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, 2015

91391 Demonstrate understanding of the properties of organic compounds

2.00 p.m. Wednesday 11 November 2015
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

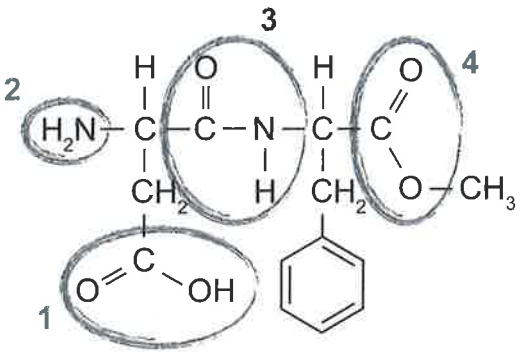
TOTAL 15

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

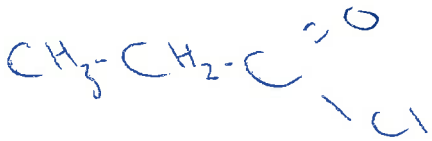
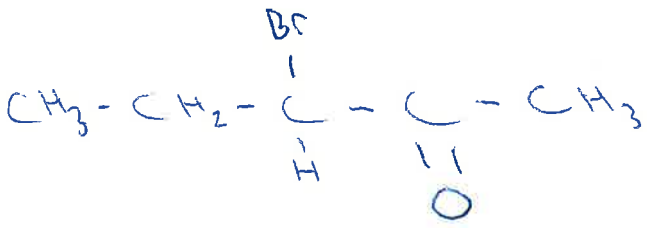
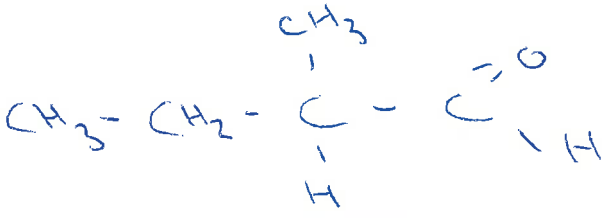
(a) The structure of aspartame is given below. Aspartame is often used as an artificial sweetener in drinks.



Identify the FOUR different functional groups within the aspartame molecule that are circled and numbered above:

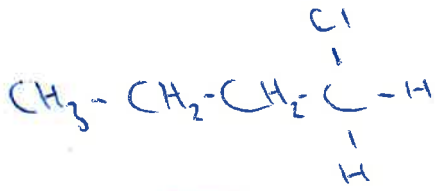
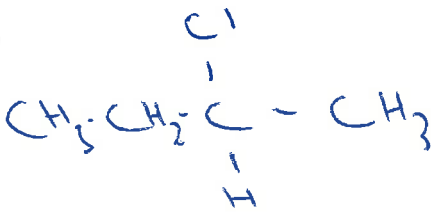
1	carboxylic acid	2	amine
3	amide link	4	ester

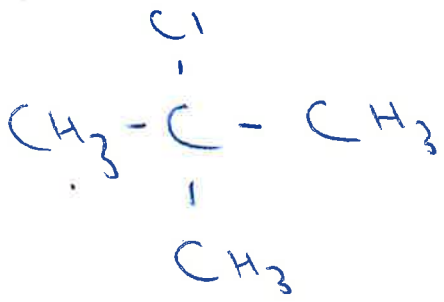
(b) Complete the table below by drawing the structural formula for the named compounds.

IUPAC systematic name	Structural formula
propanoyl chloride	
3-bromopentan-2-one	
2-methylbutanal	

ASSESSOR'S USE ONLY

(c) (i) In the boxes below, draw the three structural isomers of C_4H_9Cl that represent a primary, secondary and tertiary haloalkane.

Primary haloalkane	Secondary haloalkane
	

Tertiary haloalkane


(ii) Elaborate on the reactions occurring when each of the haloalkane isomers from (c)(i) reacts with KOH in alcohol.

In your answer you should include:

- the identification of ALL organic products formed
- an explanation of the type of reaction taking place
- reasons for the formation of any major and minor products.

1-Chlorobutane will undergo a elimination reaction with KOH to form but-1-ene, KCl and H_2O.

2-Chlorobutane will form 2 different structural isomers of butene. in its elimination reaction with KOH

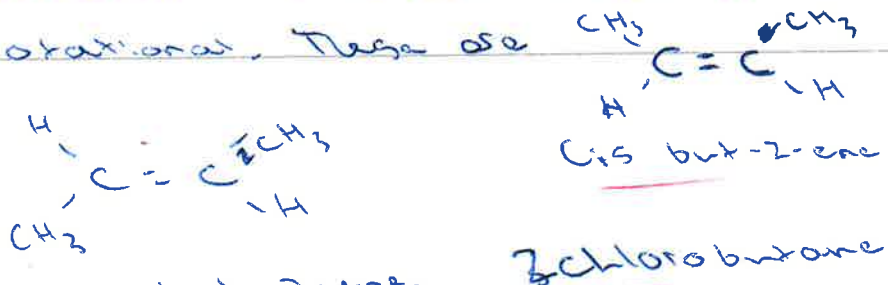
There is more space for your answer to this question on the following page.

