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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 2025

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

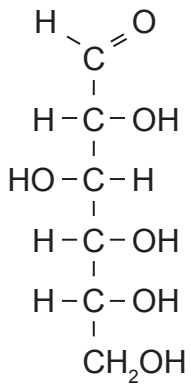
Do not write in the margins (⁝⁝⁝). This area will be cut off when the booklet is marked.

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

QUESTION ONE

There are two enantiomers (optical isomers) of glucose, called D-glucose and L-glucose.

(a) (i) Label **all** the asymmetric carbon atoms with an asterisk (*) in the structural formula of D-glucose shown below.

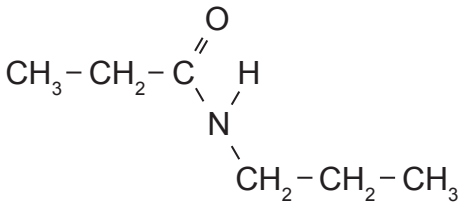


(ii) Explain how D-glucose and L-glucose could be distinguished.

(iii) When D-glucose is heated with Tollens' reagent, a silver mirror forms.

Explain this observation with reference to the functional group involved and the type of reaction occurring.

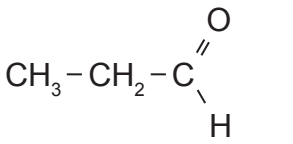
(b) Devise a reaction scheme to convert propanal into N-propylpropanamide.



N-propylpropanamide

Assume that you are provided **only** with the following reagents:

$SOCl_2$, $Cr_2O_7^{2-}/H^+$, $NaBH_4$, conc NH_3 (reagents can be used more than once).



propanal

(c) A student wanted to make some butanal, $CH_3CH_2CH_2CHO$, in the school laboratory. The student heated some butan-1-ol and excess acidified potassium permanganate, $KMnO_4/H^+$, under reflux for 20 minutes. The student then distilled the reaction mixture to collect the butanal fraction. However, no fraction was collected at 73–76 °C.

Compound	**Boiling point / °C**
Butan-1-ol	118
Butanal	74.8
Butanoic acid	163

(i) Describe the colour change that would be observed as the reaction is heated, and link this observation to the type of reaction occurring.

(ii) Explain why no fraction was collected at 73–76 °C.

(iii) Outline why the student should have used distillation instead of heat under reflux to produce butanal.

You should include an explanation of the process of distillation, and compare the position of the condenser between distillation and heat under reflux.

Refer to the diagrams provided below.

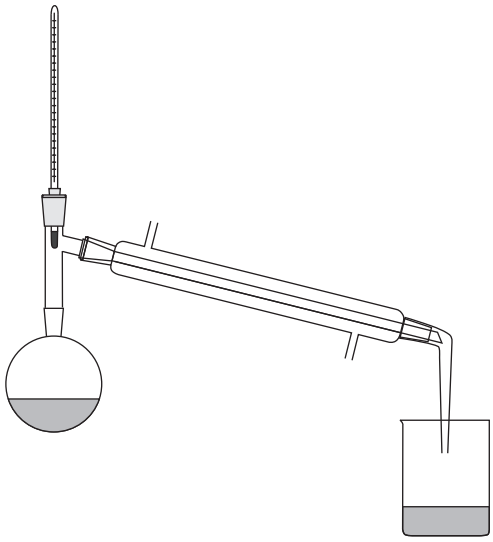


Fig. 1

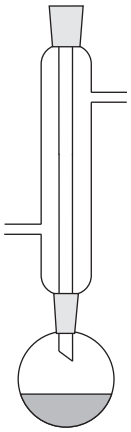
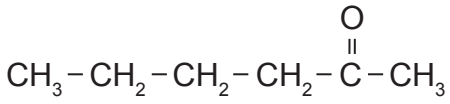
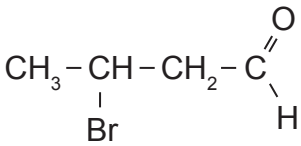


Fig. 2

QUESTION TWO

(a) (i) Complete the table below by either naming or drawing the structural formula.

	Structural formula	IUPAC name
A		
B		propyl ethanoate
C		2-methylpentanamide
D		

(ii) Draw the enantiomers (optical isomers) of Compound D in the box below.

