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2

91165

911650

Draw a cross through the box (☒) if you have NOT written in this booklet

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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Chemistry 2024

91165 Demonstrate understanding of the properties of selected organic compounds

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of selected organic compounds.	Demonstrate in-depth understanding of the properties of selected organic compounds.	Demonstrate comprehensive understanding of the properties of selected organic compounds.

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 attempt ALL the questions in this booklet.

A periodic table and other reference material are provided in the Resource Booklet L2–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area will be cut off when the booklet is marked.

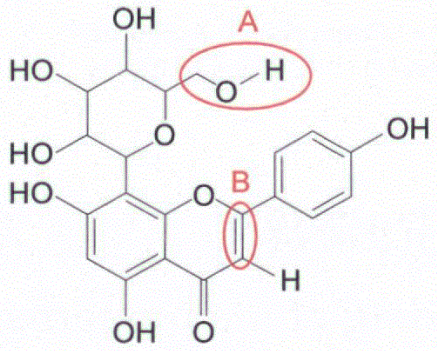
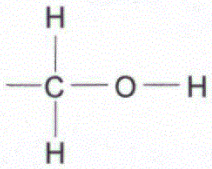
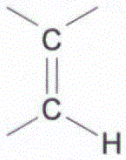
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement TOTAL 9

QUESTION ONE

The leaves of kawakawa have been used to treat a range of conditions, including toothache and gastrointestinal upsets.

Recent research has shown medicinal effects can be attributed to many molecules in kawakawa, including vitexin, shown below.

		
Vitexin	Group A	Group B

(a) The molecule vitexin has had key functional groups, A and B, circled and shown to the right.

(i) Name the functional groups that have been circled:

A: Alcohol B: Alkene

(ii) Identification tests were conducted to show the presence of groups A and B in the molecule.

Name the reagents and any conditions required for identifying group A and group B separately.

Reagents / Conditions:

A: _____

B: _____

(iii) Describe the observation that would occur in a positive test for each group.

Include:

- the reaction type
- the name of the functional group of the product
- a drawing of the functional group of the product.

A: _____

_____

_____

Functional group of the product:

B: _____

_____

_____

Functional group of the product:

(b) Kawakawa also contains some anti-inflammatory molecules. When researchers extracted these molecules from kawakawa leaves, they had to use a range of solvents including methanol, ethanol, and hexane. All three of these solvents are colourless liquids at room temperature.

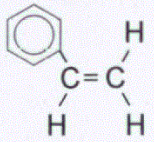
Explain the procedure you could use to distinguish between methanol, ethanol, and hexane, based solely on their physical properties.

Give reasons for the different results between solvents.

Physical properties are limited to differences in melting point, boiling point, and solubility in water.

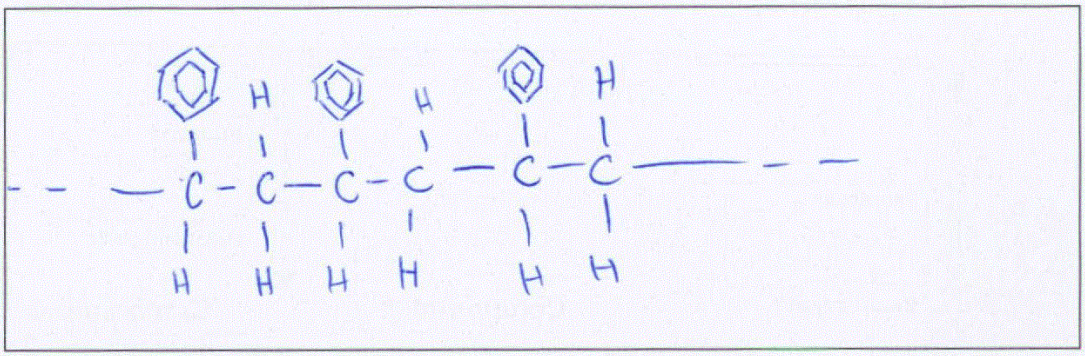
(c) Polystyrene has been used widely in the manufacture of plastic produce such as bags, plates, bowls, and cutlery. However, single-use plastics, such as these, are being phased out.

