*For Supervisor's use only*

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**90309**

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
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# Level 2 Chemistry, 2004

## 90309 Describe the structural formulae and reactions of compounds containing selected organic functional groups

Credits: Four
2.00 pm Wednesday 10 November 2004

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 pages provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 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.**

| **Achievement Criteria** | *For Assessor's use only* | |
|---|---|---|
| **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| Describe structures and reactions of organic compounds. ☐ | Apply principles of structure and reactivity to organic compounds. ☐ | Interpret and explain information about the reactivity and structure of organic compounds. ☐ |
| **Overall Level of Performance** ☐ | | |

You are advised to spend 45 minutes answering the questions in this booklet.

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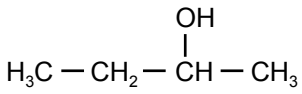
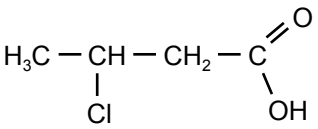
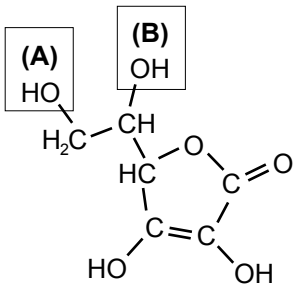
## QUESTION ONE

Complete the following table showing the structural formulae and IUPAC (systematic) names for some organic compounds.

| | structural formula | IUPAC name |
|---|---|---|
| (a) |  | |
| (b) |  | |
| (c) | | methyl propanoate |
| (d) | | 2,4-dichlorobut–1–ene |

## QUESTION TWO

Vitamin C has the structure shown on the right.




**Vitamin C**

(a) On the molecule circle the section that would readily react to decolourise bromine water.

(b) Two of the –OH groups in the molecule have been labelled as (A) and (B).

Classify these –OH groups as primary, secondary or tertiary alcohol groups.

| | | | |
|---|---|---|---|
| **(A)** | | **(B)** | |

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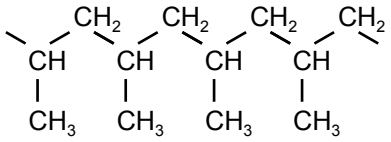
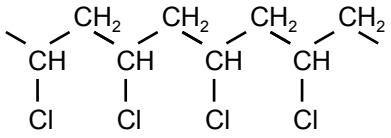
## QUESTION THREE

Two common polymers are polypropylene and polyvinyl chloride (PVC). A section of each polymer is shown in the table below. Draw the structural formula for the monomer molecule for each polymer.

| | Section of the polymer | Monomer molecule |
|---|---|---|
| (a) | polypropylene  | |
| (b) | polyvinyl chloride (PVC)  | |

## QUESTION FOUR

(a) Draw the structural formula of the **organic product** in each of the following reactions.

| | | |
|---|---|---|
| (i) | $H_3C-\underset{\underset{O}{\|\|}}{C}-OH + H_3C-CH_2-CH_2-OH \rightarrow$ | |
| (ii) | $H_3C-CH=CH_2 + HCl \rightarrow$ | |
| (iii) | $H_3C-\underset{\underset{CH_3}{\|}}{C}=CH_2 + H_2O / H^+ \rightarrow$ | |
| (iv) | $H_2C-\underset{\underset{OH}{\|}}{CH_2}-CH_3 + Cr_2O_7^{2-} / H^+ \rightarrow$ | |

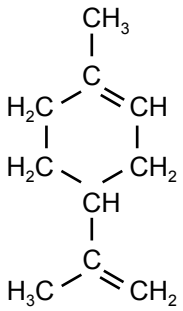
(b) Name the functional group in each of the **products** of reactions (i) to (iv) above.

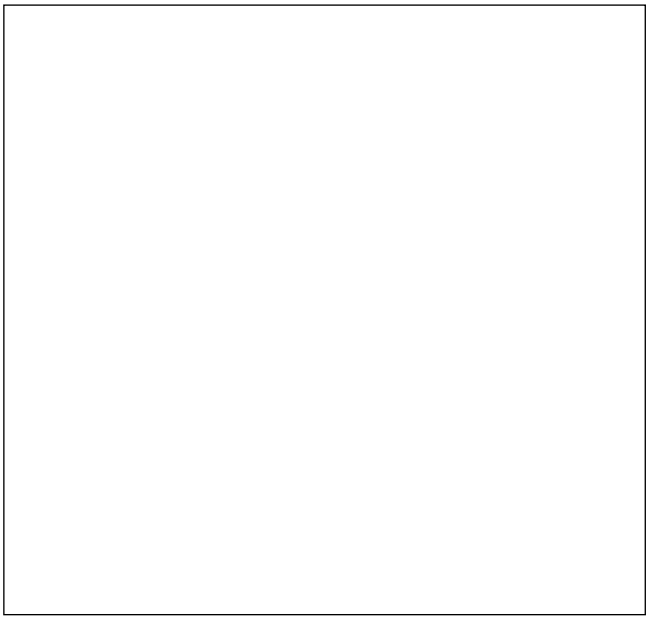
| | Functional group of product | | Functional group of product |
|---|---|---|---|
| (i) | | (ii) | |
| (iii) | | (iv) | |