ASSESSOR'S USE ONLY

but-2-ene and but-1-ene

$H_3C\,HC=CH\,CH_3$ $H_3C\,H_2C\,HC=CH_2$

According to Saytzeff's rule the carbon with the fewest H atoms attached to it adjacent to the carbon bonded to the Cl will lose another H and form a double bond with the Cl carbon in the elimination reaction. Hence but-2-ene will be the major product and but-1-ene the minor. 2-chlorobutane will also form 2 geometric isomers of but-2-ene as the two groups on the double bonded carbons are different and the double bond is fixed and non rotational. These are



cis but-2-ene

and

trans but-2-ene.

2-chlorobutane will also form the same KCl and H_2O products.

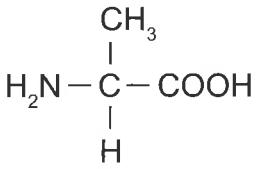
1,1, dimethyl, 1 chloroethane will react in an elimination reaction KOH to produce 1,1, dimethyl ethene and KCl and H_2O.

M6

QUESTION TWO

ASSESSOR'S USE ONLY

Alanine is an amino acid. Its structure is shown below.



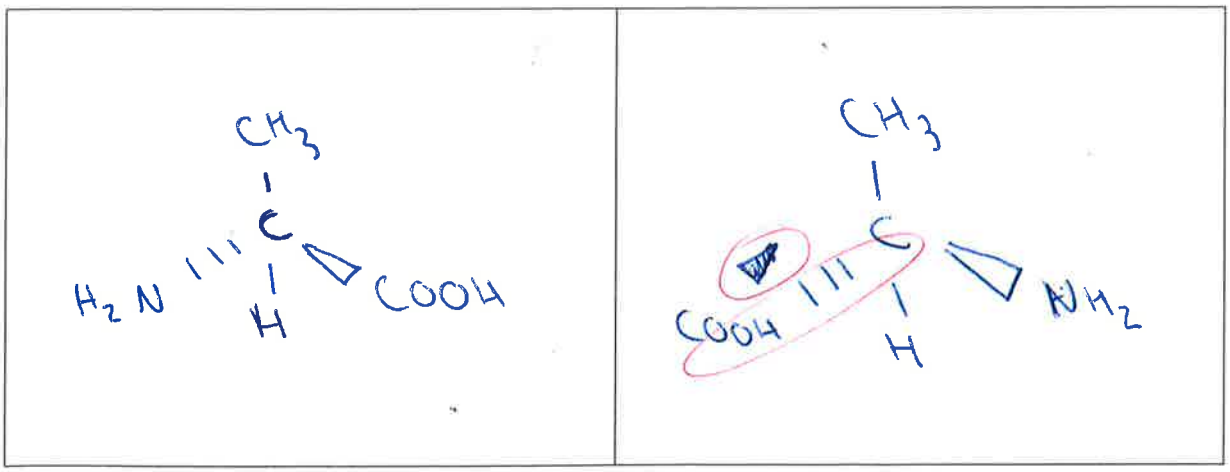
(a) (i) Describe the structural feature necessary for a compound to exist as enantiomers (optical isomers).

It has a chiral carbon in the centre with 4 different groups attached to it.

(ii) Identify one physical property that is the same for both enantiomers of alanine, and one that is different, clearly describing how this property could be used to distinguish between the enantiomers.

both enantiomers rotate the plane of polarised light. One enantiomer will rotate the plane of polarised light one way and the other enantiomer will rotate it 90° in the other direction from the first.

(b) Draw 3-D structures of the enantiomers of alanine in the boxes below.



ASSESSOR'S USE ONLY

(c) A form of the polymer nylon can be made from the two monomers below.

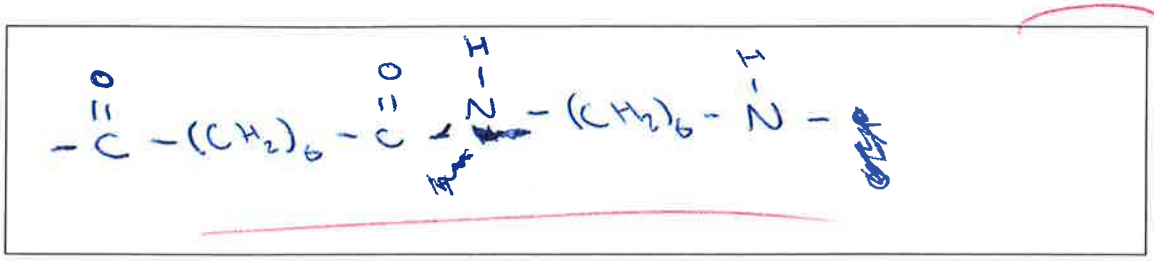
1,6-diaminohexane

$$H_2N-(CH_2)_6-NH_2$$

Sebacoyl chloride (decanedioyl dichloride)

$$Cl-\overset{\overset{O}{\|}}{C}-(CH_2)_8-\overset{\overset{O}{\|}}{C}-Cl$$

(i) In the box below draw the repeating unit of the polymer formed if these two monomers are used.