Polystyrene is an addition polymer made from the styrene monomer, shown below.



Styrene monomer

(i) In the box below, draw three repeating units of the polystyrene polymer.



(ii) Plastics are cheap and stable.

Explain why the monomer styrene is more reactive than the polymer polystyrene.

In your answer you should:

- explain the term 'addition polymerisation'
- explain the difference in structure, and link it to chemical reactivity
- relate how this difference is important for the uses of the polymer.

smaller carbon chain length

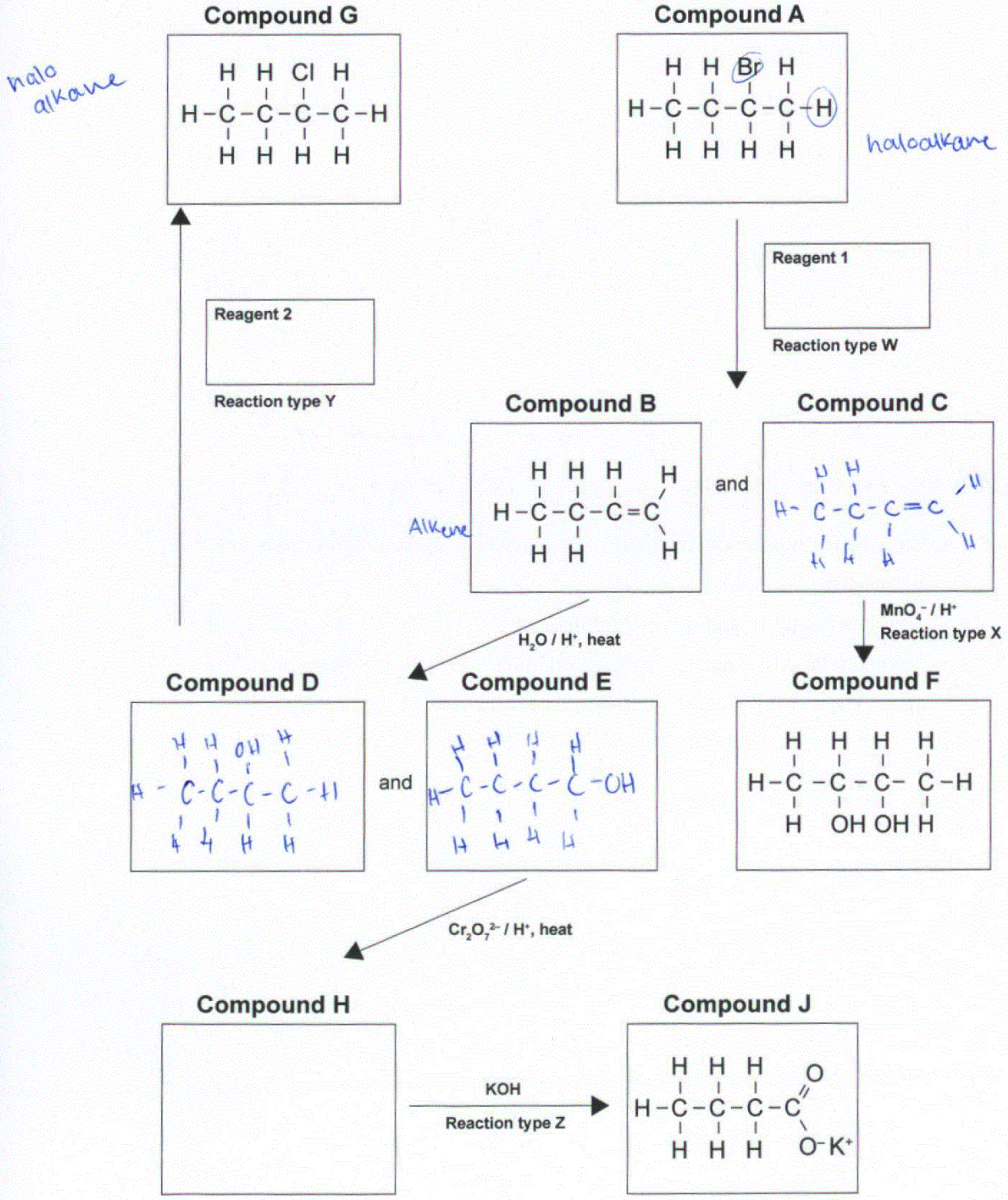
addition polymerisation is when individual monomers are added together to create a large polymer chain. The polystryrene polymer is more stable and therefore ~~is~~ has less chemical reactivity compared to the styrene monomer because it has a longer carbon chain length.

