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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Chemistry 2025

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 margins (✂/✂/✂). 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 11

QUESTION ONE

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

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

Compound	Structure	Name
A	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{NH}_2 \\ \\ \text{H} \end{array} $	ethanamine
B	$ \begin{array}{c} \text{Br} \\ \\ \text{Br}-\text{C}-\text{H} \\ \\ \text{H} \end{array} $	dibromoethane
C	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{CH}_3 & & & \\ & & & & & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & =\text{O} \\ & & & & & \backslash \\ & \text{H} & \text{H} & \text{CH}_3 & & \text{OH} \end{array} $	3,3-dimethylbutanoic acid
D	$ \begin{array}{ccccccc} \text{H} & \text{H} & \text{Br} & \text{H} & \text{H} & \text{H} & \\ & & & & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C} & =\text{C} & -\text{C} & -\text{H} \\ & & & & & & \\ \text{H} & \text{H} & \text{H} & & \text{H} & \text{H} & \end{array} $	3-bromohex-4-ene
E	$ \begin{array}{ccccccc} & & \text{H} & \text{H} & \text{H} & & \\ & & & & & & \\ \text{H}-\text{C} & \equiv \text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{H} \\ & & & & & & \\ & & \text{H} & \text{H} & \text{H} & & \end{array} $	1-pentyne
F	$ \begin{array}{ccccccc} & \text{H} & \text{CH}_3 & \text{H} & & & \\ & & & & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{H} \\ & & & \\ & \text{H} & \text{OH} & \text{H} \end{array} $	2-methylpropanol

- (b) Explain how acidified dichromate solution, $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$, can be used to distinguish between compounds G and H (below):

$\begin{array}{c} \text{Cl} \\ \\ \text{CH}_2 - \text{CH}_2 - \text{CH} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$ <p style="text-align: center;"><i>haloalkane</i></p>	$\begin{array}{c} \text{OH} \\ \\ \text{CH}_2 - \text{CH}_2 - \text{CH} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array}$ <p style="text-align: center;"><i>alcohol</i></p>
Compound G	Compound H

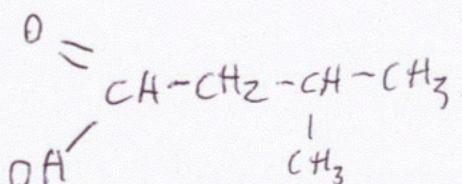
In your answer:

- identify the type of reaction occurring
- include conditions required for the reaction to occur
- describe relevant observations
- draw the product formed.

For compound H the reaction occurring is an oxidation reaction going from an alcohol to a carboxylic acid for this reaction to occur heat is required and when the reaction happens the alcohol decolorises rapidly. The product will become $\begin{array}{c} \text{O} \\ || \\ \text{CH} - \text{CH}_2 - \text{CH} - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$. For compound G the reaction ~~doesn't~~ doesn't occur ~~because~~ and the colour of compound G stays the same.

There is more space for your answer and diagram on the next page.

Product formed:



- (c) Haloalkanes are useful starting materials used in the synthesis of many more complex molecules, including many pharmaceutical products.

Below are some constitutional (structural) isomers of chloropentane, $\text{C}_5\text{H}_{11}\text{Cl}$. Use these to answer parts (i) to (iii).

$ \begin{array}{c} \text{Cl} \\ \\ \text{CH}_2 - \text{CH}_2 - \text{CH} - \text{CH}_3 \\ \quad \quad \quad \\ \quad \quad \quad \text{CH}_3 \end{array} $	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH}_2 - \text{C} - \text{Cl} \\ \quad \quad \quad \\ \quad \quad \quad \text{CH}_3 \end{array} $
Compound G	Compound I
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{Cl} \end{array} $	$ \begin{array}{c} \text{Cl} \\ \\ \text{CH}_3 - \text{CH} - \text{CH} - \text{CH}_3 \\ \quad \quad \quad \\ \quad \quad \quad \text{CH}_3 \end{array} $
Compound J	Compound K

- (i) Classify each of the haloalkanes as either primary, secondary, or tertiary:

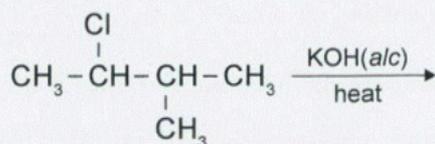
Compound G: primary

Compound I: tertiary

Compound J: primary

Compound K: secondary

Compound K forms two different products when reacted with alcoholic potassium hydroxide, $\text{KOH}(\text{alc})$, and heat.