Consider the formation of this form of nylon in a laboratory.

(ii) Describe the type of reaction occurring, and explain why this reaction results in a polymer.

In the formation of nylon a condensation reaction is occurring as two large molecules are combining and producing a small molecule, in this case HCl. This reaction forms a polymer as the H from the diamine and the Cl from the dichloride are constantly being removed from either side of the chain.

(iii) Explain why sebacoyl chloride is dissolved in a non-polar organic solvent rather than in water.

because it has an acid chloride (functional) group which reacts violently with water and produces a carboxylic acid and poisonous HCl gas which would be dangerous in a lab.

(iv) Elaborate on the reaction that will occur if a dilute aqueous solution of acid is mixed with the newly formed polymer.

ASSESSOR'S USE ONLY

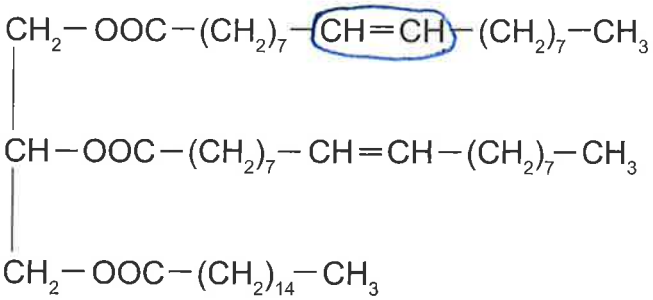
The polymer will undergo acid hydrolysation where the acid will break the amide links to form the original monomers if dilute HCl is used. or a dicarboxylic acid instead of the dioyl dichloride if H^+/H_2O is used as the acid.

MS

QUESTION THREE

ASSESSOR'S USE ONLY

(a) A triglyceride has the following structure:



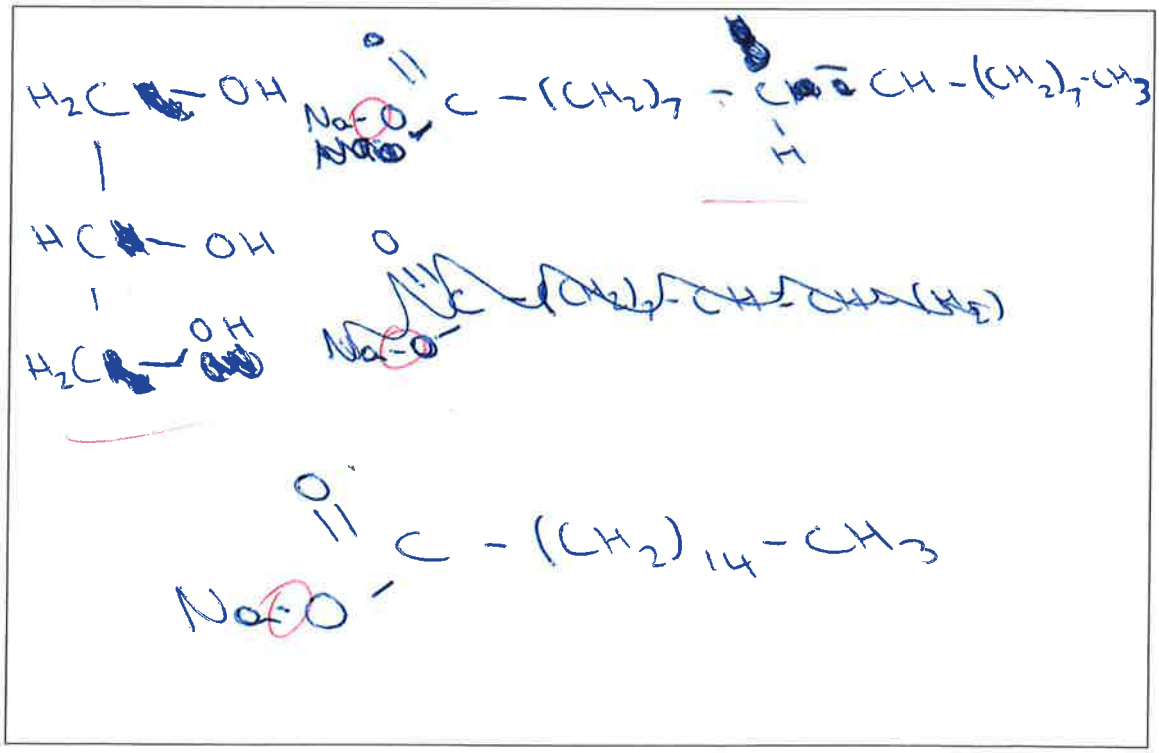
(i) Circle one of the alkene groups in the triglyceride molecule.

This triglyceride is described as unsaturated.

(ii) Describe a chemical test that can be used to show that the molecule is unsaturated. Give any observations, and state the type of reaction occurring.

