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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 3 Chemistry 2023

91391 Demonstrate understanding of the properties of organic compounds

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of organic compounds.	Demonstrate in-depth understanding of the properties of organic compounds.	Demonstrate comprehensive understanding of the properties of 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 L3–CHEMR.

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

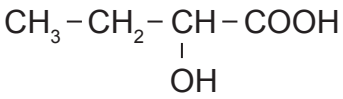
Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). 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.

QUESTION ONE

(a) 2-hydroxybutanoic acid exists as enantiomers (optical isomers).



(i) Circle and describe the structural feature that enables 2-hydroxybutanoic acid to exist as enantiomers.

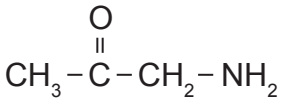
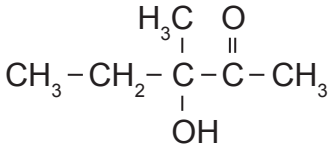
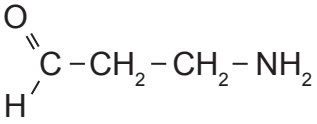
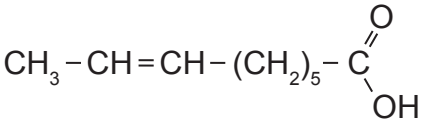
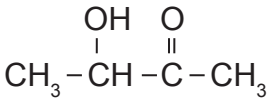
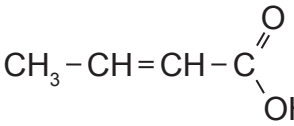
(ii) Draw the enantiomers of 2-hydroxybutanoic acid in the box below.

(b) Devise a reaction scheme to convert pentan-2-one into pentyl ethanoate.

For each step include:

- the reagents and conditions
- the structural formula of the organic product.

(c) The following table lists the structural formulae for six different organic compounds.

1		**2**	
3		**4**	
5		**6**	

(i) Choose the appropriate organic compounds from the table above to match the observations recorded from chemical tests and the solubility in water. Enter the chosen compound number in the table below.

Observations from chemical tests	**Physical properties**	**Compound number**
• Bubbles formed upon addition of sodium carbonate, Na_2CO_3, solution. • Purple solution to brown solid upon addition of potassium permanganate solution, $KMnO_4$.	Soluble in water.	
• Turns damp red litmus paper blue. • Blue solution to orange-red solid when heated with Fehling's reagent.	Soluble in water.	

(ii) Justify your chosen structural formula for each of the two compounds.

Your answer should:

- relate the observations to the functional groups identified
- identify the types of reaction involved
- account for the solubility in terms of chain length and the functional groups present.

QUESTION TWO

(a) A student has two test tubes, one containing propan-1-ol and the other containing propan-2-ol. The student adds acidified potassium permanganate to each test tube, and warms them in a water bath.

(i) Describe the colour change occurring in both test tubes.

(ii) Explain how Tollens' reagent could be used to distinguish the propanal and propanone produced in part (i).

Your answer should include:

- observations
- the type of reaction occurring
- structural formulae of any organic product(s).

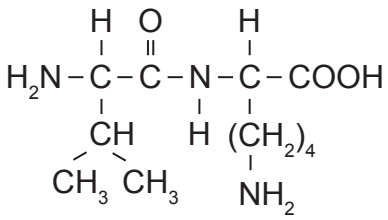
(b) $C_4H_5O_2Cl$ can exist as a number of different constitutional (structural) isomers.

Draw the structural formulae for the isomers of $C_4H_5O_2Cl$ that have the properties given:

(i) A straight-chain molecule that exists as enantiomers, turns damp blue litmus paper red, and rapidly turns bromine water from orange to colourless.

(ii) A molecule that undergoes hydrolysis in acidic conditions to produce methanol and another organic molecule that exists as *cis-trans* (geometric) isomers.

(c) Consider the dipeptide shown below.



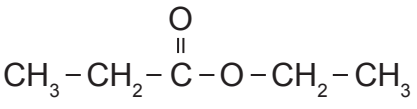
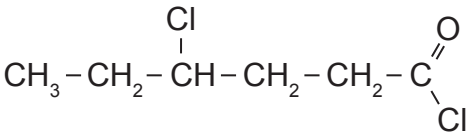
(i) Draw the structural formulae of the two amino acids used to produce the above dipeptide.

(ii) Identify and explain the type of reaction occurring in the formation of the dipeptide from the two amino acids.

(iii) Draw the structural formulae of the two organic products from acidic hydrolysis of the dipeptide.

