EXEMPLAR

90698

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 3 Chemistry, 2007

90698 Describe aspects of organic chemistry

Credits: Five
9.30 am Monday 19 November 2007

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 answer ALL the questions in this booklet.

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 2–9 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.

For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe aspects of organic chemistry. ✓	Explain and apply aspects of organic chemistry. ✓	Discuss aspects of organic chemistry. ✓
Overall Level of Performance E		

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You are advised to spend 40 minutes answering the questions in this booklet.

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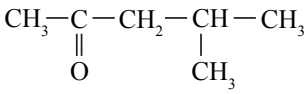
QUESTION ONE

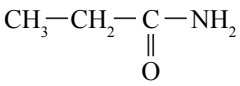
(a) Give the systematic IUPAC names for the following molecules

(i)



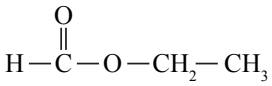
4-methyl pentan-2-one

(ii)



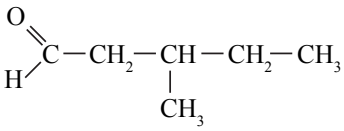
propanamide

(iii)



~~methyl ethanoate~~
ethyl methanoate

(iv)



3-methyl pentanal

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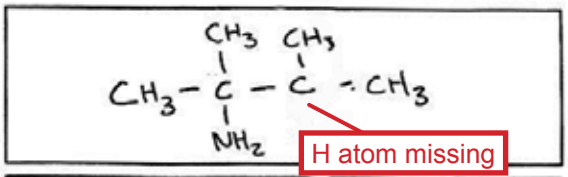
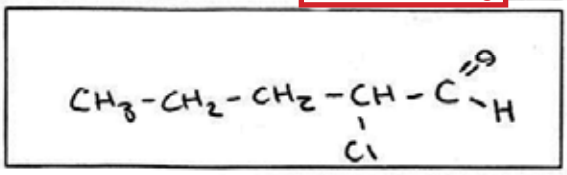
(b) Draw the structural formula of each of the organic compounds below:

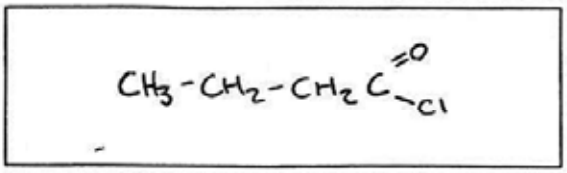
(i) 2-amino-2,3-dimethyl butane



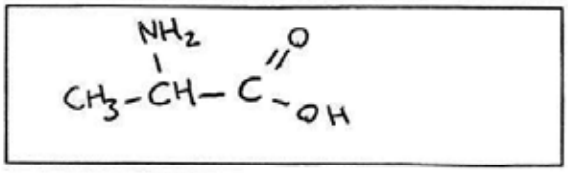
(ii) 2-chloro pentanal



(iii) An acid chloride with 4 carbon atoms



(iv) An amino acid with 3 carbon atoms



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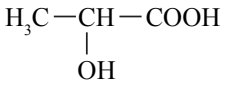
QUESTION TWO

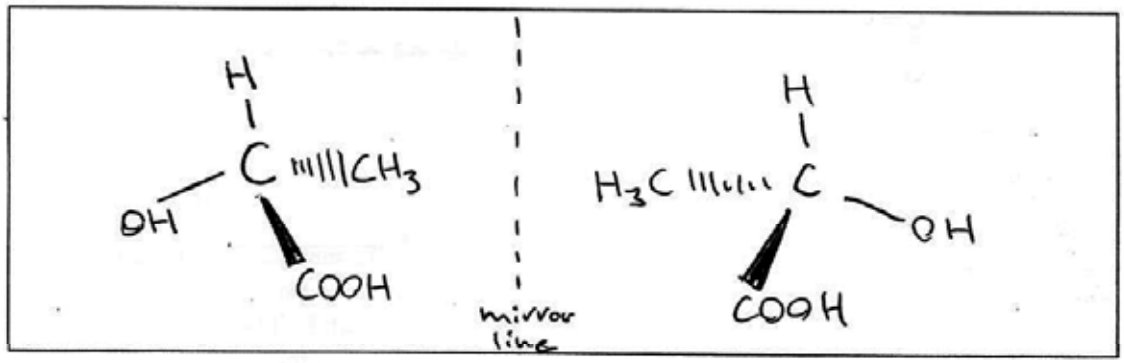
Assessor's use only

Lactic acid is the common name for 2-hydroxypropanoic acid.



