EXEMPLAR

90698

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For Supervisor's use only

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.

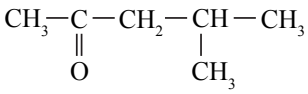
For Assessor's use only	**Achievement Criteria**				
Achievement		**Achievement with Merit**		**Achievement with Excellence**	
Describe aspects of organic chemistry.	✓	Explain and apply aspects of organic chemistry.	–	Discuss aspects of organic chemistry.	–
Overall Level of Performance	A				

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

Assessor's use only

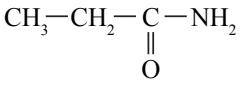
QUESTION ONE

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

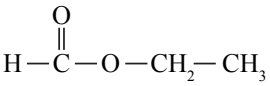
(i) 

should be pentan-2-one

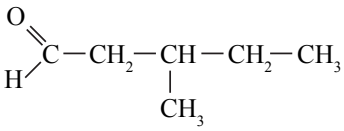
4-methyl pent-2-one.

(ii) 

1-propanamide

(iii) 

ethyl methanoate.

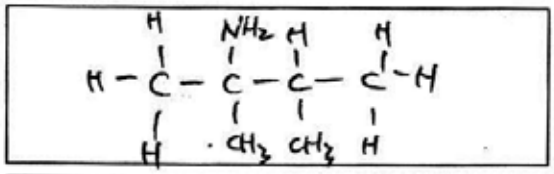
(iv) 

