



Rewarding Learning

ADVANCED
General Certificate of Education

Life and Health Sciences

Assessment Unit A2 2

assessing

Organic Chemistry

[AZ021]

Assessment

**MARK
SCHEME**

Foreword

Introduction

Mark Schemes are published to assist teachers and students in the preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16–18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

The abbreviation 'ecf' stands for 'error carried forward'.

- 1 (a) (i) fermentation [1]
- (ii) yeast [1]
warm temperature [1] allow temperature in range 15°C to 35°C
anaerobic [1] [3]
- (iii) carbon dioxide [1]
- (iv) beneficial effect: any **one** from below [1]
- reduce risk of cardiovascular disease
 - reduce risk of stroke
 - reduce risk of diabetes
 - reduce risk of dementia
- harmful effect: any **one** from below [1]
- kidney disease
 - mental health problems
 - fertility problems
 - liver damage
 - brain damage
 - reduces inhibitions [2]
- (b) (i) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [1]
- (ii) (concentrated) phosphoric acid [1]
- (iii) addition/hydration [1]
- (c) (i) biodiesel [1]
- (ii) can be replaced in a human lifetime/will not run out/
not depleted by use [1]
- (iii) carbon neutral/produce less CO_2 /global warming reduced or stated
effect reduced. Stated effects can include:
- less extremes of weather
 - less land becomes desert
 - less ice caps melting
 - smaller increase in sea levels [1]
- (d) (i)
- $$\begin{array}{c}
 \text{H} \quad \text{H} \\
 | \quad | \\
 \text{H}-\text{C}-\text{C}-\text{OH} \\
 | \quad | \\
 \text{H} \quad \text{H}
 \end{array}
 \quad \text{NOT} \quad
 \begin{array}{c}
 \text{H} \quad \text{H} \\
 | \quad | \\
 \text{H}-\text{C}-\text{C}-\text{HO} \\
 | \quad | \\
 \text{H} \quad \text{H}
 \end{array}$$
- [1]
- (ii) A = O—H [1]
B = C—H [1]
C = C—O [1]
D = C—C [1] [4]
- (iii) mass spectrometry [1]

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- 2 (a) (i) $\text{CH}_3\text{CH}=\text{CH}_2$ = propene [1] allow prop-1-ene
 $\text{CH}_3\text{CH}_2\text{CH}_3$ = propane [1] [2]
- (ii) nickel [1]
- (iii) addition/hydrogenation [1]
- (iv) sigma [1] and pi [1] [2]
- (v) yellow/orange solution [1] changes to colourless [1] [2]
- (b) (i) (free radical) substitution [1]
- (ii) chloromethane [1]
- (iii) $\text{CH}_3\text{Cl} + 3\text{Cl}_2 \rightarrow \text{CCl}_4 + 3\text{HCl}$ all formulae correct [1]
 balancing correct [1] balancing mark dependent on all formulae correct [2]
- (c) (i) combustion/oxidation [1]
- (ii) $\text{C}_n\text{H}_{2n+2}$ [1]

(iii)

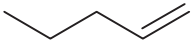
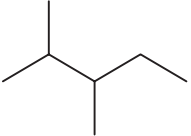
IUPAC name	Structural formula
pentane [1]	<pre> H H H H H H-C-C-C-C-C-H H H H H H </pre>
2-methylbutane	<pre> H CH₃ H H H-C-C-C-C-H H H H H </pre>
(2,2-)dimethylpropane	<pre> H CH₃ H H-C-C-C-H H CH₃ H </pre>

[3]

- (d) (i) propan-1-ol [1]
- (ii) elimination/dehydration [1]
- (iii) concentrated [1] phosphoric acid [1] [2]

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		AVAILABLE MARKS
3	(a) <u>fractional</u> distillation NOT distillation	[1]
	(b) (i) contains only hydrogen and carbon (atoms)	[1]
	(ii) burns/reacts to release heat	[1]
	(c) (i) mass of hydrogen = 1.29 – 1.08 = 0.21 g	[1]
	(ii) moles of carbon = $\frac{1.08}{12} = 0.09$ [1]	
	moles of hydrogen = $\frac{0.21}{1} = 0.21$ [1]	
	ratio = 3:7 so empirical formula C ₃ H ₇ [1] ecf if only correct answer written award [3]	[3]
	(iii) C ₆ H ₁₄	[1]
	(d) (i) A = cracking [1] B = reforming [1]	[2]
	(ii) X = pent-1-ene [1] Y = 2,3-dimethylpentane [1]	[2]
	(iii) X	
		[1]
	Y	
		[1]
		[2]

