EXEMPLAR

90698

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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

3

For Supervisor's use only

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.

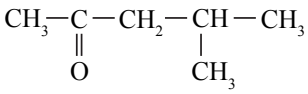
For Assessor's use only	**Achievement Criteria**				
Achievement		**Achievement with Merit**		**Achievement with Excellence**	
Describe aspects of organic chemistry.	✓	Explain and apply aspects of organic chemistry.	✓	Discuss aspects of organic chemistry.	–
Overall Level of Performance	M				

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

Assessor's use only

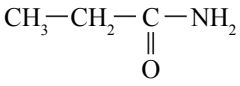
QUESTION ONE

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

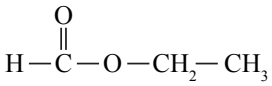
(i) 

should be pentan-2-one

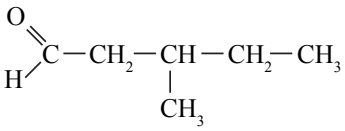
4-methyl pent-2-one

(ii) 

propanamide

(iii) 

ethyl methanoate

(iv) 

3-methyl pentanal

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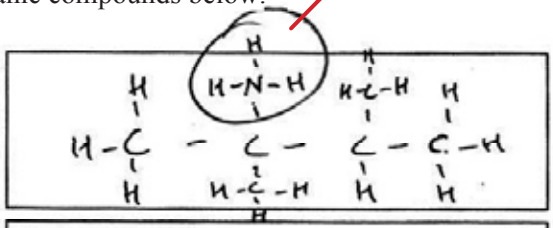
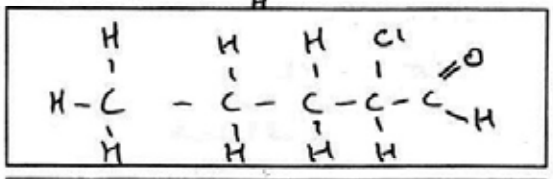
incorrect: should be $-NH_2$

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

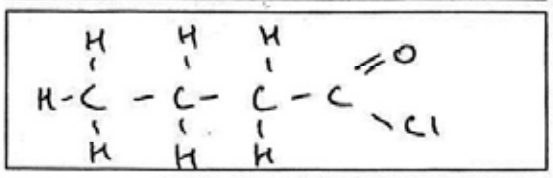
(i) 2-amino-2,3-dimethyl butane



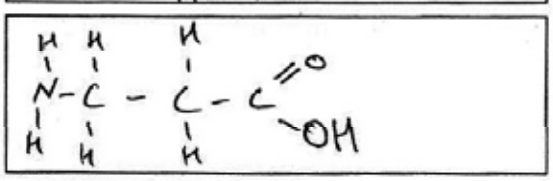
(ii) 2-chloro pentanal



(iii) An acid chloride with 4 carbon atoms



(iv) An amino acid with 3 carbon atoms



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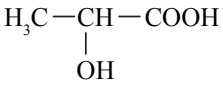
QUESTION TWO