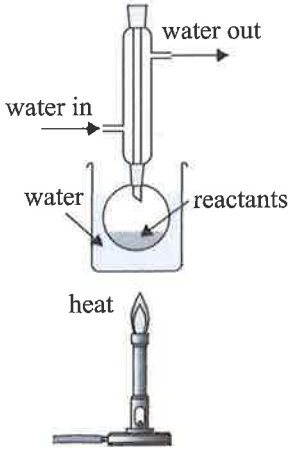
If you mix it with Br_2 (water from orange) the solution will decolourise quickly as the alkene group undergoes an addition reaction with Br_2 to form a dibromo alkane group which is colourless.

(iii) Draw the structural formulae of the organic products formed by hydrolysis of this triglyceride using aqueous sodium hydroxide.



(iv) Explain why the equipment below is used for hydrolysis of the triglyceride.

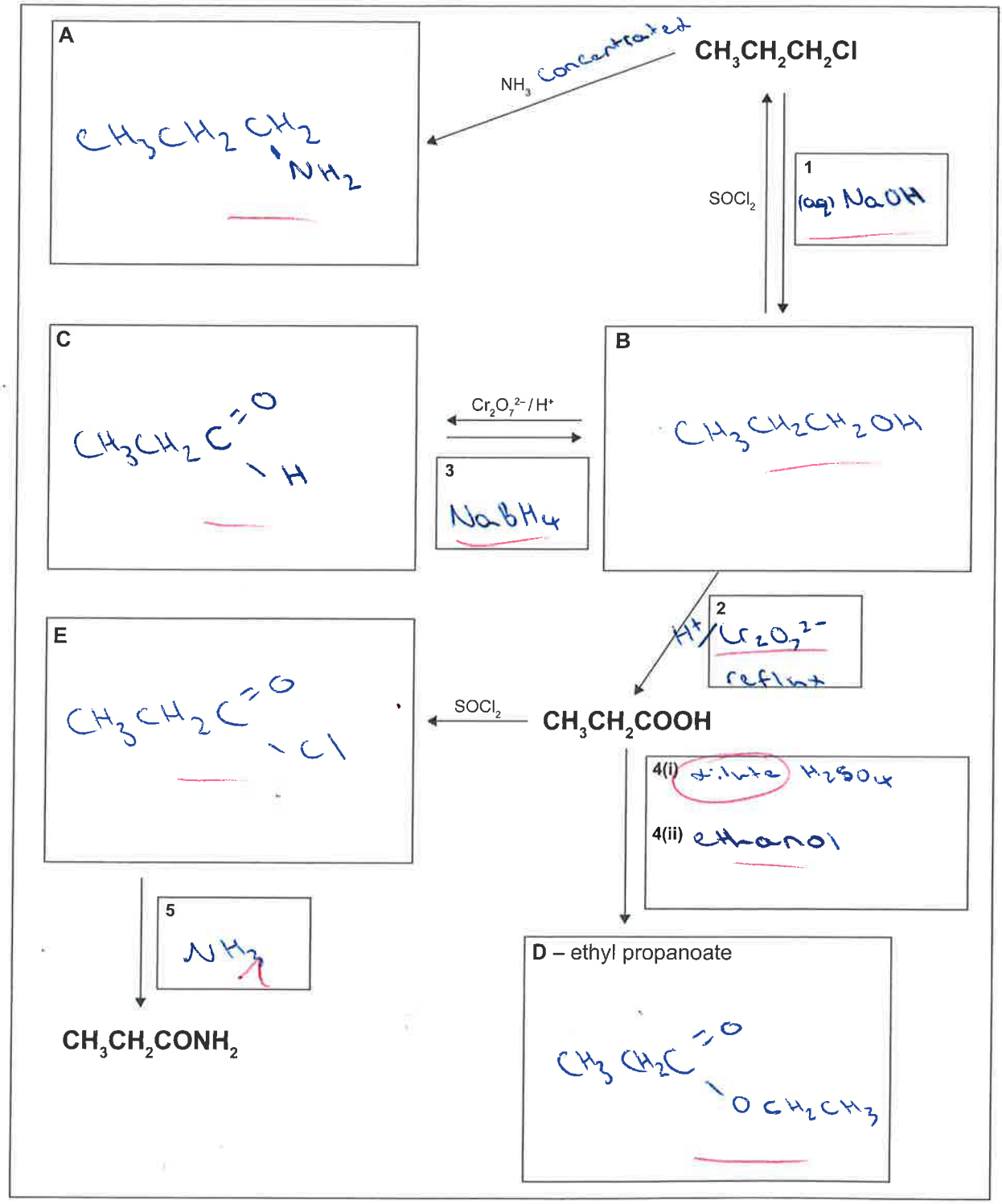
ASSESSOR'S USE ONLY



The is a refluxing equipment where you heat up the triglyceride with NaOH and ~~hydrolysis~~ it. Then it reacts to form its products at high temperature as it has the reaction has a high activation energy. The high temperature turns the substances into the gas form so they need to be condensed back down to liquid by using a cold water jacket. /1

Question Three continues on the following page.

(b) Complete the following reaction scheme by drawing the structural formulae of the organic compounds **A** to **E**, and identifying reagents **1** to **5**.