## QUESTION FIVE

Assessor's use only

Draw the structure of the **major** product formed when two molecules of HCl add to limonene (a substance found in citrus fruit).

limonene  + 2 HCl ⟶



## QUESTION SIX

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(a) A compound of molecular formula $C_2H_2Cl_2$ can exist as *cis–trans* (geometrical) isomers. **Draw**, and **name**, the *cis–trans* isomers.

(b) There is another structural isomer of $C_2H_2Cl_2$ that **cannot** exist as *cis–trans* isomers. Draw the structural formula for this molecule and explain why this molecule cannot exist as *cis–trans* isomers while the one you have drawn above in (a) can.

## QUESTION SEVEN

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Chemical tests can be used to distinguish between pairs of compounds.

Identify tests to distinguish between the following pairs of compounds and:

(i) describe the test to be carried out,
(ii) describe the expected observations for the test used,
(iii) clearly explain how the test results can be used to distinguish between the molecules in each pair of compounds and why the test used is a suitable one.

(a) butan–1–ol and but–2–ene

(i) Test: _____

(ii) Observations: _____

_____

_____

(iii) Explanation: _____

_____

_____

_____

_____

_____

_____

(b) butanoic acid and methylbutanoate.

(i) Test: _____

(ii) Observations: _____

_____

_____

(iii) Explanation: _____

_____

_____

_____

_____

_____

_____

## QUESTION EIGHT

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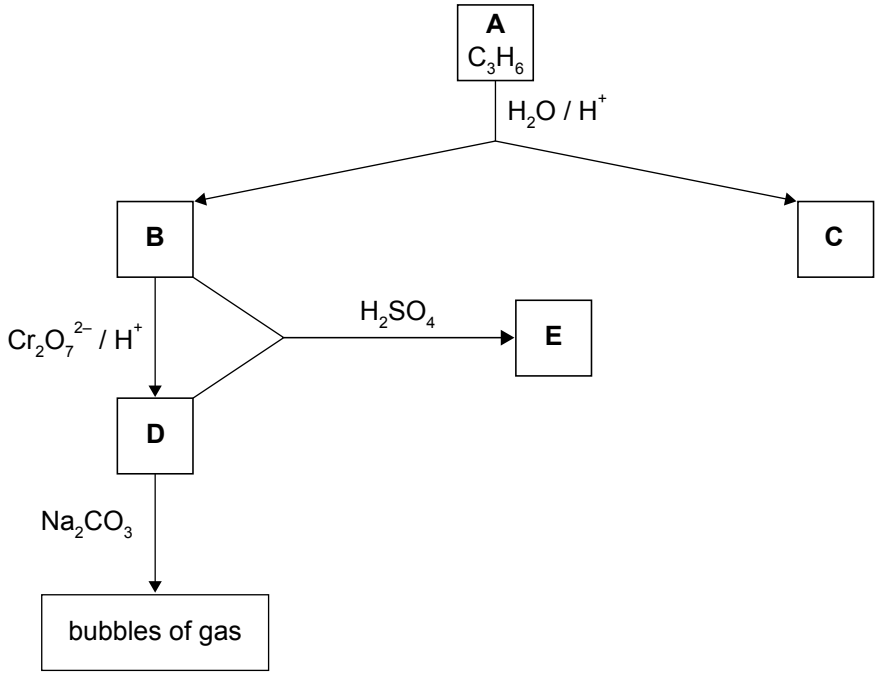
An unsaturated compound **A**, $C_3H_6$, reacts with water under acidic conditions to form two new products, **B** and **C**. Product **B** reacts with acidified potassium dichromate solution to form **D**. Product **D** reacts with a solution of sodium carbonate producing bubbles of gas. Product **B** reacts with **D** in the presence of sulfuric acid and compound **E** is formed. Compound **E** has a characteristic smell.




Complete the table below by writing the structural formula and name for each compound **A**, **B**, **C**, **D** and **E**.

| Compound | Structural formula | Name |
|---|---|---|
| **A** | | |
| **B** | | |
| **C** | | |
| **D** | | |
| **E** | | |

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

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Question number