(e) **Indicative content:**

- carbon monoxide has no environmental impact
 - oxides of nitrogen cause acid rain
 - oxides of sulfur cause acid rain
 - carbon particulates cause global dimming
 - unburned hydrocarbons cause smog
 - catalytic converter converts pollutants into less polluting products
 - carbon monoxide is changed/oxidised to carbon dioxide
 - oxides of nitrogen are changed/reduced to nitrogen
 - unburned hydrocarbons are changed/oxidised to carbon dioxide & water
- } any 2

Level of Response	Marking Criteria	Marks
Excellent Must contain at least five indicative content points	Candidates provide an excellent description of the environmental impact of the products and the use of catalytic converters. They use excellent spelling, punctuation and grammar and the form and style are of an excellent standard.	[5]–[6]
Good Must contain at least three indicative content points	Candidates provide a good description of the environmental impact of the products and the use of catalytic converters. They use good spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
Basic Must contain at least one indicative content point	Candidates provide a limited description of the environmental impact of the products and the use of catalytic converters. They use some good spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[2]
The response is not worthy of credit		[0]

[6]

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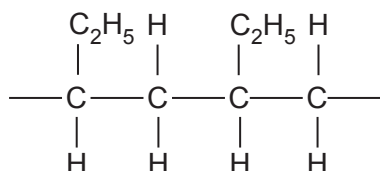
**AVAILABLE
MARKS**

- 4 (a) hydroxyl NOT hydroxy [1]
- (b) (i) differ by a CH₂ unit [1]
similar chemical properties [1]
 show a gradation in physical properties [1] NOT physical states [3]
- (ii) C₆H₁₃OH/C₆H₁₄O [1]
- (c) (i) acidified/dilute sulfuric acid [1]
 sodium/potassium dichromate(VI) solution [1]
 warm [1]
 propan-2-ol – change from orange to green [1]
 2-methylpropan-2-ol – no change [1] [5]
- (ii) blue solution [1]
 changes to a red [1] precipitate [1] [3]
- (iii) [1]
- $$\begin{array}{ccccccc}
 & & \text{H} & & \text{CH}_3 & \text{H} & & & \\
 & & | & & | & | & & & \\
 \text{H} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{H} \\
 & & | & & | & & | & & \\
 & & \text{H} & & \text{O-H} & & \text{H} & &
 \end{array}$$
- butan-1-ol [1] [2]
- (d) (i) anti-bump granules/boiling stones/boiling chips [1]
- (ii) arrows showing water in at bottom left and arrows showing water out at top right [1]
- (iii) CH₃CHBrCH₃ + NaOH → CH₃CH(OH)CH₃ + NaBr
 correct formulae and balancing on LHS [1]
 correct formulae and balancing on RHS [1] [2]
- (iv) prevent explosion/allow gases to expand [1]

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- 5 (a) 4 carbons with open bonds at end [1] include correct structure ie.



correct repeating unit [1] allow equation if repeating unit shown as product

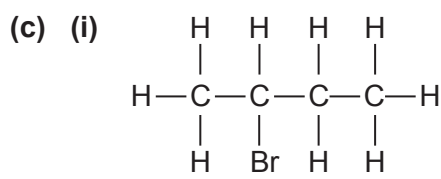
[2]

- (b) (i) any **two** from:
incineration/recycling/feedstock for cracking

[2]

(ii) inert/cannot be hydrolysed/cannot be broken down by microbes in the environment

[1]



[1]

2-bromobutane [1]

[2]

(ii) electrophilic addition

[1]

- (d) C=C has two of the same atoms bonded to the same carbon atom

[1]

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- 6 (a) A = salicylic acid/2-hydroxybenzoic acid [1]
B = ethanoic anhydride/acetic anhydride [1]

[2]

(b) circle around COOH group

[1]

- (c) (i) moles of A = $\frac{6.21}{138} = 0.0450$
moles of aspirin = 0.0450 [1]

theoretical yield of aspirin = $0.0450 \times 180 = 8.10 \text{ g}$ [1]

[2]

ecf

- (ii) percentage yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{6.30}{8.10} \times 100$ [1] = 77.8 [1] [2]
ecf

(iii) any **two** from:
side reactions [1]
not all of A reacted [1]
loss by mechanical transfer [1]
not all aspirin crystallised [1]

[2]

- (d) purple/violet if salicylic acid impurities present [1]
remains yellow if no impurities [1]

[2]

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Total

100