QUESTION TWO

(a) An incomplete reaction scheme starting with, 2-bromobutane, **Compound A**, is shown.

(i) Draw the structural formulae of **Compounds C**, **D**, **E**, and **H** in the labelled boxes provided.

(ii) Complete the **Reagents 1** and **2** in the labelled boxes provided.

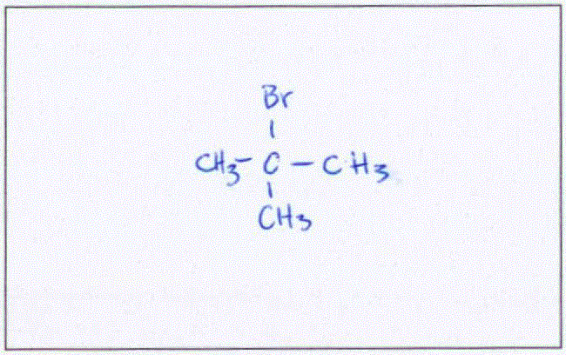


(iii) Name the **Reaction types W, X, Y,** and **Z** in the table below.

Reaction type W	Elimination reaction
Reaction type X	Addition reaction
Reaction type Y	Substitution reaction
Reaction type Z	Oxidisation reaction

(b) The starting material **Compound A**, and one of the final products **Compound G**, are both secondary haloalkanes.

Draw the tertiary isomer of bromobutane and explain why it is classified as tertiary.



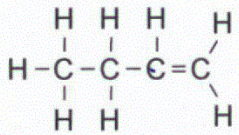
C_4H_9Br

~~2-bromop~~

2-bromo 2-methyl propane

2-Bromo 2-methylpropane is classified as tertiary because the halogen atom - Br - is attached to a carbon atom that is bonded with three other carbon atoms, so is therefore a tertiary isomer of bromobutane

(c) (i) When **Compound B** reacts with hydrochloric acid, HCl, without heat, two products are formed in differing amounts.



Compound B

rich get richer

NMJ

prop-1-ene

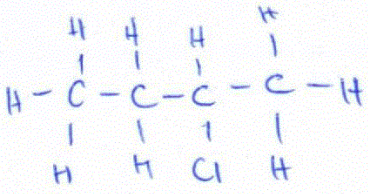
Discuss the reaction of **Compound B** with hydrochloric acid.

In your answer you should:

- name and explain this type of reaction – addition - double bond ✓
- draw the structures of both products, in the appropriate box for the major and minor products
- justify your choice of major and minor products.

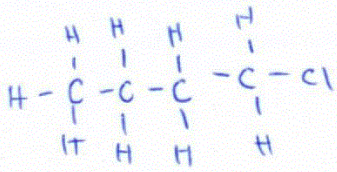
This is an addition reaction. The double covalent bond in the prop-1-ene molecule ~~is~~ is broken, allowing atoms to be added to the molecule. ~~1-chlorobutane is the major product in this reaction.~~ According to Markonikov's rule - 'the rich get richer' - the major product is made when the hydrogen atom is added to the side of the once double bond that has more hydrogens already - so 1-chlorobutane is the major product made by this reaction. 2-chlorobutane is the minor product made by this reaction because the hydrogen atom with the least amount of hydrogens already. 'Poor get poorer'

2-chlorobutane



Minor product

1-chlorobutane



Major product

(ii) Compare the reaction of **Compound B** with chlorine, Cl_2, against the previous reaction of **Compound B** with HCl.

