Rewarding Learning

ADVANCED
General Certificate of Education
2022

Life and Health Sciences

Assessment Unit A2 2

assessing

Organic Chemistry

[AZ021]

MONDAY 13 JUNE, AFTERNOON

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.

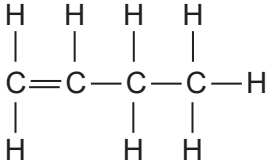
The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed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

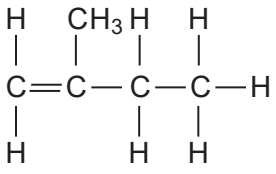
				AVAILABLE MARKS
1	**(a)**	contains no C═C or C≡C/contains only single bonds [1] **only** contain carbon and hydrogen atoms [1]	[2]	
	(b)	crude oil heated to form a vapour [1] **condenses** at different temperatures [1]	[2]	
	(c)	**(i)** reforming	[1]	
		(ii) $CH_3(CH_2)_4CH_3$ = hexane [1] $CH_3CH(CH_3)CH(CH_3)CH_3$ = 2,3-dimethylbutane [1]	[2]	
	(d)	**(i)** $C_4H_{10} + 6\frac{1}{2}O_2 \rightarrow 4CO_2 + 5H_2O$	[2]	
		(ii) oxides of sulfur: acid rain [1] carbon particulates: global dimming/smog/respiratory problems [1] unburnt hydrocarbons: (photochemical) smog/toxic [1]	[3]	
	(e)	**(i)** $N_2 + O_2 \rightarrow 2NO$	[1]	
		(ii) catalytic converter [1] convert (NO) to N_2 [1]	[2]	15
2	**(a)**	molecular formula: CCl_4 [1] IUPAC name: tetrachloromethane [1]	[2]	
	(b)	(free radical) substitution	[1]	
	(c)	molecular formula: C_2H_6 [1] IUPAC name: ethane [1]	[2]	
	(d)	cracking	[1]	
	(e)	propanal	[1]	
	(f)	acidified [1] potassium dichromate(VI) [1] oxidation [1]	[3]	
	(g)	electrophilic [1] addition [1]	[2]	
	(h)	hexane/C_6H_{14}	[1]	
	(i)	$C_6H_{12} + H_2 \rightarrow C_6H_{14}$	[1]	
	(j)	nickel	[1]	
	(k)	elimination/dehydration	[1]	
	(l)	concentrated phosphoric acid	[1]	
	(m)	structural formula:  [1] but-1-ene [1]	[2]	19

AVAILABLE MARKS

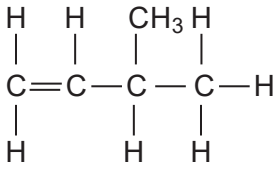
3 **(a)** family of organic compounds with the **same** general formula [1]
any **two** from:
each member differs by a CH_2 unit [1]
gradation in physical properties [1]
similar chemical properties [1] max [3]

(b) C_nH_{2n} [1]

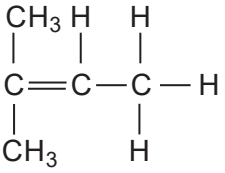
(c) **(i)** any **one** from below with correct name



[1] 2-methylbut-1-ene [1]



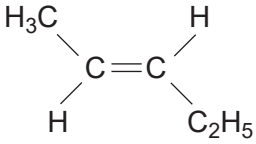
[1] 3-methylbut-1-ene [1]



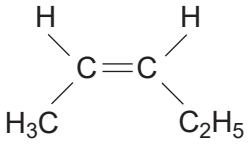
[1] 2-methylbut-2-ene [1] [2]

(ii)

E



Z



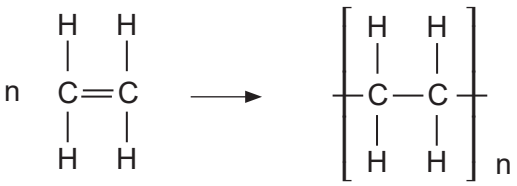
[1] for each structure and [1] for correct labelling [3]

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

(ii) C_6H_{10} [1]

(iii) **mix** with bromine water [1]
orange layer changes [1] to colourless [1] [3]

