Rewarding Learning

ADVANCED
General Certificate of Education
2022 Reserve Series

Life and Health Sciences

Assessment Unit A2 2

assessing

Organic Chemistry

[AZ021]

THURSDAY 23 JUNE, MORNING

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.

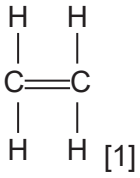
The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed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

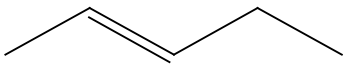
It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience 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.

COVID-19 Context

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

				AVAILABLE MARKS
1	**(a)**	a molecule containing C=C or C≡C [1]		
		contains only carbon and hydrogen [1]	[2]	
	(b)	**(i)** fractional distillation	[1]	
		(ii) they have **different** boiling points	[1]	
	(c)	**(i)** reforming	[1]	
		(ii) pentane [1]		
		2-methylbutane [1]	[2]	
	(d)	**(i)** $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ formula [1] balancing [1]	[2]	
		(ii) sulfur dioxide – acid rain [1]		
		carbon particulates – global dimming [1]		
		oxides of nitrogen – photochemical smog [1]	[3]	
	(e)	**(i)** $N_2 + 2O_2 \rightarrow 2NO_2$	[1]	
		(ii) catalytic converter [1]		
		converts/reduces (nitrogen dioxide) to nitrogen [1]	[2]	15
2	**(a)**	molecular formula: C_5H_{10} [1]		
		IUPAC name: pentene [1]	[2]	
	(b)	(thermal) cracking	[1]	
	(c)	structural formula:  [1]		
		IUPAC name: ethene [1]	[2]	
	(d)	dehydration/elimination	[1]	
	(e)	concentrated [1] phosphoric acid [1]	[2]	
	(f)	molecular formula: $CHCl_3$ [1] IUPAC name: trichloromethane [1]	[2]	
	(g)	(free radical) substitution	[1]	
	(h)	butanal	[1]	
	(i)	reagent: acidified [1] potassium dichromate (VI) [1] type of reaction: oxidation [1]	[3]	

(j)  [1]

(k) pentane [1]

(l) $C_5H_{10} + H_2 \rightarrow C_5H_{12}$ [1]

(m) nickel [1]

(n) electrophilic [1] addition [1] [2]

AVAILABLE MARKS

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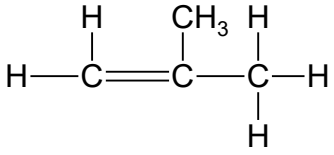
3 **(a)** C_nH_{2n} [1]

(b) similar chemical properties [1]
show a graduation in physical properties [1]
successive members differ by a CH_2 unit [1] [3]

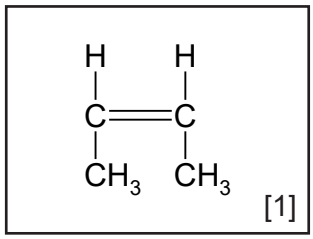
(c) **(i)** structural formula:



[1]

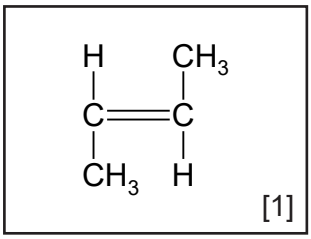
IUPAC name: (2-)methylpropene (allow 2-methylprop-1-ene) [1] [2]

(ii)



[1]

cis but-2-ene



[1]

trans but-2-ene

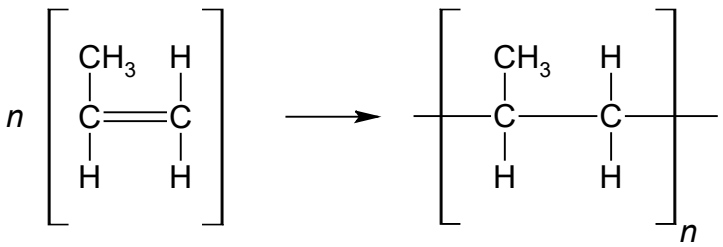
both IUPAC names correct [1]
cis & trans correctly labelled [1] [4]

(d) **(i)** cyclopentene [1]

(ii) C_5H_8 [1]

(iii) reagent: bromine water [1]
observations: orange layer [1] change to colourless [1] [3]

(e) **(i)**



monomer & polymer structure correct [1]
brackets and repeat [1] [2]

(ii) addition [1] polymerisation [1] [2]

(iii) they are inert/produce toxic gases when incinerated /non-biodegradable [1]

(iv) removing toxic gases in incineration exhaust [1]
developing biodegradable polymers [1] [2]

AVAILABLE MARKS

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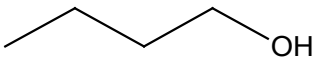
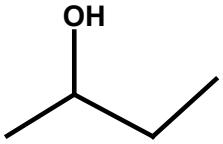
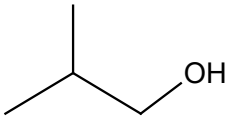
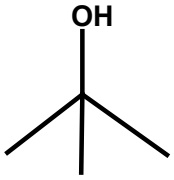
4 **(a)** **(i)** secondary alcohol has 2 carbon atoms directly bonded to the carbon that the OH/hydroxyl group is attached to. [1]