QUESTION THREE

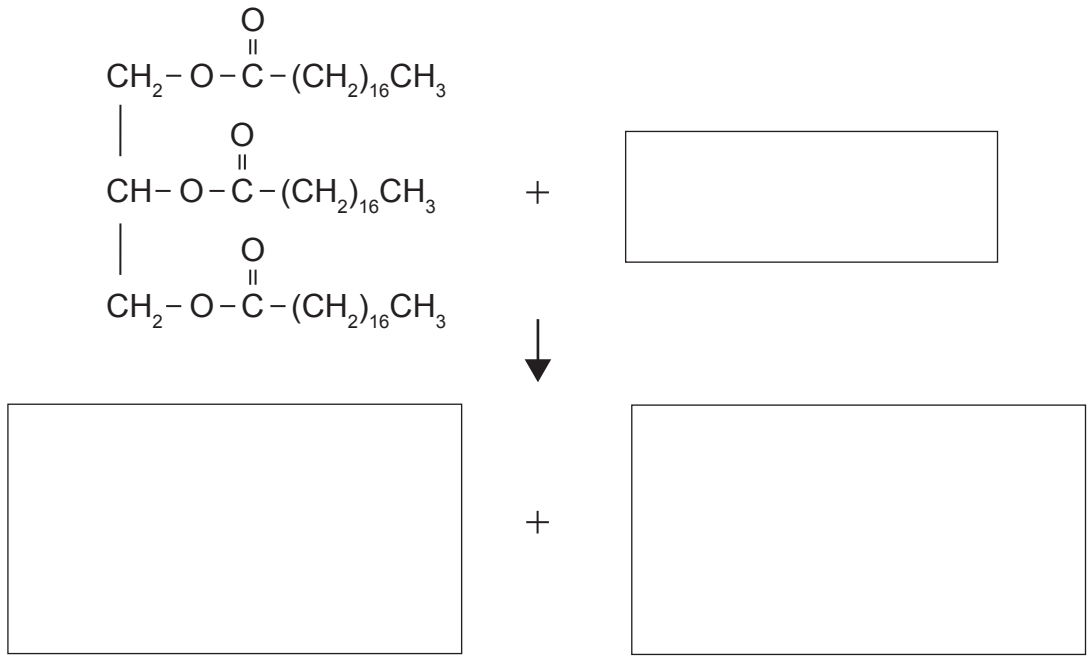
(a) Complete the table below to show either the structural formula or the IUPAC (systematic) name for each organic molecule.

Structural formula	IUPAC (systematic) name
	pentan-3-one
	
	
	2-methylbutanamide

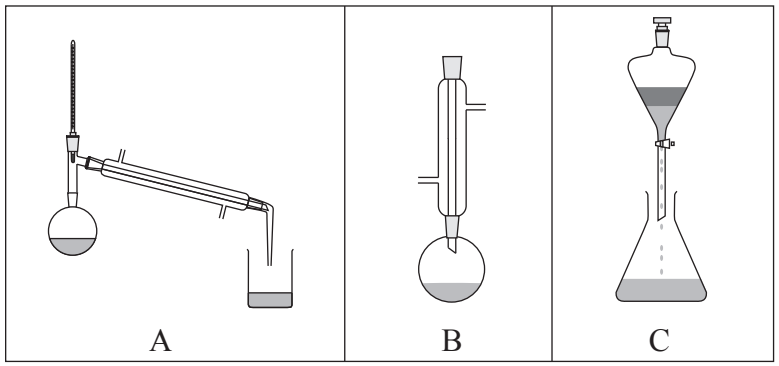
Question Three continues on the next page.

(b) Triglycerides are found in fats and oils.

(i) Complete the **balanced** equation to show the basic hydrolysis of the triglyceride provided, using structural formulae for organic products.



(ii) Select ONE of the following pieces of equipment that could be used to hydrolyse the triglyceride and give reasons for your choice.



Letter of equipment selected: _____

Reasons: _____

(c) **Compound C** is a branched-chain molecule with the molecular formula $C_4H_9O_3N$.

- **Compound C** shows the following properties and reactions:
  - exists as enantiomers (optical isomers)
  - undergoes acidic hydrolysis to produce **Compound D**
- **Compound D** reacts with acidified potassium dichromate to produce **Compound E**.
- Both **Compounds D** and **E** turn damp blue litmus paper red.
- **Compound E** reacts with excess $SOCl_2$ to produce **Compound F** and steamy acidic fumes.

Draw the structural formulae of **Compounds C**, **D**, **E**, and **F** in the boxes below:

Compound C	
Compound D	
Compound E	
Compound F	

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

QUESTION NUMBER