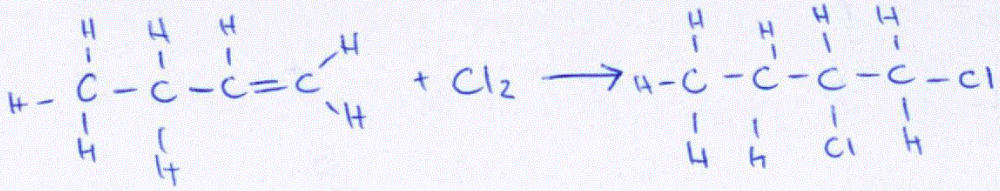
In your answer you should:

- explain why a different number of products are formed in the same type of reaction
- draw any relevant product structures.

because Cl2 markonikov does not apply

a different number of products are formed in this reaction, despite it also being an addition reaction. This is because Markonikov's rule cannot be applied because there are no hydrogen atoms being added the molecule, so there won't be a major and minor product.

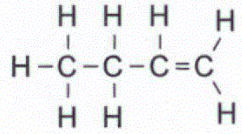
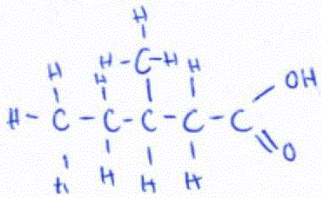
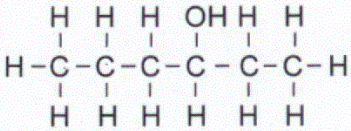
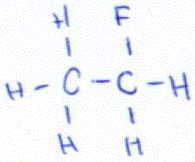
Space for drawing structures



QUESTION THREE

(a) Four organic compounds are given in the table below.

Complete the table by drawing the structure or giving the IUPAC (systematic) name

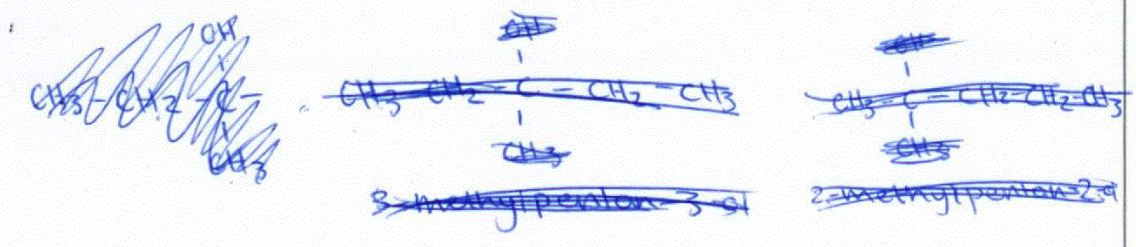
Structure	Name
 **Compound K**	but-1-ene
 **Compound L**	3-methylpentanoic acid
 **Compound M**	hexan-3-ol
 **Compound N**	fluoroethane

(b) **Compound M** above has the formula $C_6H_{14}O$.

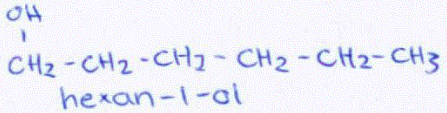
Draw all of the structural isomers that are primary alcohols for this formula.

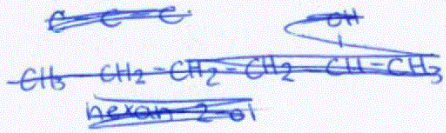
There is space below, as well as additional space at the back of this booklet, for working.

