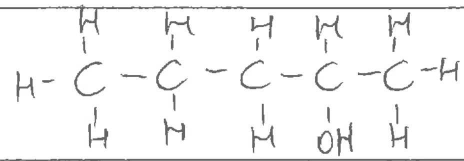
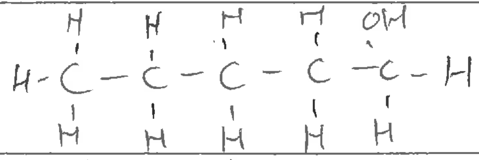
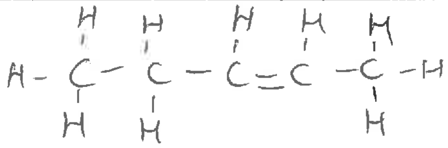
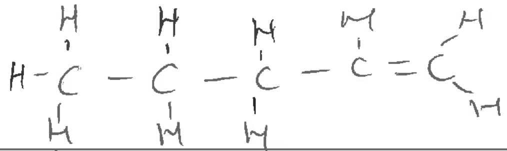
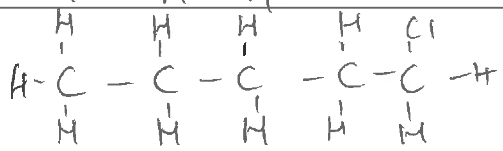
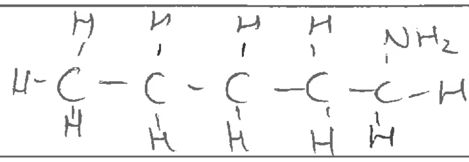
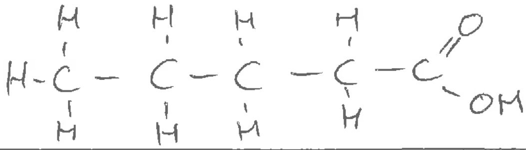
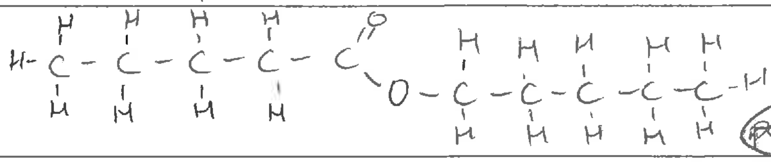
pencil

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



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

ASSESSOR'S USE ONLY

Compound	Structure
P	 pentan-2-ol
Q	 pentan-1-ol
R	 pent-2-ene
S	 pent-1-ene
T	 1 chloropentane
U	 pentan-1-amine
V	 penanoicacid
W	 ~~pentanoyl~~ pentyl pentanoate

Reagent 1	$SOCl_2$
Reagent 2	conc H_2SO_4

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

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

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.

ASSESSOR'S USE ONLY

~~use distillation~~ when propan-1-ol is added to ~~H~~ acidified dichromate a oxidation reaction is taking place. This should be done using the process of distillation, where the solution is heated to speed up the rate of reaction. Since oxidation is taking place the colour of the solution will change from ~~orange~~ orange to green. Since propanal has the lowest boiling point once it is formed and the temperature has reached its BP the propanal will turn into gas while the propan-1-ol ~~propanoic acid~~ propanoic acid (if made) still remain liquids. The vapour ~~BP~~ of propanal will ~~enter a~~ rise upwards and enter a condenser which has cold water running through it to cool the gas down back into a liquid which should only be propanal

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

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.

So the solution will remain blue

propanone is a keytone and is not further oxidised whereas propanal undergoes oxidation to form propanoic acid and will turn from Blue and form an orange ~~ppt~~ precipitate.

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

$CH_3CH_2CHO \rightarrow CH_3CH_2COOH$

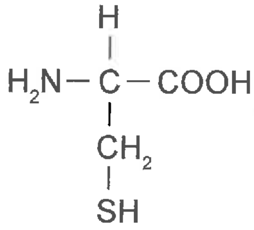
E7

QUESTION THREE

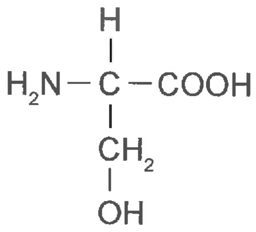
ASSESSOR'S USE ONLY

Peptides are molecules that form when amino acids combine.

The following structures show the amino acids cysteine and serine.