ASSESSOR'S USE ONLY

00

A4

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

91391

Grade score 15 – Low Merit

Q1

(c)(ii) Lacking the concept of asymmetry for major and minor products

Q2

(a)(ii) Lacking one physical property that is the same for both enantiomers

(b) Bonds drawn to incorrect atoms

(c)(iv) Lacking the ammonium salt product

Q3

(a)(iii) Incorrect covalent bonds drawn between the Na and the O atoms

(b) States and conditions are required for reagents

91391

913910

3

SUPERVISOR'S USE ONLY

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, 2015

91391 Demonstrate understanding of the properties of organic compounds

2.00 p.m. Wednesday 11 November 2015
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

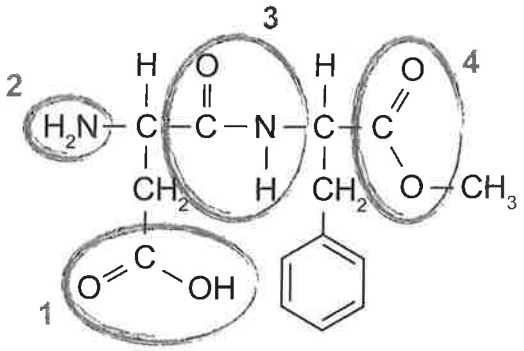
TOTAL 16

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

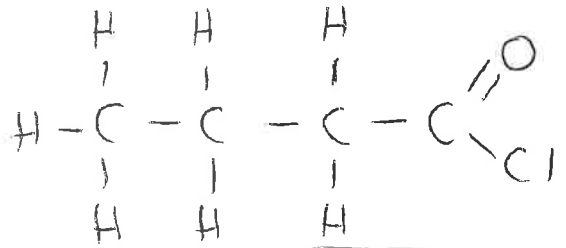
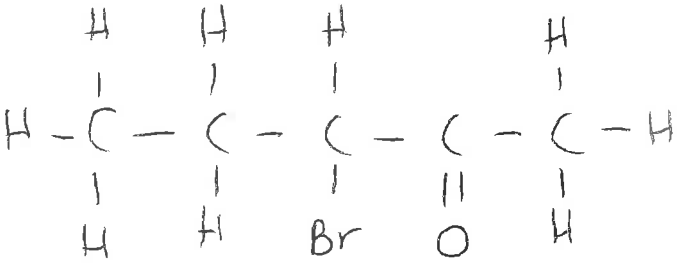
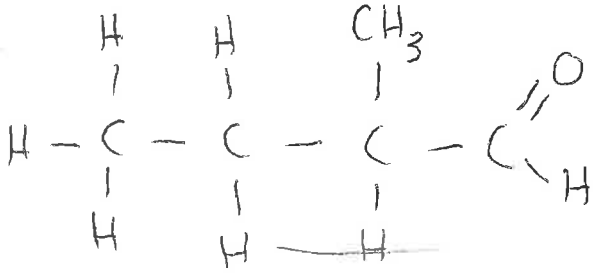
(a) The structure of aspartame is given below. Aspartame is often used as an artificial sweetener in drinks.



Identify the FOUR different functional groups within the aspartame molecule that are circled and numbered above:

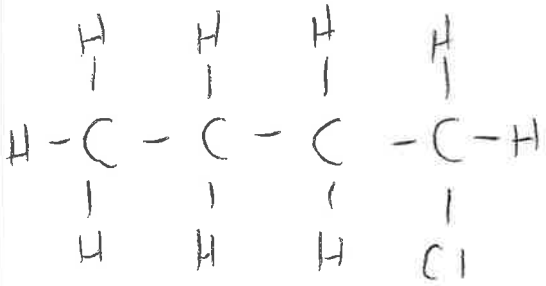
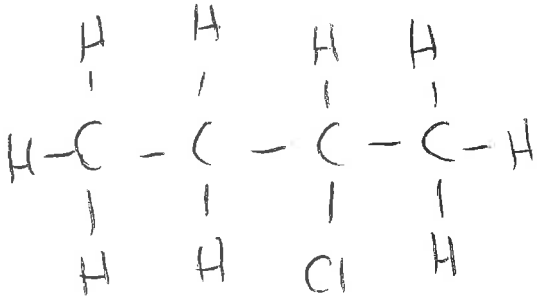
1	carboxyl group	2	Amino
3	~~Pept~~ Amide	4	Ester

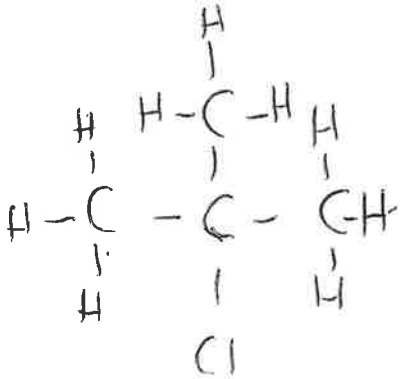
(b) Complete the table below by drawing the structural formula for the named compounds.