3-methyl pentanal

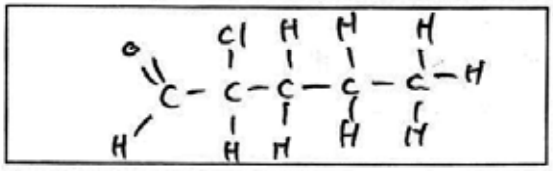
A

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

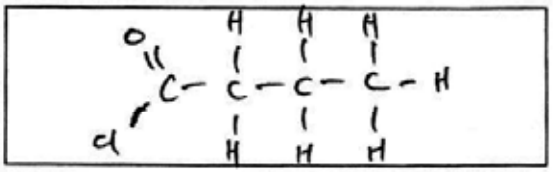
(i) 2-amino-2,3-dimethyl butane



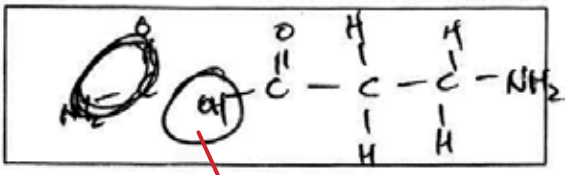
(ii) 2-chloro pentanal



(iii) An acid chloride with 4 carbon atoms



(iv) An amino acid with 3 carbon atoms



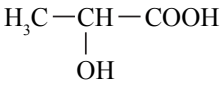
should be HO—

A

QUESTION TWO

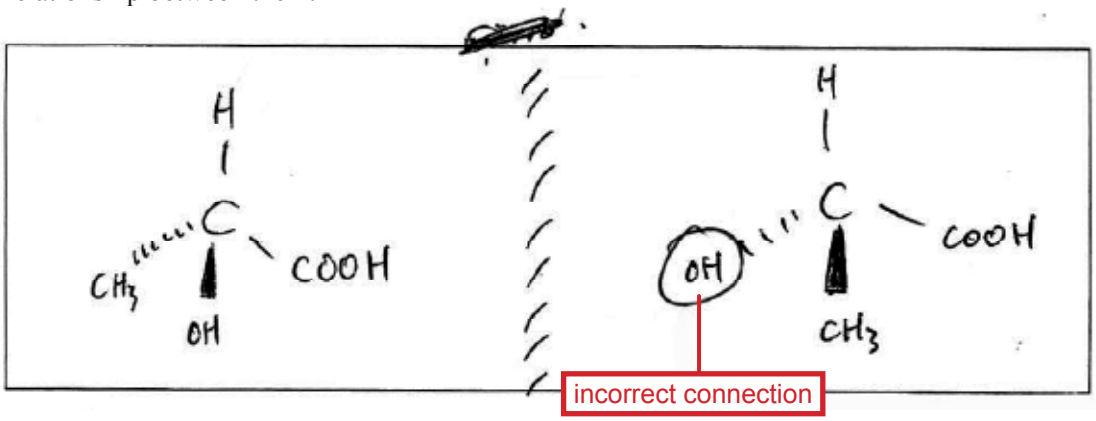
Assessor's use only

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



Lactic acid can exist as enantiomers (optical isomers)

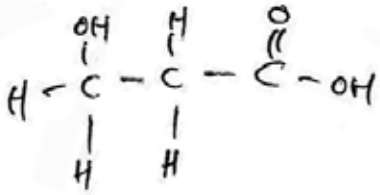
(a) Draw three-dimensional structures for the two enantiomers of lactic acid that clearly show the relationship between them.



A

(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)

In order to be enantiomer the chiral (Central) carbon atom must have four different atoms or groups attached around it. Compound X does not have a chiral carbon atom bonded to four different groups while 2-hydroxypropanoic acid does.

M

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

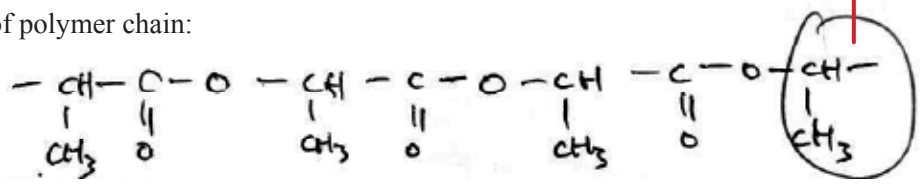
Assessor's use only

Draw three repeating units of this polymer.

Monomer: HO—CH(CH$_3$)—C(=O)—OH

exceeds three repeating units

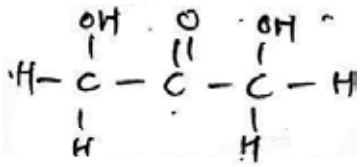
Section of polymer chain:



A

(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**

isomeric structure with valid attempt at justification

Justification for the structure drawn:

The lower BP indicates weaker intermolecular force, lesser hydrogen-bonding. It is non-acidic and no acidic properties after treated with $Cr_2O_7^{2-}$ so it must be ketone.