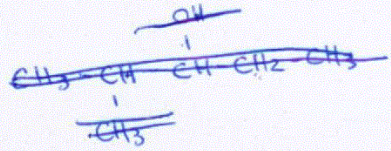
Space for working

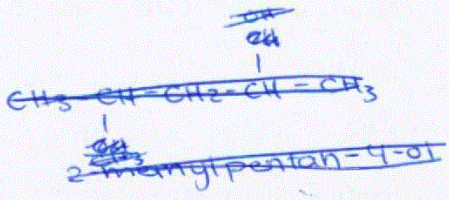


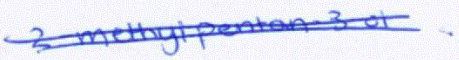
Space for drawing isomers

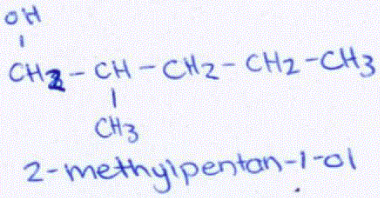


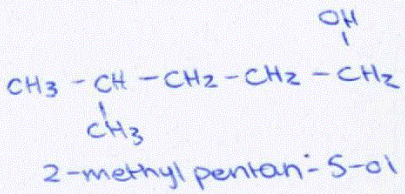


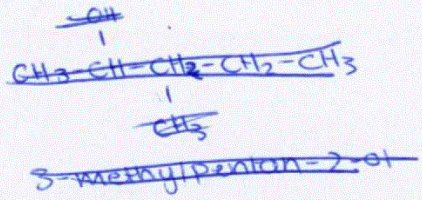


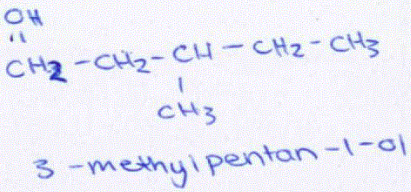


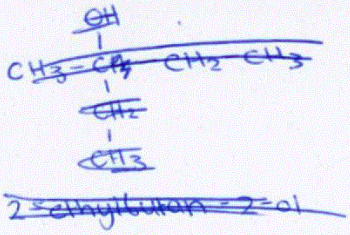


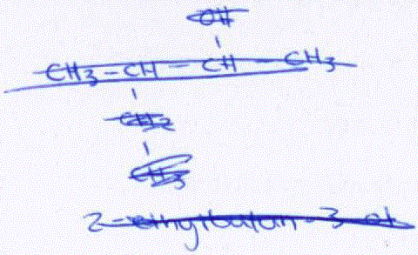


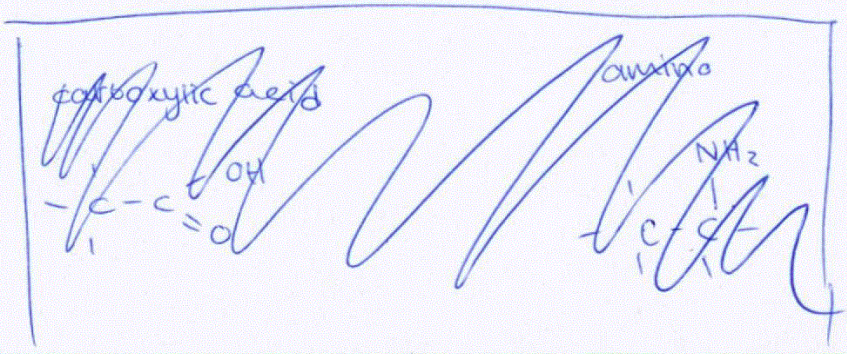








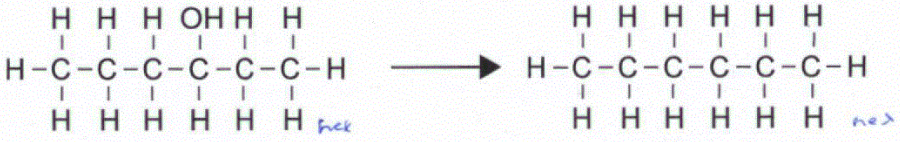




* continued on pg. 14

Question Three continues on the next page.