IUPAC systematic name	Structural formula
propanoyl chloride	
3-bromopentan-2-one	
2-methylbutanal	

(c) (i) In the boxes below, draw the three structural isomers of C_4H_9Cl that represent a primary, secondary and tertiary haloalkane.

ASSESSOR'S USE ONLY

Primary haloalkane	Secondary haloalkane
	

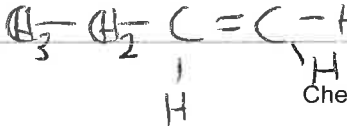
Tertiary haloalkane


(ii) Elaborate on the reactions occurring when each of the haloalkane isomers from (c)(i) reacts with KOH in alcohol.

In your answer you should include:

- the identification of ALL organic products formed
- an explanation of the type of reaction taking place
- reasons for the formation of any major and minor products.

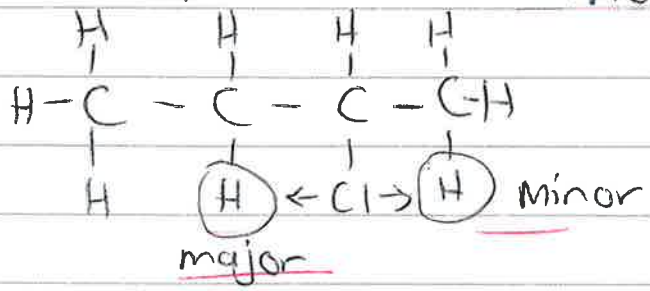
The reaction taking place with the haloalkane and alcoholic KOH is an elimination reaction, removal of HCl.
The primary halo alkane will have one organic product,
pentan-1-ene



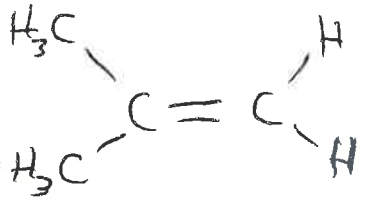
There is more space for your answer to this question on the following page.

ASSESSOR'S USE ONLY

The secondary haloalkane will however have a minor and major product, pentan-1-ene (MINOR) and pentan-2-ene (MAJOR), because the H from an adjacent carbon could come from either side and the major product is when the H is taken from the carbon with the least amount already.



This also applies with the tertiary alcohol as it will have a ~~major and minor product also~~, The tertiary alcohol will have this product, 2methylpropan-1-ene, as the molecule is symmetrical and will produce this either way.

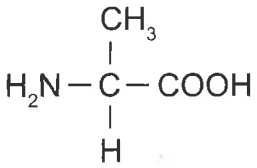


M6

QUESTION TWO

ASSESSOR'S USE ONLY

Alanine is an amino acid. Its structure is shown below.



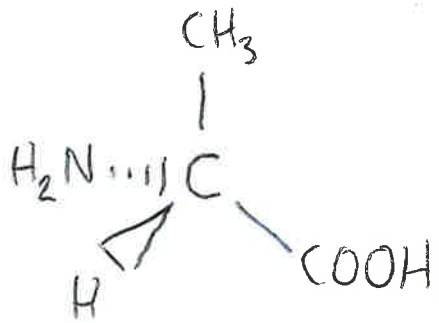
(a) (i) Describe the structural feature necessary for a compound to exist as enantiomers (optical isomers).

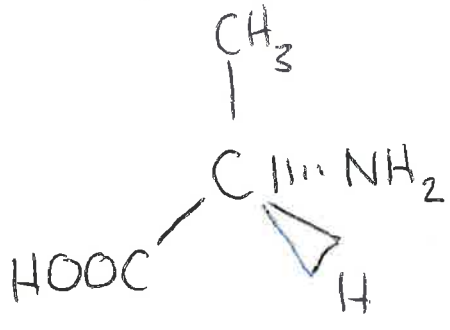
A chiral carbon, carbon with 4 different substituents attached.

(ii) Identify one physical property that is the same for both enantiomers of alanine, and one that is different, clearly describing how this property could be used to distinguish between the enantiomers.

Both enantiomers will have the same biological properties but will rotate the plane of plane-polarised light in DIFFERENT directions, this is how you can distinguish between the two.

(b) Draw 3-D structures of the enantiomers of alanine in the boxes below.





(c) A form of the polymer nylon can be made from the two monomers below.

1,6-diaminohexane

$$H_2N-(CH_2)_6-NH_2$$

Sebacoyl chloride (decanedioyl dichloride)

$$Cl-\overset{\overset{O}{\|}}{C}-(CH_2)_8-\overset{\overset{O}{\|}}{C}-Cl$$

(i) In the box below draw the repeating unit of the polymer formed if these two monomers are used.

$$\text{---}NH-(CH_2)_6-NH-\overset{\overset{O}{\|}}{C}-(CH_2)_8-\overset{\overset{O}{\|}}{C}-NH-(CH_2)_6-NH\text{---}$$

Consider the formation of this form of nylon in a laboratory.

(ii) Describe the type of reaction occurring, and explain why this reaction results in a polymer.

