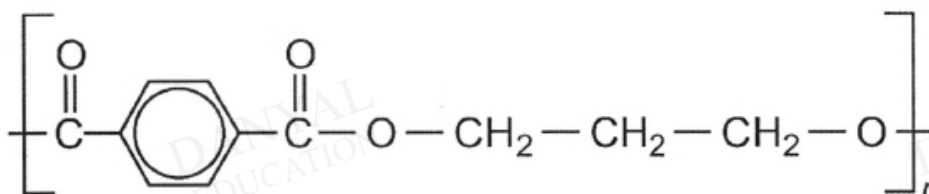


O Level Pure Chemistry Structured

Organic Chemistry Test 4.0

Q1

Many soft drinks bottles are made of thermoplastics, polyethylene terephthalate (PET), which is formed from polymerisation of two different monomers and has the following structures:



- (a) (i) Draw the structural formula of the two monomers that can be polymerised to PET.

[2]

- (ii) Name the type of polymerisation involved and give the reason for your choice.

[1]

- (b) Most environmental friendly green bags are made of 100% non-woven polypropene which is recyclable but not biodegradable.

- (i) Write an equation, showing the structural formula, to illustrate the formation of polypropene from its monomer.

[1]

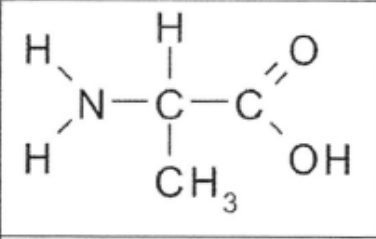
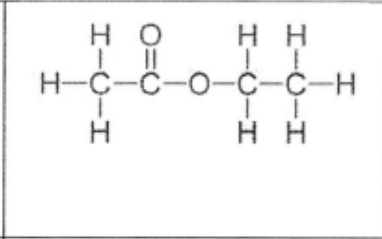
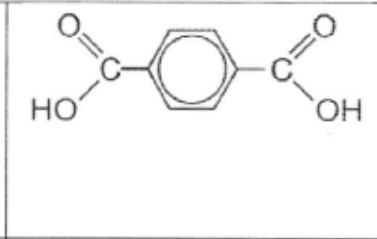
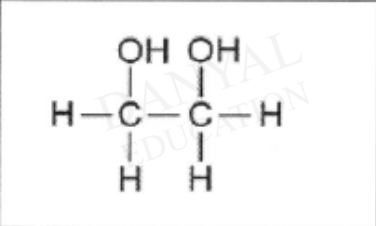
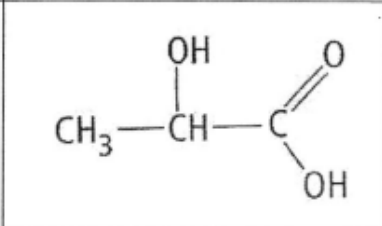
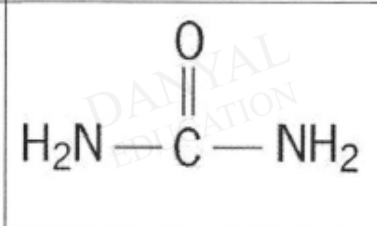
- (ii) Name the type of polymerization involved.

[1]

- (iii) Suggest why non-woven polypropene is still not considered environmentally friendly.

[1]

(c) Two of the following molecules can form condensation polymers by itself.

		
molecule A	molecule B	molecule C
		
molecule D	molecule E	molecule F

Identify the two molecules (A, B, C, D, E and/or F) and draw the structure of the repeating unit of each polymer in the boxes provided.

molecule that can form a condensation polymer by itself:	molecule: _____
structure of repeating unit:	

molecule that can form a condensation polymer by itself:	molecule: _____
structure of repeating unit:	

[4]

[Total: 10 marks]

Q2

When compound **A** (C_2H_6O), an alcohol, was heated with acidified potassium manganate (VII), an organic compound **B** was formed. When a mixture of **A** and **B** was heated in the presence of a catalyst, a sweet smelling liquid **C** ($C_4H_8O_2$) was obtained.

(a) Describe the observation when compound **A** is heated with acidified potassium manganate (VII).

.....[1]

(b) (i) Draw the structural equation for the reaction that occurs between **A** and **B**. Identify compound **A**, **B** and **C** and write their respective names next to their structural formula in the equation.

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[3]

(ii) State the conditions required for the reaction in (b) (i).

.....[1]

(c) Compound **A** can be used as a car fuel.
In some countries it is produced from the sugars in sugar cane.

(i) Name the process used to produce compound **A** from sugar.

.....[1]

(ii) Suggest why most of the compound **A** is not produced by the process named in (c) (i).

.....[1]

(iii) An environmentalist makes a comment about using compound **A** as a fuel.

