



*Rewarding Learning*

**ADVANCED**  
**General Certificate of Education**  
**2023**

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## **Life and Health Sciences**

**Assessment Unit A2 2**

*assessing*

**Organic Chemistry**

**[AZ021]**

**WEDNESDAY 14 JUNE, MORNING**

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**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

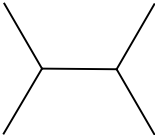
Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16–18-year-old students in schools and colleges. The job of the examiners is to 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.

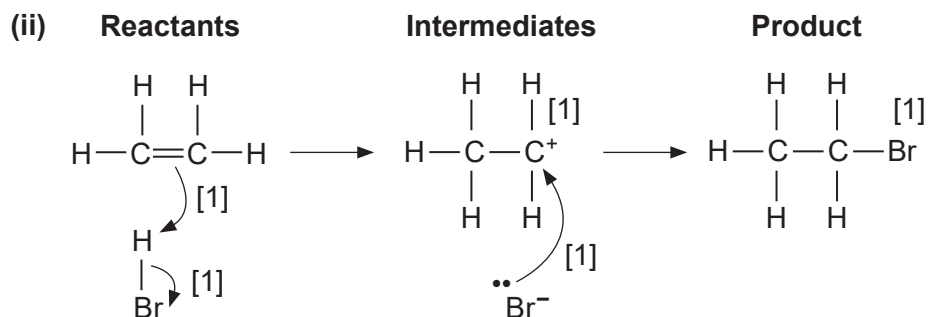
The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed 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.

- 1 (a) (i)** Any **two** of
- Death/damage of marine mammals
  - Death/damage of sea birds
  - Damage to coastal ecosystems (including beaches etc)
- [2]
- (ii)** Contains carbon and hydrogen only [1]
- (iii)** Crude oil evaporates/is vaporised [1]  
Gases condense at different heights/points/temperatures [1]  
Compounds separated by boiling point [1] [3]
- (iv)** reforming/cracking [1]
- (b) (i)** A molecule that contains no C=C or C≡C bonds [1]
- (ii)** Alkane [1]
- (iii)**  $C_8H_{18} + \frac{25}{2}O_2 \longrightarrow 8CO_2 + 9H_2O$
- Formula [1] Balancing [1] [2]  
balancing mark dependent on correct formula
- (c)** toxic – Carbon monoxide [1]  
Acid rain – sulfur dioxide [1] [2]
- (d) (i)** Catalytic converter [1]
- (ii)**  $2NO_2 \longrightarrow N_2 + 2O_2$
- Formula [1] Balancing [1] [2]  
balancing mark dependent on correct formula
- (iii)** reduction [1]
- (e) (i)** alcohol [1]  
biodiesel [1] [2]
- (ii)** CO<sub>2</sub> is used up in plant growth/they are carbon neutral (almost carbon neutral or similar). [1]
- (iii)** less readily available/require modifications to engines/  
more expensive. [1]
- 2 (a) (i)**
- 
- [1]
- (ii)** Pent-2-ene [1]
- (b) (i)** Bromine water [1]
- (ii)** Yellow/orange to colourless [1]
- (iii)** (Z) is saturated/contains only C-C / is an alkane [1]

- 3 (a) (i) ethene contains pi bond [1]  
 which is centre of high electron density [1]  
 H-Br is attracted/attacks [1] [3]



Curly arrow from C=C to H of H-Br [1]

Curly arrow from H-Br bond to Br [1]

intermediate structure correct [1]

Curly arrow from Br<sup>-</sup> ion to C<sup>+</sup> [1]

Product structure correct [1] [5]

(iii) bromoethane (allow 1-bromoethane) [1]

(iv) carbocation/carbonium ion [1]

(b) (i)  $C_3H_6 + H_2 \longrightarrow C_3H_8$  [1]

(ii) nickel [1]

(iii) Hydrogenation/addition [1]

(iv) making margarine/hardening cooking oils [1]

(c) (i)  $CH_4 + 2Cl_2 \longrightarrow CH_2Cl_2 + 2HCl$

Formula [1] Balancing [1] [2]  
 balancing mark dependent on correct formula

(ii) uses (UV) light to speedup/start the reaction/break bonds [1]

(d) (i)  $C_4H_8O$  [1]

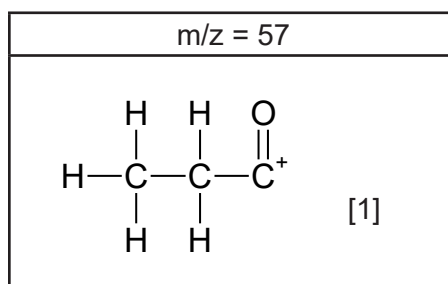
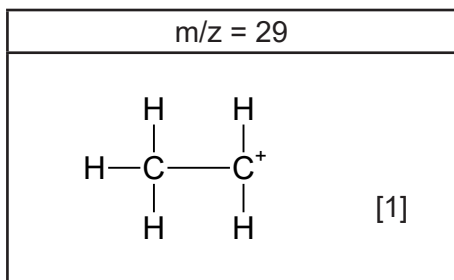
(ii) aldehyde [1]