(ii) Draw both products of the reaction, and circle the correct label.

$\text{CH}_3-\text{CH}=\underset{\text{CH}_3}{\underset{ }{\text{C}}}-\text{CH}_3$	$\text{CH}_2=\text{CH}-\underset{\text{CH}_3}{\underset{ }{\text{CH}}}-\text{CH}_3$
Circle: MAJOR / MINOR	Circle: MAJOR / MINOR

(iii) Elaborate on the reaction of **Compound K** with alcoholic potassium hydroxide, $\text{KOH}(\text{alc})$, and heat.

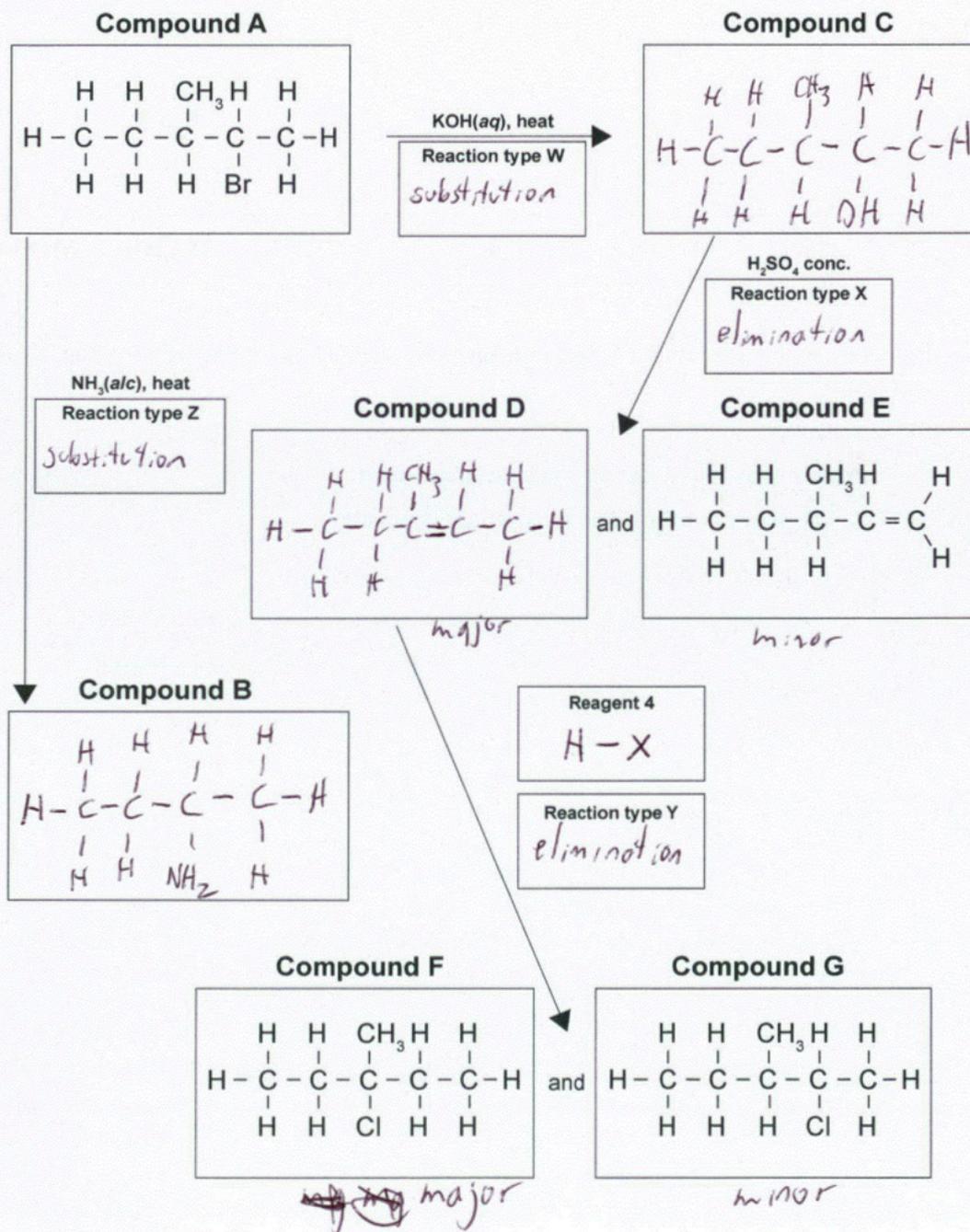
In your answer:

- explain why two different products are formed
- justify your choice of major and minor products.

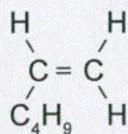
Two different products are formed because the double bond must get to the carbon ~~the~~ ~~the~~ attached to the carbon which is attached to the chlorine) with the least amount of hydrogens and therefore a hydrogen must get taken away from that carbon and so since this compound is secondary this means it's possible for two products to form so the ^{for the} major product I took a hydrogen away from the carbon with one hydrogen and for the minor product I took the hydrogen away from the carbon with 3 hydrogens.

QUESTION TWO

- (a) An incomplete reaction scheme is shown below.
- Draw the structural formulae of **Compounds B, C, and D** in the labelled boxes provided.
 - Complete the **Reaction type W, X, Y, and Z** in the labelled boxes provided.
 - Complete **Reagent 4** in the labelled box provided.

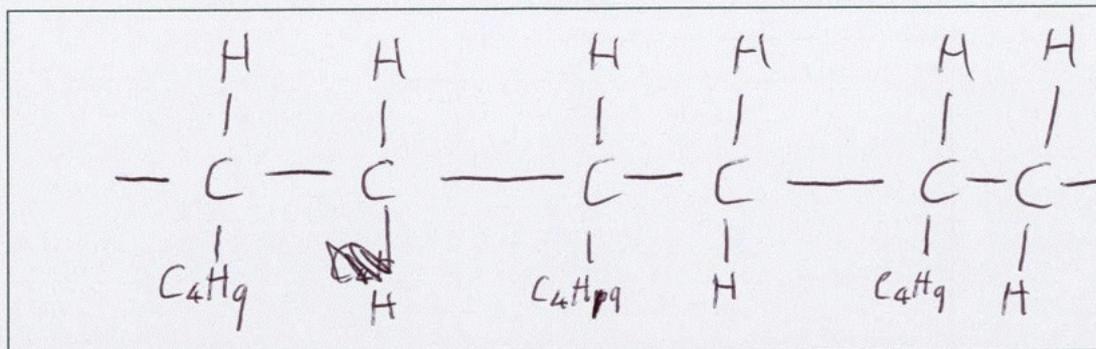


- (b) **Compound E** can be redrawn, as below, to enable it to be viewed as a monomer suitable to undergo addition polymerisation.



Compound E

- (i) Draw three repeating units of the polymer that would be produced using the monomer **Compound E** in the box below.



- (ii) Explain the process of addition polymerisation.

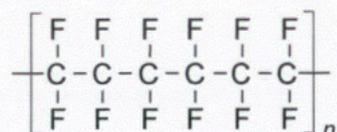
In your answer:

- identify the structure and bonding feature of **Compound E** that makes it suitable to undergo addition polymerisation
- explain how an addition polymerisation reaction occurs
- compare the relative reactivity of the monomer and the polymer. ?