Compound **A** as a fuel is 'carbon neutral' because using it does not add to the amount of carbon dioxide in the atmosphere.

Do you agree with the comment? Explain your reasoning.

.....
.....
.....

[2]

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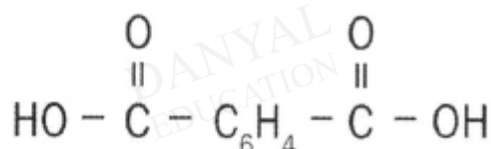
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Q3

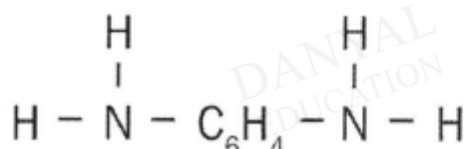
- In the early 1970s, a polymer known as Kevlar was invented by Stephanie Kwolek, an American chemist. Kevlar fibre is used for making bulletproof vests, army helmets and 'puncture-proof' tyres. Kevlar fibre is also used in the protective clothing worn by firefighters.

Kevlar is made by condensation polymerisation from two different monomers – 1,4-benzenedicarboxylic acid and 1,4-diaminobenzene.

The structural formulae of these monomers are shown below.



1,4-benzenedicarboxylic acid



1,4-diaminobenzene

- (a) (i) Draw the structural formula of the organic compound formed when 1,4 benzenedicarboxylic acid is reacted with an excess of sodium carbonate.

[1]

- (ii) Write the formula of the gas produced in reaction (a) (i) and describe a simple laboratory test to confirm the identity of the gas produced.

.....
.....[2]

- (b) Explain what is meant by condensation polymerisation.

.....
.....[1]

(c) (i) Draw the structural formula of one repeat unit of Kevlar.

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[1]

(ii) Suggest two possible gases produced on the combustion of Kevlar.

.....[1]

(d) Suggest the name of a synthetic polymer that has the same functional group as Kevlar. Give a reason for your choice.

.....
.....[2]

(e) Sea fishing nets used to be made from natural fibres. Many nets are now made from synthetic fibres. Suggest one **advantage**, other than strength, and one **disadvantage** of using synthetic fibres named in (d) rather than natural fibres to make sea fishing nets.

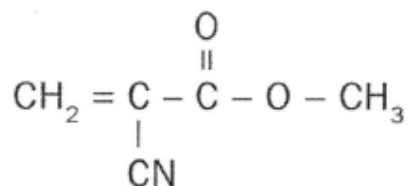
.....
.....[2]

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Q4

Superglue is a very strong adhesive used to fasten materials, such as wood, together. The active ingredient in superglue is methyl cyanopropenoate, commonly known as methyl cyanoacrylate. The structure of methyl cyanopropenoate is shown below.



methyl cyanopropenoate

Superglue polymerises when exposed to moisture in the air. This causes the glue to set.

- (a) Draw the structural formulae of the two functional groups present in methyl cyanopropenoate. Name the two functional groups.

[2]

- (b) What type of polymerisation does methyl cyanopropenoate undergo when it forms superglue?

.....[1]

- (c) Draw the structural formula of the polymer formed, showing two repeat units.

[1]

- d) Other than superglue, suggest another name for the polymer formed in (c).

.....[1]

- (e) Name two possible gases that are produced when the polymer formed in (c) is burnt in excess oxygen.

.....[1]

- (f) (i) A sample of methyl cyanopropenoate is shaken with bromine water.
Describe what you would observe.

.....
.....[1]

- (ii) What type of reaction has occurred in (f) (i)?

.....[1]

- (iii) Write the formula of the organic product formed in (f) (i).
Hence calculate the mass of one mole of the organic product formed

[2]

Q5

(a) Ketones are a homologous series of organic compounds.

The table shows the names, formulae and boiling points of some ketones.

name	structural formula	boiling point / °C
2-propanone	$\begin{array}{c} \text{O} \\ \\ \text{CH}_3 - \text{C} - \text{CH}_3 \end{array}$	56
2-butanone	$\begin{array}{c} \text{O} \\ \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{CH}_3 \end{array}$	80
3-pentanone	$\begin{array}{c} \text{O} \\ \\ \text{CH}_3 - \text{CH}_2 - \text{C} - \text{CH}_2 - \text{CH}_3 \end{array}$	
3-hexanone	$\begin{array}{c} \text{O} \\ \\ \text{CH}_3\text{CH}_2 - \text{C} - \text{CH}_2\text{CH}_2\text{CH}_3 \end{array}$	123

(i) Deduce the general formula and functional group of the ketone homologous series

general formula functional group [2]

(ii) Predict the boiling point of 3-pentanone.