Lactic acid can exist as enantiomers (optical isomers)

(a) Draw three-dimensional structures for the two enantiomers of lactic acid that clearly show the relationship between them.



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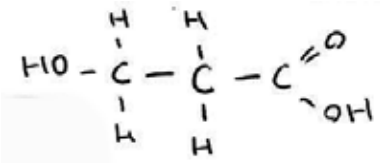
(b) Compound **X** is a structural isomer of lactic acid. Compound **X** will turb blue litmus red but cannot exist as enantiomers.

(i) Draw the structural formula for Compound **X**.



Structure of Compound **X**

(ii) Explain why this structure cannot exist as enantiomers.

It has no chiral carbon - no carbon with 4 different groups attached, so it cannot exist in forms that are non-transposable.

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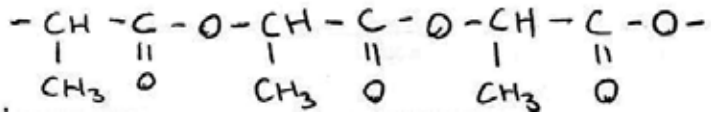
(c) Lactic acid is able to form a condensation polymer in the presence of dilute sulfuric acid.

Assessor's use only

Draw three repeating units of this polymer.

Monomer: HO—CH(CH$_3$)—C(=O)—OH

Section of polymer chain:



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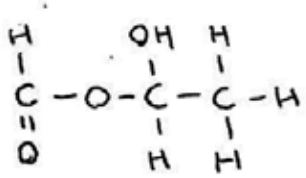
(d) Compound **Z** is an isomer of lactic acid that has a much lower boiling point than lactic acid. A water solution of Compound **Z** does not change the colour of blue litmus. When Compound **Z** is reacted with acidified dichromate solution, the resulting organic compound shows no acidic properties, and it is not a cyclic molecule.

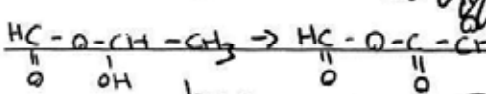
Draw the structural formula for Compound **Z** and justify your answer using the information given above.



Structure of Compound **Z**

Justification for the structure drawn:

lactic acid has a higher BP than this molecule because it has more -OH groups, which hydrogen bond with each other. Compound Z does not change blue litmus as it has no acid groups. When reacted with $Cr_2O_7^{2-}/H^+$, the reaction is



becoming =O, which has no acidic properties. If the alcohol group were on end end carbon, the only other option, it would oxidise to COOH. Compound Z is clearly not cyclic.