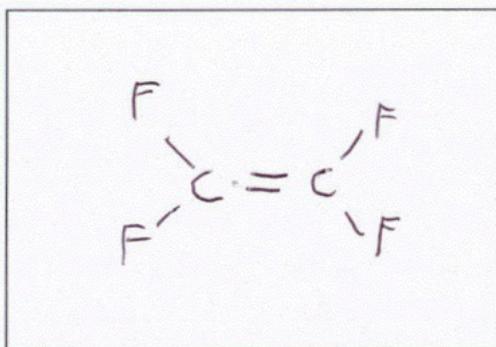
The compound can undergo addition polymerisation due to its double bond meaning it has a "fixed" position a addition polymerisation reaction occurs when it has a double bond and when there is heat, pressure and a catalyst.

Polytetrafluoroethylene, (Teflon), is a polymer known for use in breathable, waterproof textile fabrics. Alternatives are being developed that aim to provide similar advantageous properties to Teflon with less environmental impact.

The structure of Teflon is show below.



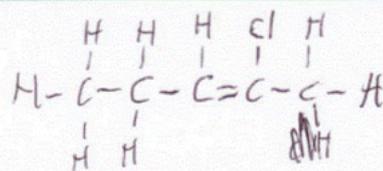
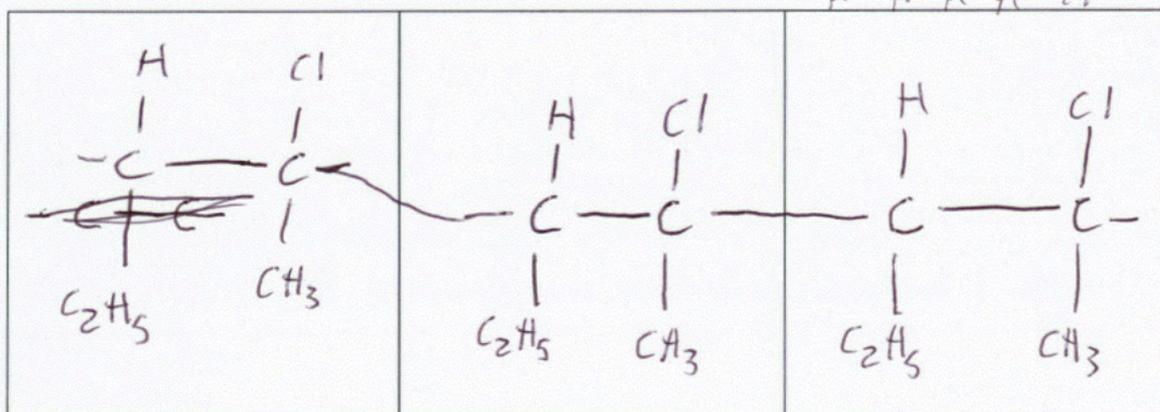
(iii) In the box below, draw the monomer that Teflon is made from.



(iv) Teflon is also used as a non-stick coating on cooking pots and frying pans.

Identify the physical and chemical properties of Teflon that make it suitable for this use.

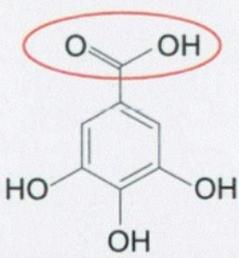
(c) Draw three straight-chain (non-branched) isomers of $\text{C}_5\text{H}_{11}\text{Cl}$.



QUESTION THREE

Pōhutukawa bark can be brewed into a tea and used in a range of rongoā (traditional medicines). as it contains organic acids, such as ellagic and gallic acids, which have antioxidant, antiseptic, and anti-nausea properties.

- (a) While extracting the pōhutukawa bark, the following compounds can be isolated.

	$\begin{array}{c} \text{NH}_2 \\ \\ \text{CH}_2 - (\text{CH}_2)_5 - \text{CH}_3 \end{array}$	$\begin{array}{c} \text{NH}_2 \\ \\ \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array}$
gallic acid	1-heptanamine	1-propanamine

- (i) Name the functional group circled above.

alcohol

- (ii) Explain the procedure you could use to distinguish between 1-heptanamine and 1-propanamine solutions based solely on their physical properties.

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

In your answer:

- describe the test method
- compare the observation for each compound
- explain the test result for each compound.