(ii)

Name	Skeletal formula	Classification
Butan-1-ol [1]		Primary
butan-2-ol	 [1]	Secondary
2-methylpropan-1-ol [1]		**Primary** [1]
2-methylpropan-2-ol	 [1]	**Tertiary** [1]

[6]

(b) **(i)** $CH_3CHBrCH_2CH_3 + NaOH \rightarrow CH_3CH(OH)CH_2CH_3 + NaBr$

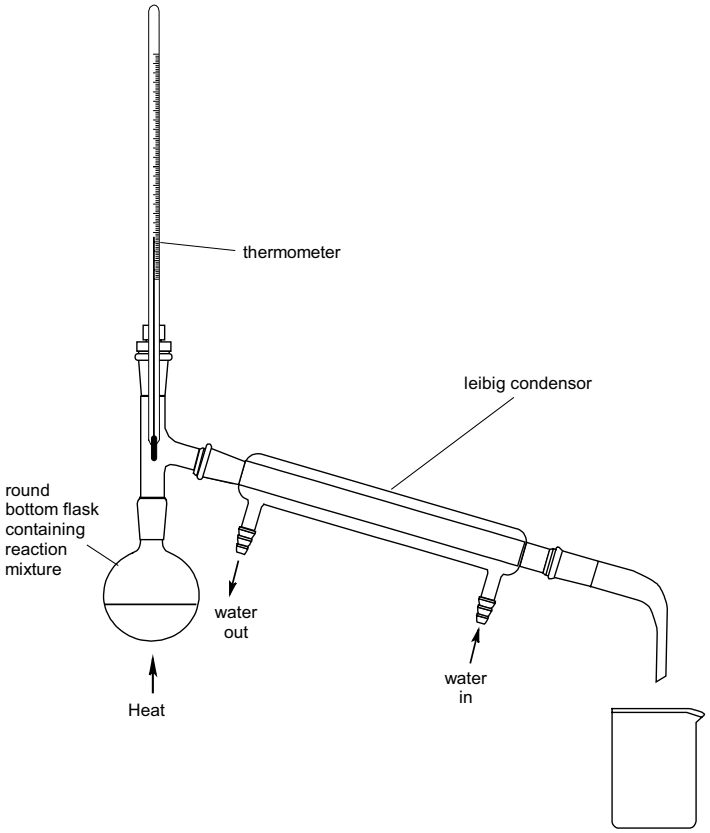
LHS [1] RHS [1] [2]

(ii) reflux [1]

(iii) anti-bumping granules [1]

(iv) distillation [1]

(v)



apparatus assembled correctly and sealed at top [1]

correctly labelled: round bottom flask [1]

(Leibig) condenser [1]

water in/out [1]

thermometer [1] [5]

(vi) 2-bromobutane/water [1]

(c) **(i)** moles of C = $\frac{73.85}{12}$ = 6.154 [1]

moles of H = $\frac{13.85}{1}$ = 13.85 [1]

moles of O = $\frac{12.30}{16}$ = 0.768 [1]

ratio 8:18:1

$C_8H_{18}O$ [1] [4]

(ii) has general formula $C_nH_{2n+2}O$ / $C_nH_{2n+1}OH$ [1] 23

Indicative Content

AVAILABLE MARKS

5 **(a)**
- iron(III) chloride/ferric chloride solution is used
- (ferric chloride) is yellow/pale yellow
- changes to violet/purple
- dissolve crystals in minimum volume of hot ethanol/solvent
- (gravity) filter hot
- cool and crystalise (in ice bath)
- suction/vacuum filter to collect crystals
- rinse with (ice) cold water
- sharp melting point = pure
- melts over a range/melting point lowered = impure

Level of Response	Marking Criteria	Marks
Excellent	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 **7 or more** indicative points.	[5]–[6]
Good	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 **4–6** indicative points.	[3]–[4]
Basic	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. **1–3** indicative points used.	[1]–[2]
	This response is not worthy of credit	[0]

[6]

(b) **(i)** $C_9H_8O_4$ [1]

(ii) 20.97 g [2]

$$\frac{15.10 \times 100}{72} = 20.9722$$ [1]

correct rounding [1]

(iii) 16.08g [3]

moles of aspirin = $\frac{20.97}{180} = 0.1165$ [1]

moles of salicylic acid = 0.1165 [1]

mass of salicylic acid = 0.1165 × 138 = 16.08 [1]
allow ecf from **(ii)**

(c) **(i)** aspirin [1]
peak is at 180 this matches relative molecular mass of aspirin/peaks above 138 [1] [2]

(ii) 102 [1]

				AVAILABLE MARKS
(d)	**(i)**	Peak **A**: O-H [1]		
		Peak **B**: C=O [1]		
		Peak **C**: C-O [1]	[3]	
	(ii)	there would be extra peaks [1]		
		(between 700 cm^{-1} and 1200 cm^{-1} / in fingerprint region)	[1]	19
			Total	**100**