(b) Three bottles, each containing a different colourless liquid, have not been labelled. The laboratory technician confirms they are:

• ethanol • ethanoyl chloride • ethanal

A student devised the following procedure to positively identify each of the three colourless liquids:

Step 1: Add water to all three colourless liquids.

Step 2: Add Fehling's solution to the remaining two colourless liquids, and heat.

Step 3: Add acidified potassium dichromate, $K_2Cr_2O_7/H^+$, to the remaining colourless liquid, and heat.

(i) Complete the table below for each step, **only** including observations for reactions that occur.

Step	Observations	Type of reaction occurring	Name of Organic Compound identified
1			
2			
3			

(ii) Justify why the three steps should be followed in the order given to positively identify each of the three colourless liquids.

(c) Compound A has the molecular formula C_4H_8O, and exists as enantiomers (optical isomers). When dilute sulfuric acid, H_2SO_4, is added, two organic compounds are formed: Compound B and Compound C. Compound B is present in the higher proportion.

Compound B is reacted with excess thionyl chloride, $SOCl_2$, followed by concentrated ammonia, NH_3, to form Compound D. Compound D turns damp red litmus paper blue.

Compound C is heated with excess acidified potassium permanganate, $KMnO_4/H^+$, to form Compound E. Compound E forms bubbles when sodium carbonate, Na_2CO_3, solution is added.

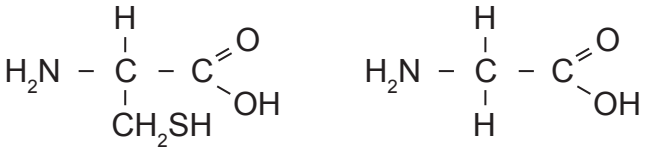
Draw the structural formulae for Compounds A, B, C, D, and E in the table on the next page.

Space for working:

Compound	Structural formula
A	
B	
C	
D	
E	

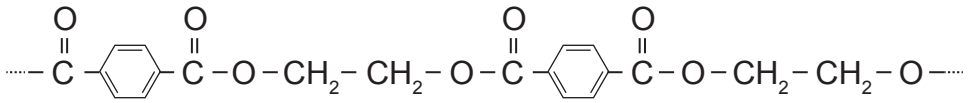
QUESTION THREE

(a) (i) Using the following two amino acids, draw the structural formulae for the two possible dipeptides that could be formed.



(ii) Identify and explain the type of reaction ocurring to form the two dipeptides.

Dacron is a polymer used in the furniture industry. Two repeating units of Dacron are shown below:



Note:  is a benzene ring, and does not change when Dacron is heated in part (iv).

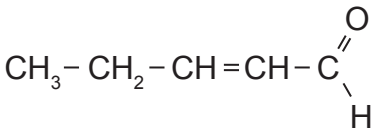
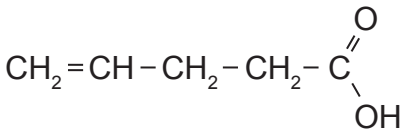
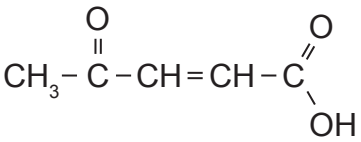
(iii) Circle ONE ester linkage in the above diagram of Dacron.

(iv) Identify and explain the type of reaction that would occur when Dacron is heated under reflux with sodium hydroxide, NaOH, solution.

Draw the structural formulae of the organic products in the box below to support your answer.

Question Three continues on the next page.

(b) (i) Consider compounds W, X, and Y, shown below:

Compound W	Compound X	Compound Y
		

Identify the ONE compound that has ALL the following properties:

- exists as *cis-trans* (geometric) isomers
- reacts with thionyl chloride, $SOCl_2$, to produce steamy fumes
- can be reduced by sodium borohydride, $NaBH_4$.

Compound (W, X, or Y): _____

Explain your choice, including why the other two compounds were eliminated.

(ii) Draw the structural formula of Compound S, given its molecular formula is $C_5H_{10}O_3$, and it has the following properties:

- can be oxidised to a ketone
- can form a cyclic ester with four carbon atoms in the ring when heated with concentrated sulfuric acid, H_2SO_4.

(iii) Draw the structural formula of Compound T, given its molecular formula is C_5H_9Br, and it has the following properties:

- branched carbon chain
- exists as enantiomers (optical isomers)
- classified as a secondary haloalkane
- causes a colour change of orange to colourless when mixed with bromine water, $Br_2(aq)$.

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

QUESTION NUMBER

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