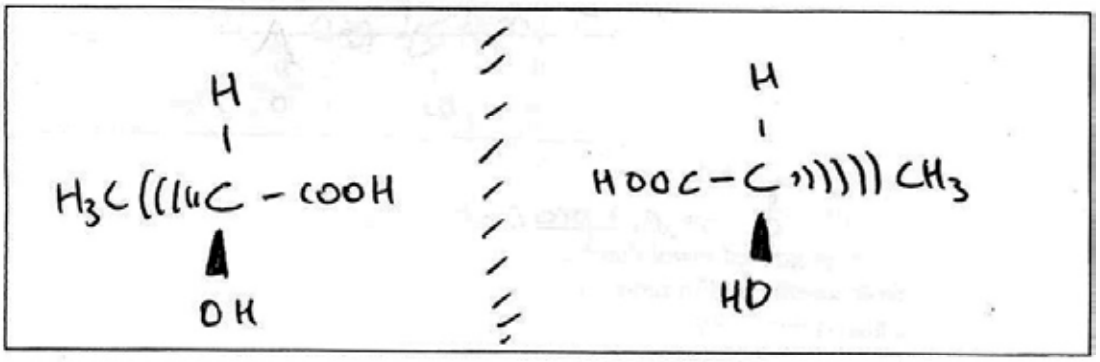
Assessor's use only

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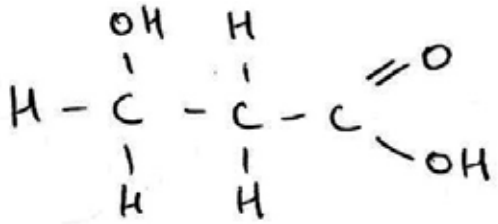
(b) Compound **X** is a structural isomer of lactic acid. Compound **X** will turn blue litmus red but cannot exist as enantiomers.

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



Structure of Compound **X**

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

It doesn't have an assymetric chiral carbon. The central carbon has two hydrogens to it, preventing optical isomerisms. Optical isomers require a carbon with 4 different groups bonded to it.

M

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

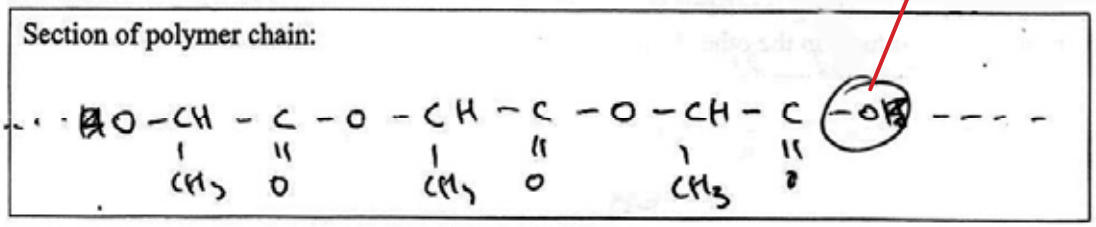
Assessor's use only

Draw three repeating units of this polymer.

Monomer: HO—CH(CH$_3$)—C(=O)—OH

one atom more than three repeating units

Section of polymer chain:



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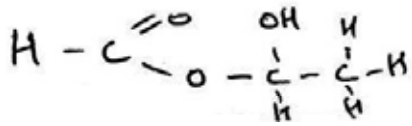
(d) Compound **Z** is an isomer of lactic acid that has a much lower boiling point than lactic acid. A water solution of Compound **Z** does not change the colour of blue litmus. When Compound **Z** is reacted with acidified dichromate solution, the resulting organic compound shows no acidic properties,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

correct isomeric structure but insufficient justification for **E**

Justification for the structure drawn:

It is an ester with a hydroxide group. primary alcohols and aldehydes are oxidised to carboxylic acids