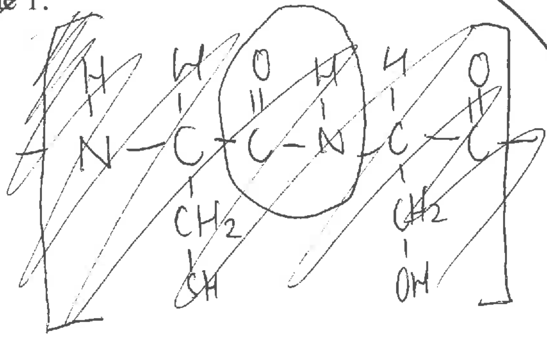
cysteine

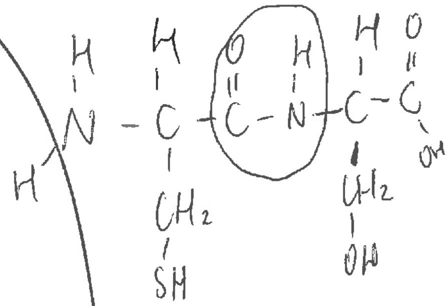


serine

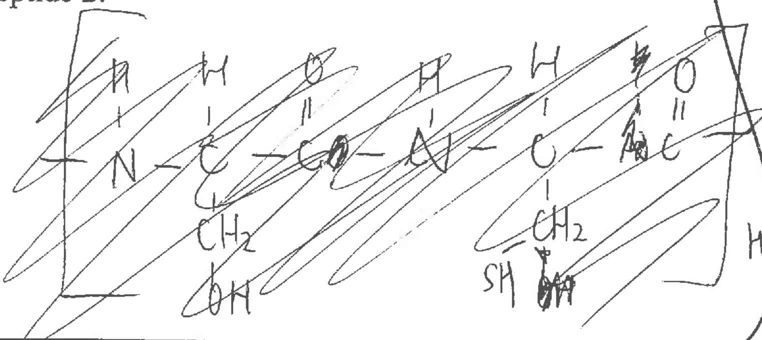
(a) (i) In the boxes below, show two possible dipeptides that can be formed by combining the two amino acids shown above.

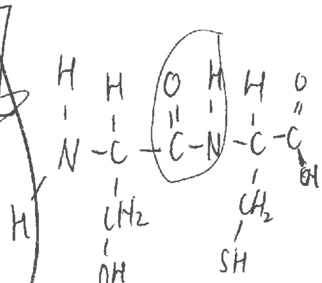
Dipeptide 1:





Dipeptide 2:

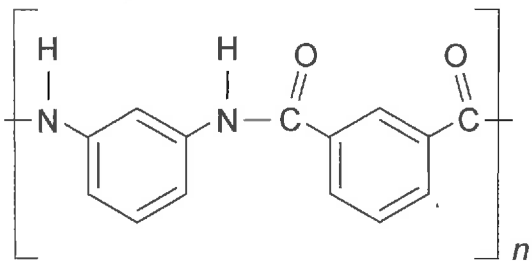


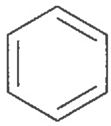


(ii) Circle the amide functional group on ONE of the dipeptides drawn in part (i).

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

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

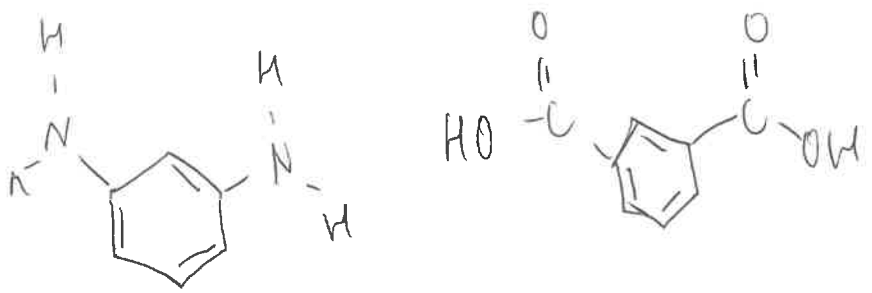


Note:  is a benzene ring and does not change when the monomers bond together to form the polymer.

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 functional group linking the monomers is an amide linkage this is because the 2 monomers undergo ~~ß~~ condensation polymerisation, it is when the 2 monomer join together whilst an smaller molecule in this case H_2O is condensed out. As the OH from the carboxylic joins with an H off the amine group making H_2O and allowing a bond to form between the different monomers.