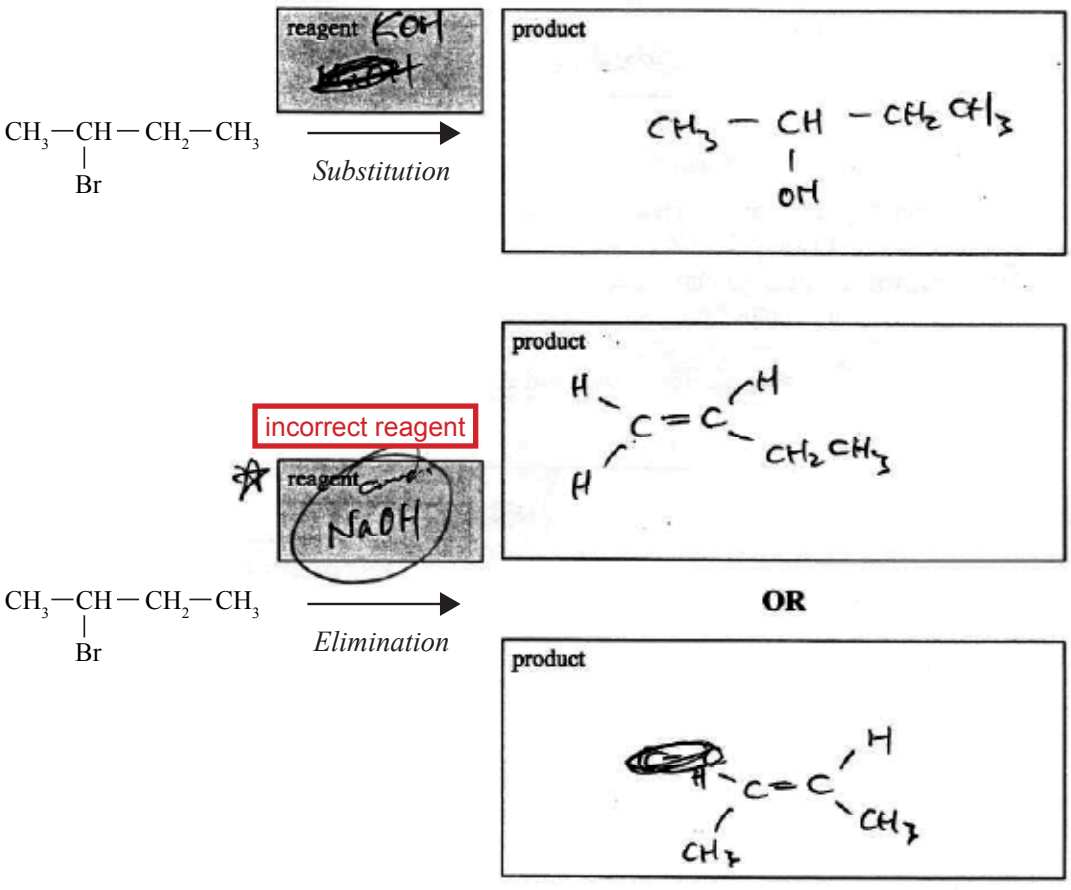
M

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.



A

(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

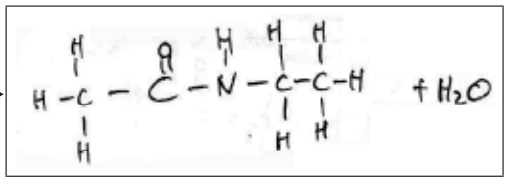
At room temperature an ***acid-base reaction*** occurs, but when the reaction mixture is heated a ***condensation reaction*** occurs.

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

Condensation reaction causes small molecules such as H_2O to be eliminated when two molecules [redacted] bond.

A

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

$CH_3COOH + CH_3CH_2NH_2$ → (heat) → 

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.

[redacted] amide

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.

Amine [redacted] (aminoethane) [redacted] is a weak base in water. So it will have basic property and turn red litmus blue.

A

has only noted observation for amine, not amide above

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: $SOCl_2$ → CH_3CH_2COCl

(ii) $CH_3-CH_2-CH(OH)-CH_3$ → reagent: NH_3 → product: $CH_3-CH_2-CH(NH_2)-CH_3$

(iii) CH_3CH_2OH → reagent 1: MnO_4^-/H^+ → product: CH_3CHO → reagent 2: $NaOH$ → CH_3COONa

(iv) $CH_3-CH_2-CH_2-OH$ → reagent 1: conc H_2SO_4 → product: $CH_3-CH=CH_2$ → reagent 2: $NaOH$ → $CH_3-CH(OH)-CH_3$

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

response on page 9

Extra paper for continuation of answers if required.
Clearly number the question.

Assessor's use only

Question number

Four (b) ① Add bromine water.

Only hex-1-ene will decolourised brown (orange) bromine water. (hex-1-ene identified)

② Add acidified dichromate.

Only ethanol and 2-methyl propan-2-ol will be oxidised and $Cr_2O_7^{2-}$ (orange) will turn into Cr^{3+} (green). (ethanoyl chloride identified)

ethanol will become carboxylic acid while 2-methyl propan-2-ol become ketone. when treated with $Cr_2O_7^{2-}/H^+$.

Carboxylic acid will have acidic properties while ketone doesn't.

A

incorrect discussion re 2-methyl propan-2-ol, and nothing valid for ethanoyl chloride