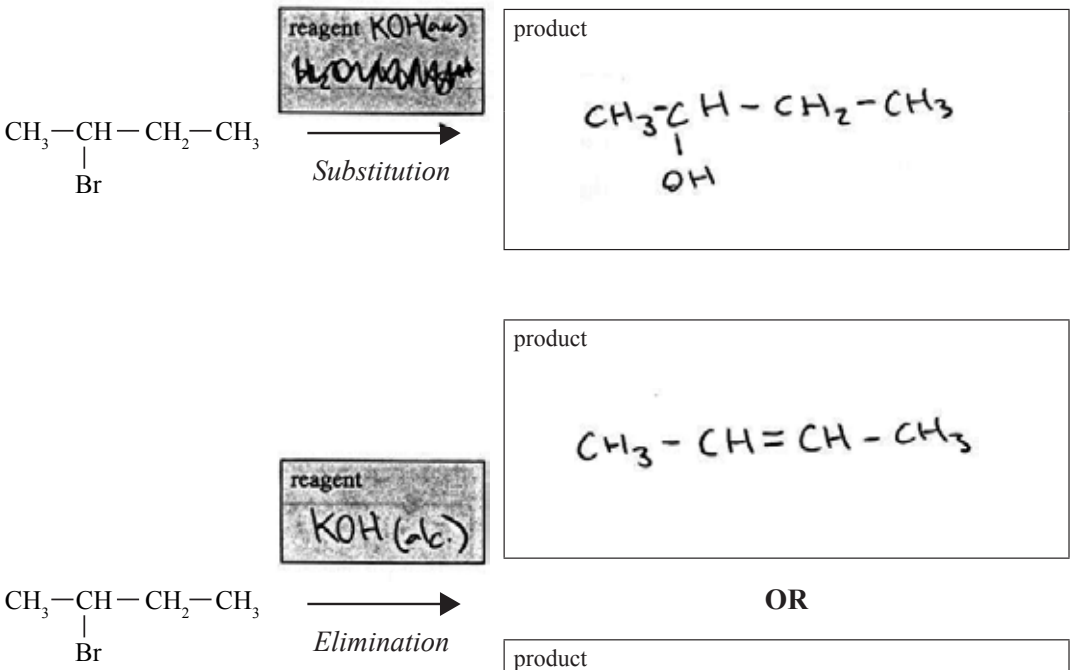
E

QUESTION THREE

Assessor's use only

(a) 2-bromobutane reacts by ***substitution*** to form 2-butanol. However, if the reaction conditions are changed, an ***elimination*** reaction occurs. There are two possible products for the elimination reaction.

Complete the following reaction scheme by indicating the reagents in the shaded boxes and the organic products in the other boxes for each of these reactions of 2-bromobutane.



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(b) Changing reaction conditions results in different products for the reaction of ethanoic acid (CH_3COOH) with aminoethane ($CH_3CH_2NH_2$).

Assessor's use only

At room temperature an ***acid-base reaction*** occurs, but when the reaction mixture is heated a ***condensation reaction*** occurs.

(i) Define what is meant by the term ***condensation reaction***.

A condensation reaction is a reaction in which two large non-organic molecules join, releasing a small molecule, usually water.

A

(ii) Complete the following equations for the reactions between ethanoic acid and aminoethane.

$CH_3COOH + CH_3CH_2NH_2$ → (heat) → $CH_3-\overset{\overset{O}{\|}}{C}-\overset{\overset{H}{|}}{N}-CH_2-CH_3 + H_2O$

Condensation reaction

$CH_3COOH + CH_3CH_2NH_2$ → (room temperature) → $CH_3COO^- + CH_3CH_2NH_3^+$

Acid-base reaction

E

(iii) Give the name of the functional group in the product of the **condensation** reaction.

~~ester link~~ peptide bond

N

(iv) Describe a chemical test that would distinguish between the product of the condensation reaction and aminoethane, and explain any observations in terms of the reactions involved.

mix with water and test with litmus.

The dipeptide formed in the condensation reaction will not react with water, so does not affect litmus.

in water, $CH_3CH_2NH_2(aq) + H_2O(l) \rightleftharpoons CH_3CH_2NH_3^+(aq) + OH^-(aq)$

so it will turn pink litmus blue.

not penalised a second time, as already penalised in (iii)

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QUESTION FOUR

Assessor's use only

A

(a) Complete each of the equations below by writing the **organic product** in the blank boxes and the **reagent needed** in the shaded boxes.

(i) CH_3CH_2COOH —[reagent: PCl_5]→ CH_3CH_2COCl

(ii) $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$ —[NH_3]→ product: $CH_3-CH_2-\underset{\underset{NH_2}{|}}{CH}-CH_3$