..... [1]

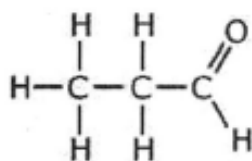
(iii) Using the information above, deduce the significance of the number "3" in the name "3-hexanone".

..... [1]

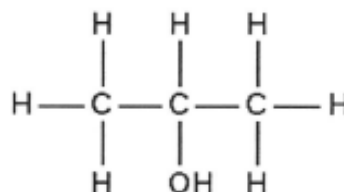
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- (iv) 2-propanone, propanal (an aldehyde) and 2-propanol are all compounds of carbon, hydrogen and oxygen.



propanal



2-propanol

State with reasons, which of these three compounds are isomers of each other.

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.....
.....
..... [2]

- (b) Ketones can be made by the oxidation of some alcohols.
For example, 2-propanone can be formed from the oxidation of 2-propanol.

- (i) State a suitable oxidising agent that can be used for the oxidation of 2-propanol to 2-propanone, and the observation that would be made during this reaction.

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.....
..... [2]

- (ii) Write an equation for the oxidation of 2-propanol to 2-propanone.
Show the organic compounds as displayed formulae.

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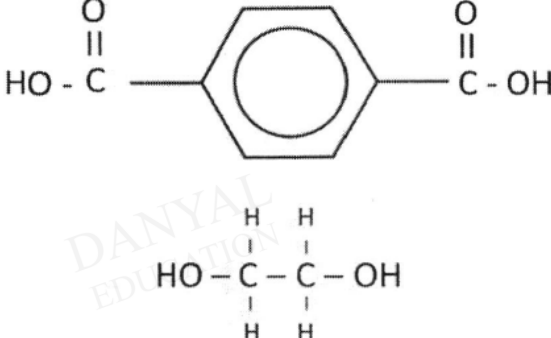
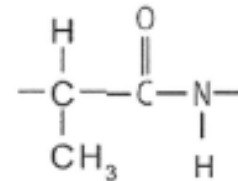
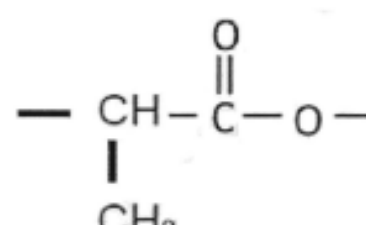
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[1]

Answers

Organic Chemistry Test 4.0

Q1

(a)(i)		<p>1 1</p>	
(ii)	<p>Condensation polymerisation as a small molecule of water is eliminated when 2 monomers polymerised.</p>	<p>1</p>	
(b)(i)	<p>(c) <i>doe b</i></p> $n \begin{array}{c} \text{CH}_3 \\ \\ \text{C}=\text{C} \\ \quad \backslash \\ \text{H} \quad \text{H} \end{array} \rightarrow \begin{array}{c} \text{CH}_3 \quad \text{H} \quad \text{CH}_3 \quad \text{H} \\ \quad \quad \quad \\ -\text{C}-\text{C}-\text{C}-\text{C}- \\ \quad \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array} \quad \text{or in 'shorthand'} \quad \left(\begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ -\text{C}-\text{C}- \\ \quad \\ \text{H} \quad \text{H} \end{array} \right)_n$ <p><i>n</i> = a big number of monomers polymer <i>n</i> units long (2 shown)</p>	<p>1</p>	
(ii)	<p>Addition polymerisation</p>	<p>1</p>	
(iii)	<p>Since is not biodegradable, it remains as a waste material in the environment and takes up landfill space. Or when burnt, it produces carbon dioxide and other harmful pollutants</p>	<p>1</p>	
(c)	<p>molecule that can form a condensation polymer by itself:</p> <hr/> <p>structure of repeating unit:</p> <hr/> <p>molecule that can form a condensation polymer by itself:</p> <hr/> <p>structure of repeating unit:</p>	<p style="text-align: center;">A</p>  <p style="text-align: center;">E</p> 	<p>4</p>

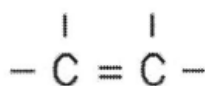
Q2

7a	Purple potassium manganate(VII) is decolourised / turns colourless.	1
bi	Compound A is ethanol, B is ethanoic acid and C is ethyl ethanoate. [2] [3√ - 2m; 2√ - 1m; 1√ - 0m]	3
<div style="text-align: center;"> <p style="text-align: center;"> $\begin{array}{c} \text{H} \quad \text{O} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{H} \\ \text{ethanoic acid} \end{array} + \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{O}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \\ \text{ethanol} \end{array} \rightleftharpoons \begin{array}{c} \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{C}-\text{C}-\text{H} \\ \quad \quad \quad \quad \\ \text{H} \quad \quad \quad \text{H} \quad \text{H} \\ \text{ethyl ethanoate} \end{array} + \begin{array}{c} \text{H}-\text{O}-\text{H} \\ \text{water} \end{array}$ </p> </div> <p>Structural equation -1m [minus 1m if no label of A, B or C for each compound but correct naming of each structural compound]</p>		
bii	Add concentrated sulfuric acid as a catalyst and heat the mixture.	1
ci	Fermentation	1
cii	The process is very slow. / The yield is very low.	1
ciii	The amount of carbon dioxide emitted during the combustion of ethanol [1] is balanced by the taking in of carbon dioxide by sugar cane during photosynthesis [1]. As there is no net gain in carbon dioxide, the environmentalist is correct.	2