This is a condensation reaction as a small molecule, HCl, is removed and the other two are linked. Because these are both monomers with double functional groups they are able to produce long chains of the product.

(iii) Explain why sebacoyl chloride is dissolved in a non-polar organic solvent rather than in water.

Because sebacoyl chloride is a non-polar substance and will not dissolve in a polar substance like water.

ASSESSOR'S USE ONLY

ASSESSOR'S USE ONLY

(iv) Elaborate on the reaction that will occur if a dilute aqueous solution of acid is mixed with the newly formed polymer.

If acid is mixed into the reaction then the acid will react with the -NH to give $-NH_2^+$ by donating a proton (H^+).

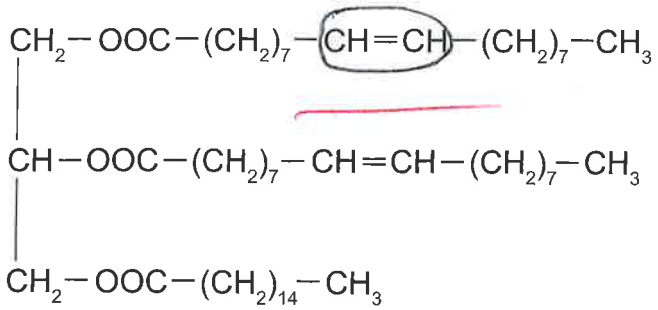
00

M5

QUESTION THREE

ASSESSOR USE ONLY

(a) A triglyceride has the following structure:



(i) Circle one of the alkene groups in the triglyceride molecule.

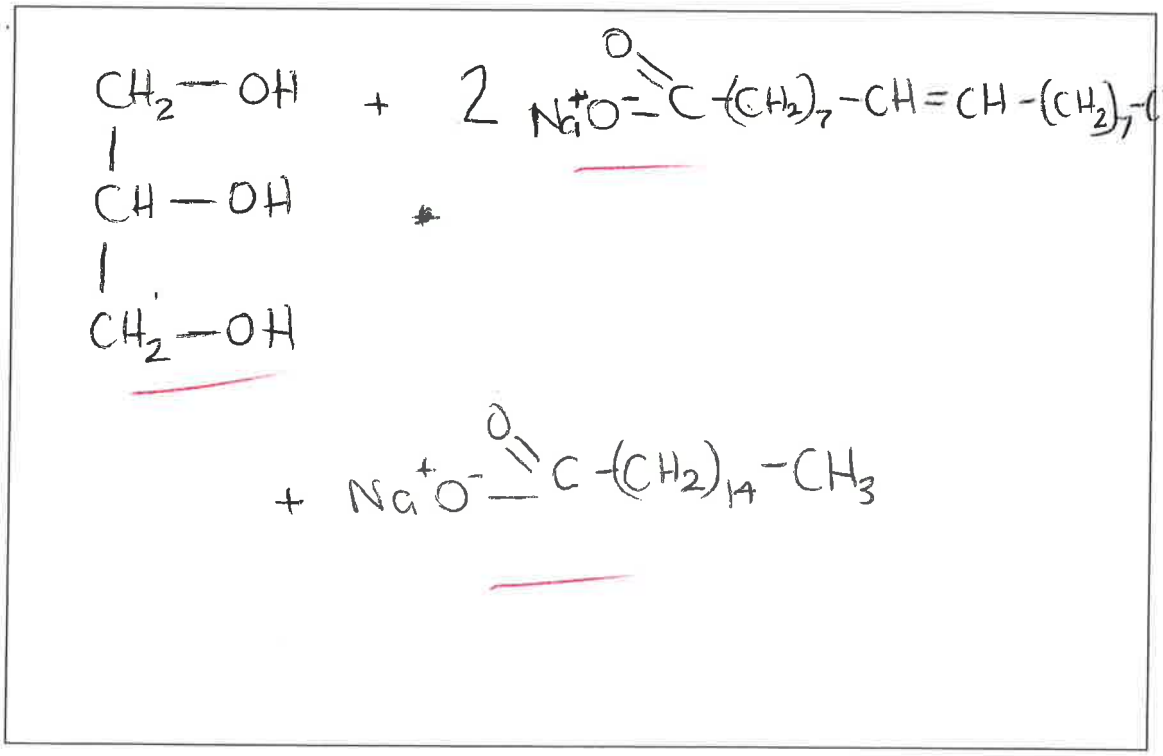
This triglyceride is described as unsaturated.

(ii) Describe a chemical test that can be used to show that the molecule is unsaturated.

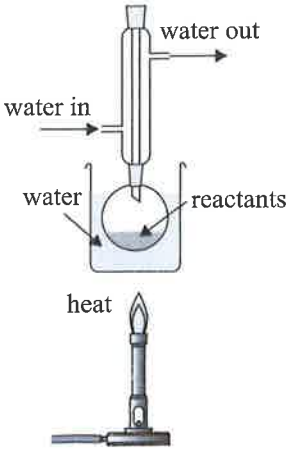
Give any observations, and state the type of reaction occurring.