(iii) distillation [1]

(iv) Fehling's solution/Benedict's reagent/acidified potassium dichromate(VI) [1]



(ii)



Penalise missing charge once

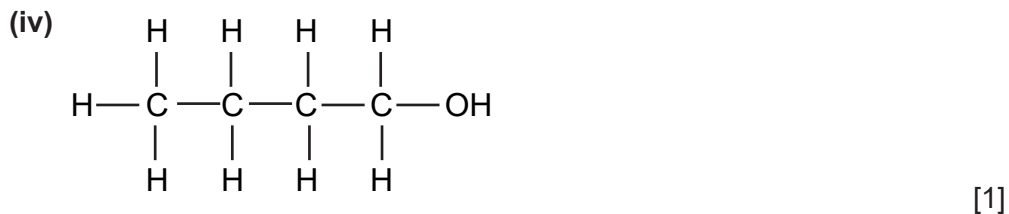
[2]

17

5 (a) (i)  $\text{C}_n\text{H}_{2n+2}\text{O} / \text{C}_n\text{H}_{2n+1}\text{OH}$  [1]

(ii) Hydroxyl group/OH is attached to a carbon that is attached to 2 other carbon atoms [1]

(iii) propan-1-ol [1]

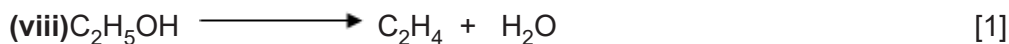


(v) Alcohol: C [1]

Explanation: Idea that it is a tertiary (alcohol) [1] [2]

(vi) idea that  $(\text{C}_4\text{H}_{10}\text{O})$  is the simplest whole number ratio of atoms / idea that  $(\text{C}_4\text{H}_{10}\text{O})$  cannot be simplified. [1]

(vii) concentrated phosphoric acid [1]



(ix) ethene [1]

(b) Indicative content

Description of hydration of ethene using steam

- 300°C
- 60atm
- Concentrated phosphoric acid catalyst

Description of fermentation of sugars in solution

- Uses yeast
- Anaerobic
- Approx. 35°C

Comparison of methods of production

- Fermentation is cheaper/hydration is more expensive
- Fermentation is slower/hydration is faster
- Fermentation has a lower yield/hydration has a higher yield
- Fermentation has a lower purity/hydration has a higher purity
- Hydration is continuous
- Fermentation is batch

Level of Response	Marking Criteria	Marks
<b>Excellent</b>	Candidate clearly articulates the details of the two industrial processes. There is excellent use of spelling, punctuation and grammar. Form and style are of an excellent standard using <b>8 or more</b> indicative points.	[5]–[6]
<b>Good</b>	Candidate provides a good description of the two industrial processes. There is good use of spelling, punctuation and grammar. Form and style are of a good standard using <b>4–7</b> indicative points.	[3]–[4]
<b>Basic</b>	Candidate provides a limited description of the industrial process. There is limited use of spelling, punctuation and grammar. Form and style are of basic standard. <b>1–3</b> indicative points used.	[1]–[2]
	This response is not worthy of credit	[0]

[6]

(c) (i) (percentage) transmittance

[1]

(ii) Any **three** from:

- There is an absorbance between  $3200 - 3600\text{cm}^{-1}$
- Shows presence of OH alcohol
- No absorbance between  $1650 - 1800\text{cm}^{-1}$
- No absorbance between  $2500 - 3200\text{cm}^{-1}$

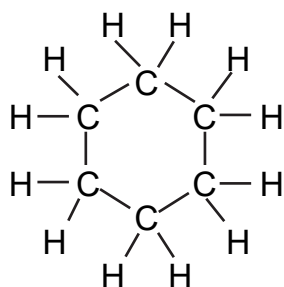
[3]

20

AVAILABLE  
MARKS

6 (a) (i) Condensation (polymerisation) [1]

(ii)



[1]

(iii) To prevent the solutions (completely) mixing [1]

(iv) Nylon forms between the layers [1]

Removed with tweezers/tongs [1]

(b) (i) Place small amount of solid in capillary tubing (closed at one end) [1]  
(heat quickly to near melting point then) heat slowly near melting point [1]  
Record temperature where aspirin (starts and finishes) melting [1] [3]

(ii) Will melt over a (wider) range of temperatures/melting point would be lower than 135°C [1]

(c) (i) ferric chloride/iron(III) chloride [1]

(ii) from yellow to violet/purple [1]

(iii) idea of using (ice) cold water [1]

(d) (i) 5.96 [1]

(ii) 4.57

moles of aspirin = 0.0331 [1]

Moles of salicylic acid = 0.0331 [1]

Mass of salicylic acid = 4.57 [1] [3]

**Total**

**AVAILABLE  
MARKS**

16

**100**