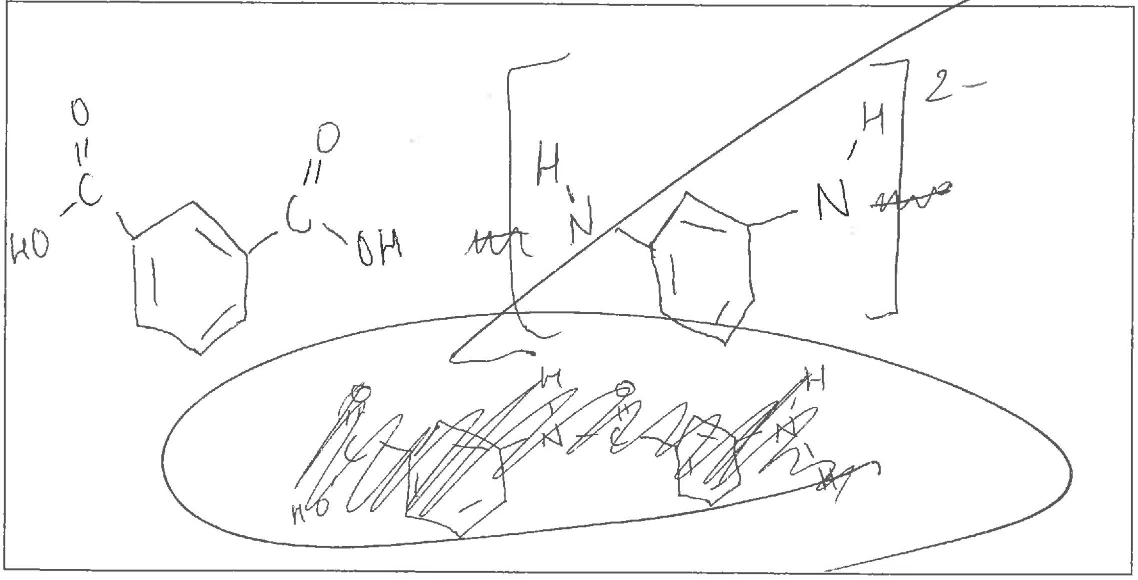
The polymer is an ~~a~~ polyamide due to the amide linkage

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

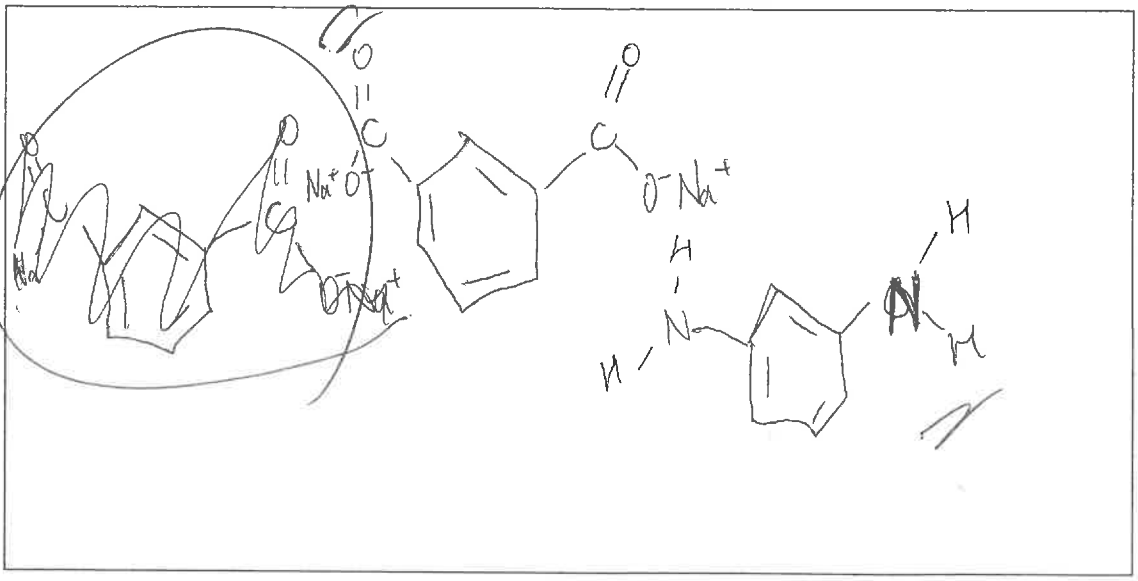
ASSESSOR'S USE ONLY

Show the products of the hydrolysis of Nomex® using:

(i) aqueous acid



(ii) aqueous base.



E7

Subject:	Chemistry	Standard:	91391	Total score:	21

Q	Grade score	Annotation
1	E7	This response gains E7, rather than E8 because the explanation of enantiomers is incomplete. Had the candidate also described the feature of being non-superimposable mirror images they would have gained an E8.
2	E7	To gain an E8 the candidate would have needed to: Either in part (b)(i), have more clearly explained the need to remove propanal from the reaction mixture immediately to prevent further oxidation to propanoic acid, Or in part (b)(ii), included the need for warming the mixture.
3	E7	To gain E8, the candidate needed to correctly draw the protonated diamine structure in part (c)(i).