You could use ~~use~~ H₂O which would determine that its a base and the intensity of the reaction would determine the difference between them

Question Three continues
on the next page.

- (iii) Describe how red and blue litmus paper can be used to distinguish between gallic acid and 1-heptanamine solutions.

Include observations in your answer.

Red litmus paper remains red ~~with an acid or turns red~~ with an acid and turns blue with a base and blue litmus paper remains blue with a base or turns red with an acid so since gallic acid is an acid it will cause the red litmus paper to remain red and the blue litmus paper to turn red and since 1-heptanamine is a base it will cause

- (iv) Devise an alternative method (without using litmus) to identify the functional group circled in gallic acid.

In your answer:

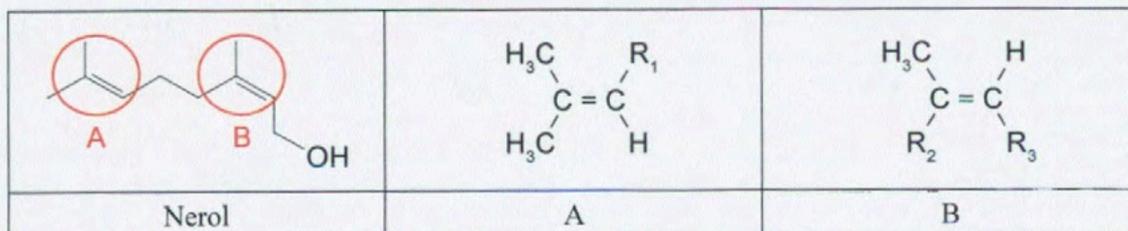
- state the reagent needed and the general products formed
- describe the observation, and link to the products formed.

To identify the alcohol group you can use $H^+/Cr_2O_7^{2-}$ this will form a carboxylic acid and will cause the alcohol to decolourise therefore determining that the functional group is intact an alcohol.

back of book

- (b) Pōhutukawa flowers contain many terpene compounds (volatile organic compounds) that contribute to their fragrance. An example of a terpene, nerol, is shown below.

Two functional groups (A and B) have been circled and shown to the right, where the label 'R' has been used in place of the complex remainder of the molecule. **Note that R₁, R₂, and R₃ groups are all different.**



- (i) Identify which of A and B will exist as geometric isomers.

B

- (ii) Justify your choice in (b)(i) by explaining the requirements for geometric isomerism.

The requirements for geometric isomerism is for there to be a double bond which they both have and for there to be ~~different~~ two different groups on a carbon so since compound A has the same H₃C group on one carbon this means it doesn't have the requirements for geometric isomerism whereas compound B does. Due to it having H₃C and R₂ on one carbon atom and H and R₃ on the other.

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

QUESTION
NUMBER

Question 3 - (a) - (iii)

- the blue litmus paper to remain the same and the red litmus paper to turn blue.

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

QUESTION
NUMBER

91165

Achievement

Subject: L2 Chemistry

Standard: 91165

Total score: 11

Q	Grade score	Marker commentary
One	A4	The candidate was awarded A4 for the following reasons: in (b) they identified the type of reaction occurring and the condition, but were unable to identify the observations or the correct product structure; in (c)(i) they identified 4 from 4 classifications; in (c)(ii) they identified the correct major and minor products; in (c)(iii) they identified that the chlorine and a hydrogen was being removed to form a double bond, but did not fully explain the elimination reaction, nor the different products.
Two	A4	The candidate was awarded A3 for the following reasons: in (a) they correctly identified 6 from 8 structures / reaction types; in (b) (i) they drew three repeating units of the polymer; in (b) (iii) they drew the monomer of Teflon.
Three	A3	The candidate was awarded A3 for the following reasons: in (a)(iii) they correctly linked the use of litmus paper to distinguish between gallic acid and 1-heptanamine; in (b)(i) they identified that B would be able to exist as geometric isomers; in (b)(ii) they identified that a double bond is required, but did not explain why it was necessary or why different groups are required for geometric isomerism.