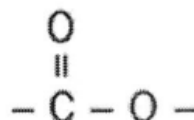
Q3

10ai	$\text{NaO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{C}_6\text{H}_4-\overset{\text{O}}{\parallel}{\text{C}}-\text{ONa}$
aii	<p>CO₂ [1] Bubble the gas through limewater. White precipitate formed indicates the presence of carbon dioxide gas. [1]</p>
b	<p>Condensation polymerisation is a process whereby monomers with different functional groups are joined together to form a large molecule with the removal of small molecules such as water.</p>
ci	$\begin{array}{ccccccc} & & & \text{O} & & \text{O} & \\ & & & \parallel & & \parallel & \\ -\text{N} & -\text{C}_6\text{H}_4 & -\text{N} & -\text{C} & -\text{C}_6\text{H}_4 & -\text{C} & - \\ & & & & & & \\ \text{H} & & \text{H} & & & & \end{array}$
:ii	<p>Any two of the following: [both gases must be correct to score 1m] carbon dioxide, carbon monoxide, nitrogen dioxide, water vapour</p>
d	<p>Nylon. [1]</p>
<p>Both nylon and Kevlar contains amide linkages. [1]</p>	
e	<p>Advantage: It is durable / light / waterproof [1]</p> <p>Disadvantage: Any one of the following [1] It is non-biodegradable as It cannot be decomposed naturally by the bacteria in the soil. / It can remain buried in landfills for a long period of time which means more lands are needed for landfill sites. / It can cause water pollution as it may clog up rivers and drains which might become breeding ground for mosquitoes / when thrown into sea, it can endanger marine animals. / It can cause air pollution when burnt as it produces toxic gas like carbon monoxide.</p>

Q4
 i10a



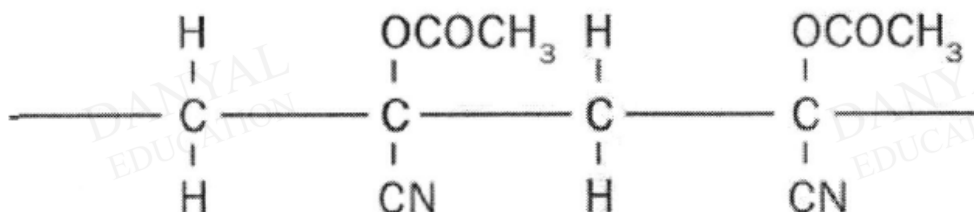
carbon-carbon double bond



ester

b Addition polymerisation

c



d Poly(methyl cyanopropenoate)

e Any two of the following gases:

Carbon dioxide, water vapour, nitrogen dioxide
 [both gases must be correct to score 1m]

f i Reddish brown aqueous bromine turns colourless.

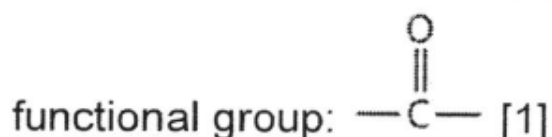
f ii Addition reaction / addition of bromine / bromination

f iii $CH_2BrCBrCNCOOCH_3$ [1]

Mass of one mole = $(12 \times 5) + 5 + (80 \times 2) + 14 + (16 \times 2)$
 = 271 g [1]

Q5

(i) general formula: $C_nH_{2n}O$ [1]



(ii) accept 101 – 104 °C [1]

(a)

(iii) indicates position of C=O functional group (on the main hydrocarbon chain / backbone) [1]

(iv) 2-propanone and propanal are isomers [1]

They have the same molecular formula (of C_3H_6O) but different structural formula [1]

- (b) (i) potassium manganate (VII) or potassium permanganate / KMnO_4 [1]
colour change from purple to colourless [1]
OR
potassium dichromate (VI) / $\text{K}_2\text{Cr}_2\text{O}_7$ [1]
colour change from orange to green [1]
- (ii) $\text{C}_3\text{H}_7\text{OH} + [\text{O}] \rightarrow \text{C}_3\text{H}_6\text{O} + \text{H}_2\text{O}$ [1]
All bonds must be shown.