(iii) CH_3CH_2OH —[reagent 1: $Cr_2O_7^{2-}/H^+$]→ product: CH_3COOH

—[reagent 2: NaOH]→ CH_3COONa

(iv) $CH_3-CH_2-CH_2-OH$ —[reagent 1: $KOH_{(alc)}$]→ product: $CH_3-CH=CH_2$

—[reagent 2: H_2O/H^+]→ $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$

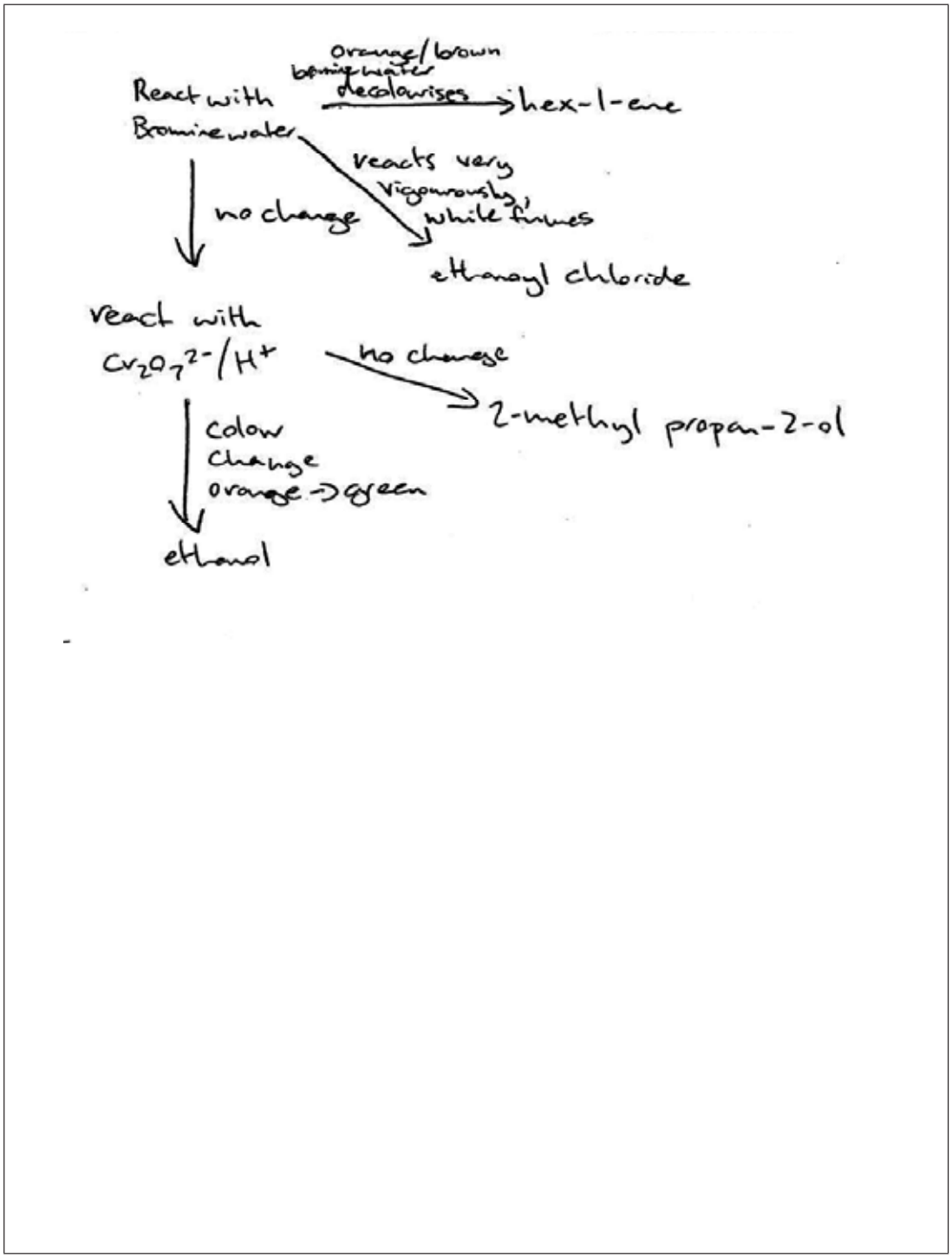
M

(b) The identity of a colourless liquid is unknown. It is thought to be one of the following:

- ethanoyl chloride (CH_3COCl),
- ethanol (CH_3CH_2OH),
- 2-methyl propan-2-ol ($(CH_3)_3COH$), or
- hex-1-ene ($CH_2=CHCH_2CH_2CH_2CH_3$).

Devise a scheme using **bromine water** and **acidified dichromate** to identify the colourless liquid. Describe the observations expected at each stage (equations not required).

Assessor's use only



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