(e) **(i)**



- LHS [1]
- RHS [1] [2]

AVAILABLE MARKS

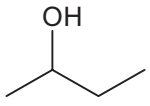
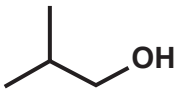
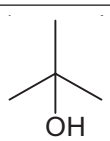
(ii) indicative content:
polythene is inert/non-biodegradable [1]
incineration [1]
recycling/reusing [1]
feedstock for **cracking** [1]
removing toxic gases from **incineration** exhaust gases [1]
develop biodegradable polymers/bioplastics [1]

Level of Response	Marking Criteria	Marks
Excellent Must contain at least **five** indicative content points	Candidates provide an excellent description of the environmental problems with polythene and strategies to limit pollution. 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 problems with polythene and strategies to limit pollution 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 problems with polythene and strategies to limit pollution 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]

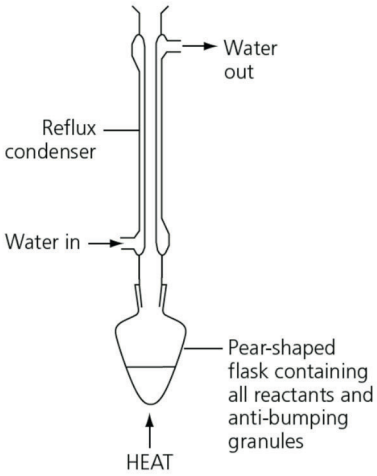
[6] 22

4 (a) (i) Primary alcohol has hydroxyl group connected to a carbon atom that is connected to one other carbon atom whereas secondary alcohols have the hydroxyl group attached to a carbon atom that is connected to two other carbons [1]

(ii)

name	skeletal formula	classification
butan-1-ol	 [1]	primary
butan-2-ol [1]		**secondary** [1]
2-methylpropan-1-ol	 [1]	primary
2-methylpropan-2-ol [1]		**tertiary** [1]

[6]

			AVAILABLE MARKS
(b)	**(i)**	$CH_3CHBrCH_3 + NaOH \rightarrow CH_3CH(OH)CH_3 + NaBr$ LHS [1] RHS [1] [2]	
	(ii)	 Vertical condenser [1] Water in/out correct [1] pear-shaped flask [1] antibump granules in flask [1] [4]	
	(iii)	**repeated boiling and condensing** of a (reaction) mixture [1]	
	(iv)	promote smooth boiling [1]	
	(v)	(fractional) distillation [1]	
	(vi)	2-bromopropane/water [1]	
(c)	**(i)**	moles of C = $\frac{68.18}{12}$ = 5.682 mol [1] moles of H = $\frac{13.64}{1}$ = 13.64 mol [1] moles of O = $\frac{18.18}{16}$ = 1.136 mol [1] empirical formula: $C_5H_{12}O$ [1] [4]	
	(ii)	one oxygen atom/matches general formula for alcohols/ $C_nH_{2n+1}OH/C_nH_{2n+2}O$ [1]	22
5	**(a)**	ethanoic acid [1]	
	(b)	**(i)** catalyst [1]	
		(ii) exothermic/heat released [1] dissipate heat [1] [2]	
		(iii) **hydrolyse** any unreacted ethanoic anhydride [1]	
		(iv) faster/drier product [1]	
	(c)	iron(III) chloride/ferric chloride solution [1] yellow [1] to purple [1] [3]	

(d) Any **4** from:

- dissolve sample in a minimum volume [1] of hot ethanol [1]
- filter whilst hot [1]
- allow to cool and crystallise [1]
- suction filter off the crystals [1] [4]

(e) **(i)** moles of salicylic acid = $\frac{20.0}{138}$ = 0.145 mol [1]

theoretical yield of aspirin = 0.145 × 180 = 26.1 g [1] [2]

(ii) percentage yield = $\frac{20.0}{26.1}$ × 100 = 76.6 % [1] [1]

(f) **(i)** pure sample sharp melting point [1]
impure sample melts over a range/at a lower temperature [1] [2]

(ii) compare spectrum of sample with spectrum of pure sample [1]

(g) A is O—H [1]
B is any C═O [1]
C is C—O [1] [3]

Total

AVAILABLE MARKS
22
100