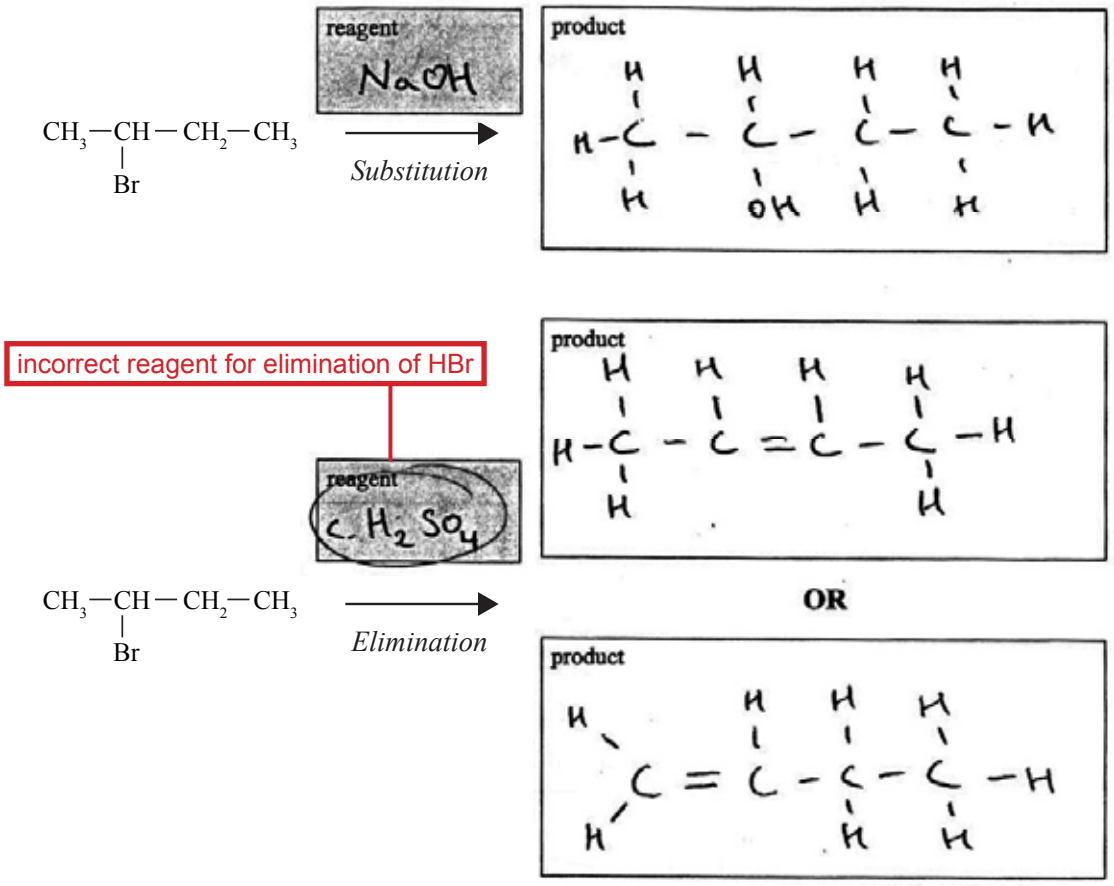
M

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***.

When two seperate molecule become bonded to form a single molecule, with the elimination of a smaller molecule (e.g. H_2O, HCl)

A

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

$CH_3COOH + CH_3CH_2NH_2$ **Condensation reaction** —heat→ $CH_3CONHCH_2CH_3 + H_2O$

missing + charge on ion

$CH_3COOH + CH_3CH_2NH_2$ **Acid-base reaction** —room temperature→ $CH_3COO^- + CH_3CH_2NH_3^+$

M

not penalised for this

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

polyamide

A

(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.

Place both solutions into water and add a few drops of universal indicator. Aminoethane will partially dissociate to form hydroxide ions in the water and therefore a pH greater than 7 (purple/blue with indicator). The polyamide will not form a basic solution.

M

QUESTION FOUR

Assessor's use only

(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 → CH_3CH_2COCl

reagent: PCl_5 correct reagent

A

(ii) $CH_3-CH_2-CH(OH)-CH_3$ $\xrightarrow{NH_3}$ product: $CH_3-CH_2-CH(NH_2)-CH_3$

(iii) CH_3CH_2OH → CH_3COONa

reagent 1: H^+/MnO_4^-

product: CH_3COOH

reagent 2: $NaOH$

(iv) CH_3-CH_2- ...

reagent 1: conc. H_2SO_4

product: $CH_3-CH=CH_2$

reagent 2: KOH in CH_3OH

$CH_3-CH(OH)-CH_3$

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

Adding bromine to all solutions will identify the hex-1-ene, as it will rapidly discolour the brown bromine solution, causing it to become colourless. The ethanol will react with the acidified dichromate causing it change from an orange solution to a green solution. The ethanol (now identified) will then react with the ethanoyl chloride to make an ester, with very dense fumes given off and a sweet-smelling solution produces. The 2-methyl propan-2-ol will not react with either the bromine water or $H^+(Cr_2O_7^{2-}$ and is therefore the remaining solution.

this ester is not sweet-smelling, but not penalised for this

E