(c) (i) Describe a two-step series of reactions to convert **Compound M** into **Compound P**.



Compound M **Compound P**

Step 1 starts with **Compound M**:

Reaction type: substitution reaction

Reagents and any conditions:

Products' functional group: Alkane

Draw the structure of ALL products.

Step 2 ends with **Compound P**:

Reaction type:

Reagents and any conditions:

(ii) The reaction in Step 1 produces two isomers with the same functional group in equal quantities.

Explain why there is no major or minor product of the hydrocarbon produced.

In your answer you should explain:

- the type of reaction
- what determines major and minor products
- why the products are equal in this situation.

Major and minor products are determined by following Markonikov's rule of 'the rich get richer' - where the major product is made when a hydrogen atom is added to the side of the once double bond that has more hydrogens already - whereas the minar product is made when H+ atom is added to the side with the lesser amount of hydrogen atoms already.

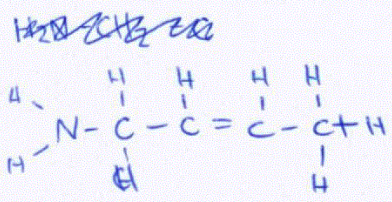
(d) **Compounds Q** and **R** below each contain a carbon to carbon double bond, but only one of them can form geometric isomers.

$H_2N-CH_2-CH=CH-CH_3$ **Compound Q**

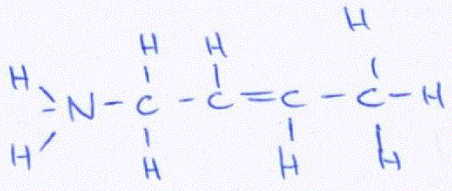
$H_2N-CH_2-CH_2-CH=CH_2$ **Compound R**

(i) Which compound forms geometric isomers? Compound Q

(ii) Draw the *cis* and *trans* geometric isomers that it forms in the boxes provided, and select the correct label.



Circle the correct isomer: (***cis***) ***trans***

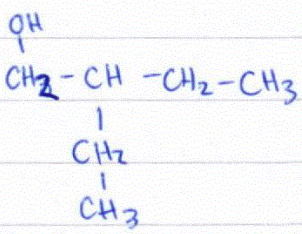


Circle the correct isomer: ***cis*** (***trans***)

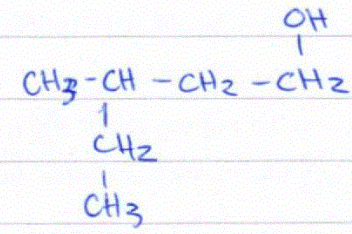
Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

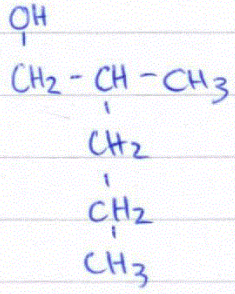
Q3 b)



2-ethyl butan-1-ol



2-ethyl butan-5-ol



2-propyl propan-1-ol

Achievement

Subject: Chemistry

Standard: 91165

Total score: 09

Q	Grade score	Marker commentary
One	A3	The candidate was awarded A3 for the following reasons: in (a)(i) they correctly identified the two functional groups; in (c) (i) they drew the correct polymer structure; in (c) (ii) they identified that monomers join together to make a polymer but were unable to link this to the C=C bond breaking.
Two	A3	The candidate was awarded A3 for the following reasons: in (a) they were able to identify at least 3 correct structures/reaction types; in (b) they were able to draw the correct isomer; in (c) (i) they were able to identify the two products but incorrectly explained how major/minor products were decided nor did they explain why it was an addition reaction.
Three	A3	The candidate was awarded A3 for the following reasons: in (a) they were able to name/draw at least two compounds; in (b) they were able to draw at least 2 primary alcohol isomers; in (d) they were able to correctly draw and label the geometric isomers.