By adding bromine water, Br_2, the double bond will open up and 2Br will be added across and the solution will turn from brown to colourless but if it was saturated there would be no change, this is an addition reaction.

(iii) Draw the structural formulae of the organic products formed by hydrolysis of this triglyceride using aqueous sodium hydroxide.



(iv) Explain why the equipment below is used for hydrolysis of the triglyceride.



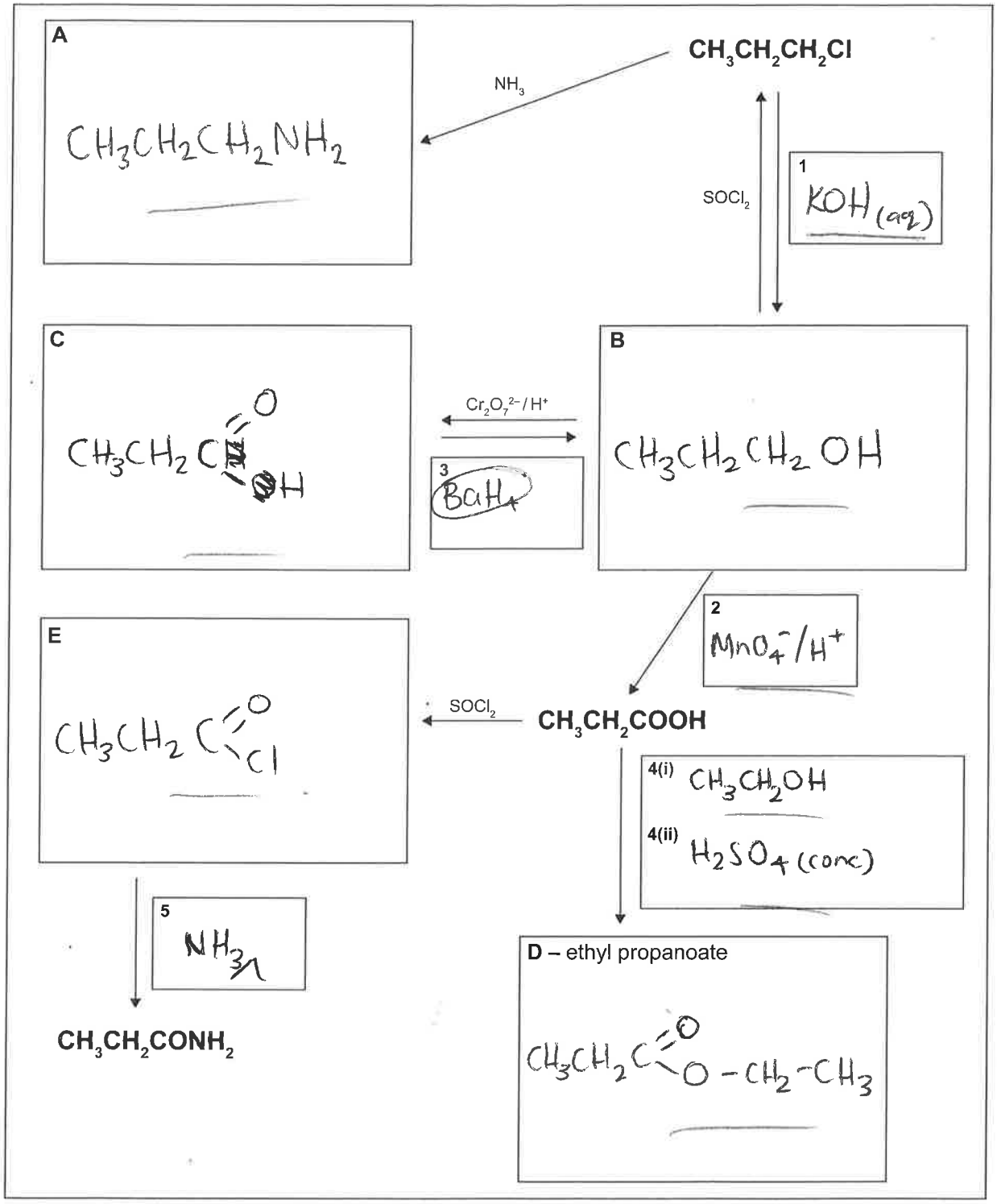
This reflux apparatus is used to condense any volitile gases back down, to fully react, so that all reactants go to products and no gases will escape. 4

ASSESSOR'S USE ONLY

Question Three continues on the following page.

(b) Complete the following reaction scheme by drawing the structural formulae of the organic compounds **A** to **E**, and identifying reagents **1** to **5**.

ASSESSOR'S USE ONLY



M5

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

91391

Grade score 16 – Higher Merit

Q1

(c)(ii) Good discussion however, for excellence candidates need to name products correctly

Q2

(a)(ii) Lacking one physical property that is the same for both enantiomers

(c)(i) Incorrect repeating unit

(c)(ii) Reference to why a polymer is formed missing

(c)(iv) Elaboration including the type of reaction and products produced required

Q3

(a)(ii) Bromine water will change colour from orange/red to colourless

(a)(iv) Reflux is used to increase the rate of reaction

(b) States are required