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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Chemistry, 2009

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

Credits: Four
2.00 pm Monday 23 November 2009

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 2–10 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 structures and reactions of organic compounds.	Link structure and reactivity of organic compounds.	Discuss 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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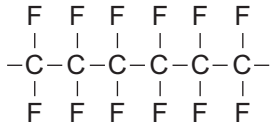
QUESTION ONE

(a) Complete the following table to show the structural formula and IUPAC (systematic) name for each of the organic compounds.

Structural formula	**IUPAC name**
$CH_3CH_2C{\equiv}CCH_3$	
$HCOOC_3H_7$	
	3-chlorobutan-1-ol
	2-chloro-3-methylbutanoic acid

(b) (i) The following diagram shows three repeating sections of a common polymer.



Draw the structural formula of the monomer molecule used to make this polymer.

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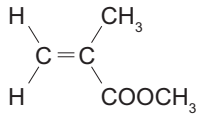
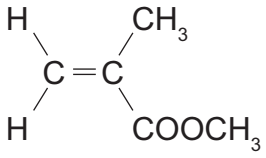
(ii) The molecule 2-methyl propenoate, shown below, is the monomer for the polymer commonly known as Perspex.



Draw the structural formula of the polymer Perspex showing TWO repeating units.

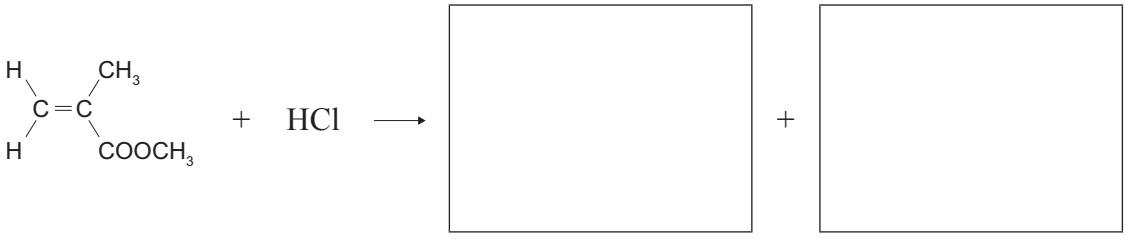
(c) (i) For the molecule below, **circle** the ester functional group and put a **square** around the alkene functional group.



(ii) Complete the equation below to show the **structural formulae** of the two organic reactants used in the preparation of 2-methyl propenoate.

(iii) 2-methyl propenoate will react with HCl to give two different haloalkane products.

Draw the **structural formulae** of the haloalkane products.



major product minor product

QUESTION TWO

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(a) For each of the THREE following reactions:

- Write the **name** or **structural formula** of the reactant used.
- State the **type** of reaction occurring. Choose from the box below.

acid-base	addition	elimination	hydrolysis	substitution

(i) Reaction One

$CH_3 - CH = CH_2$ (propene) $\xrightarrow{\textbf{Reactant A}}$ $CH_3 - CH(OH) - CH_3$ (propan-2-ol)

Reactant A: _____ Type of Reaction: _____

(ii) Reaction Two

$CH_3 - CH(OH) - CH_3$ (propan-2-ol) $\xrightarrow{\textbf{Reactant B}}$ $CH_3 - CH = CH_2$ (propene)

Reactant B: _____ Type of Reaction: _____

(iii) Reaction Three

$CH_3 - CH_2 - CH_3$ (propane) $\xrightarrow{\textbf{Reactant C}}$ $CH_3 - CH_2 - CH_2Br$ (1-bromopropane)

Reactant C: _____ Type of Reaction: _____

(b) Hydrocarbons can undergo addition and substitution reactions.

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Compare and contrast addition and substitution reactions. Use the reactions of ethane, $CH_3– CH_3$, and ethene, $CH_2= CH_2$, with chlorine as your examples in your answer.

Your answer must also include:

- a description of each type of reaction
- conditions for addition and substitution reactions
- equations showing the structural formulae of the organic reactant(s) and product(s).

QUESTION THREE

Assessor's use only

(a) Give the **structural formula** of the organic product formed when:

(i) Ethanol, C_2H_5OH, reacts with acidified potassium dichromate solution.

(ii) Ethanoic acid, CH_3COOH, reacts with sodium carbonate solution.

(b) (i) Draw ALL the structural isomers of alkenes of molecular formula C_4H_8 in the box below.

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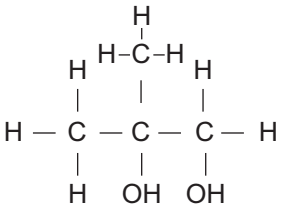
(ii) One of the isomers from the box in (b)(i) can be oxidised with potassium permanganate, $KMnO_4$, to form 2-methyl propan-1,2-diol.

Complete the following equation to show the **structural formula** of the isomer from (b)(i).

Structural formula:
Molecular formula: C_4H_8

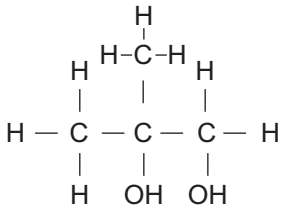
$\xrightarrow{KMnO_4}$



2-methyl propan-1,2-diol

(iii) 2-methyl propan-1,2-diol can be further oxidised with acidified potassium dichromate, $Cr_2O_7^{2-}/H^+$, to form a compound with molecular formula $C_4H_8O_3$. The compound $C_4H_8O_3$ reacts with sodium carbonate solution to form bubbles of carbon dioxide gas.

Draw the **structural formula** of the compound $C_4H_8O_3$ in the box below.



2-methyl propan-1,2-diol

$\xrightarrow{Cr_2O_7^{2-}/H^+}$

Structural formula:
Molecular formula: $C_4H_8O_3$

Explain your answer.

QUESTION FOUR

Assessor's use only

The following substances require identification:

- acidified potassium dichromate
- bromine water
- methanol
- hexane
- hex-1-ene.

Two of these substances are orange in colour, the other three are colourless.

Discuss, using only the five substances, how each could be identified.

Your answer should include:

- a clear description of what you would do
- observations
- equations showing the structural formulae of organic substances for any reactions occurring.

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

Assessor's use only

Question number