New Specification

Rewarding Learning

ADVANCED
General Certificate of Education
2018

Life and Health Sciences

Assessment Unit A2 2

assessing

Organic Chemistry

[AZ021]

THURSDAY 24 MAY, 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

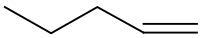
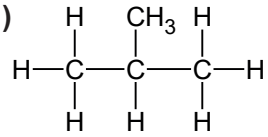
Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16–18-year-old students in schools and colleges. The job of the examiners is to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

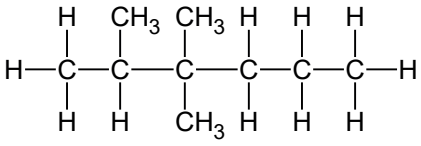
The questions and mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with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

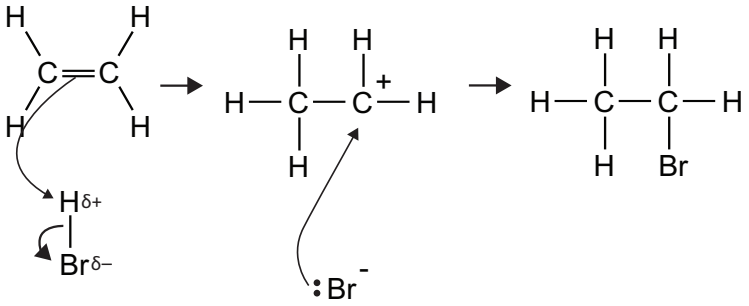
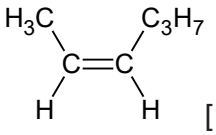
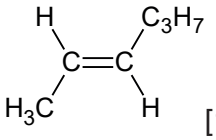
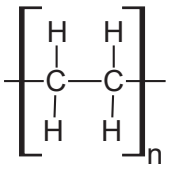
The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed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

				AVAILABLE MARKS
1	**(a)**	**(i)**	contains *only* hydrogen and carbon [1]	
		(ii)	C_3H_8 [1]	
		(iii)	hexane [1]	
		(iv)	alkenes [1]	
		(v)	F [1]	
		(vi)	D [1]	
		(vii)	 [1]	
		(viii)	 [1] 2-methylpropane/methylpropane [1] [2]	
		(ix)	reactant : hydrogen [1] catalyst : nickel [1] [2]	
	(b)	**(i)**	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ [1] correct formula [1] correct balancing [2]	
		(ii)	carbon monoxide [1] water [1] carbon/soot [1] [3] ignore CO_2	
		(iii)	carbon monoxide is toxic/soot causes global dimming/breathing difficulties/soot covers leaves preventing photosynthesis [1]	17

				AVAILABLE MARKS
2	**(a)**	*same* general formula [1] plus any **two** from: similar chemical properties gradation in physical properties differ by a CH_2 unit (2 x [1])	[3]	
	(b)	**(i)** (free radical) substitution	[1]	
		(ii) $CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$ LHS correct [1] RHS correct [1]	[2]	
		(iii) light/sunlight needed to start the reaction	[1]	
	(c)	**(i)** crude oil evaporates/vapour [1] condenses at different heights/points/temperature [1] separated based on different boiling points [1]	[3]	
		(ii) $C_9H_{20} \rightarrow C_3H_6 + C_6H_{14}$ [1] hexane [1]	[2]	
		(iii) 	[1]	
	(d)	**(i)** causes acid rain/photochemical smog	[1]	
		(ii) catalytic converter	[1]	
		(iii) $2NO_2 \rightarrow N_2 + 2O_2$	[2]	
	(e)	**(i)** ethanol [1] biodiesel [1]	[2]	
		(ii) any **two** from: derived from renewable sources CO_2 used up in plant growth/carbon neutral biofuels don't produce SO_2 so less acid rain	[2]	21

				AVAILABLE MARKS
3	(a)	(i)	sigma bonds (only) in alkanes [1] (sigma and) pi bond in alkenes [1] pi bond weaker or more open to attack/addition reactions [1] [3]	
		(ii)	 [3]	
		(iii)	electrophilic [1] addition [1] [2]	
		(iv)	bromoethane [1]	
	(b)		cis trans [1]  [1]  [1] [3]	
	(c)	(i)	polythene or poly(ethene) [1]	
		(ii)	 polymer structure [1] (square) brackets and repeat [1] [2]	
		(iii)	any **two** from: incineration to release energy recycling feedstock for cracking [2]	17

AVAILABLE MARKS

4 **(a)** same molecular formula [1]
different structural formula/atoms arranged differently [1] [2]

(b) **(i)** concentrated [1] phosphoric acid [1] [2]

(ii) elimination/dehydration [1]

(c) **Indicative content:**

- heating/warming
- with acidified potassium dichromate(VI) (solution)
- 2-methylbutan-2-ol: solution remains orange
- pentan-2-ol: solution change from orange to green
- 2-methylbutan-2-ol is a tertiary alcohol and can't be oxidised
- pentan-2-ol is a secondary alcohol and can be oxidised
- secondary alcohols can be oxidised to ketones

Level of Response	Marking Criteria	Marks
Excellent Must contain at least **five** indicative content points	Candidates provide an excellent description of how to distinguish between the two alcohols using oxidation reactions with excellent detail on the observations and chemistry involved. 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 how to distinguish between the two alcohols using oxidation reactions with good detail on the observations and chemistry involved. 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 points	Candidates provide a limited description of how to distinguish between the two alcohols using oxidation reactions with little detail on the observations and chemistry involved. 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]

(d) **(i)** C 70.6/12 = 5.88 [1]
H 13.7
O 15.7/16 = 0.98 [1]
$C_6H_{14}O$ [1] [3]

(ii) $C_6H_{14}O$ [1] 15

			AVAILABLE MARKS
5	**(a)**		

Substance	IUPAC name	Structural formula
A	pentanal	$CH_3CH_2CH_2CH_2CHO$
B	2-methylbut-2-ene [2]	$(CH_3)_2C=CHCH_3$
C	pentan-1-ol	$CH_3CH_2CH_2CH_2CH_2OH$ [1]
D	propanoic acid [1]	CH_3CH_2COOH

[4]

(b) bromine water [1]
colour change from orange [1]
to colourless [1] [3]

(c) Benedict's/Fehling's solution [1] and warm [1]
blue (solution) [1] becomes a red (precipitate) [1]
or other appropriate [4]

(d) primary [1]
OH bonded to carbon which is bonded to one other carbon atom [1] [2]

(e) propan-1-ol [1] 14

6 **(a)** **(i)** ethanoic acid [1]

(ii) preparation: mix salicylic acid and ethanoic anhydride [1]
add a little concentrated phosphoric acid slowly [1]
heat (under reflux) for 30 minutes [1]
add water (to hydrolyse any remaining ethanoic anhydride) [1]
pour onto crushed ice/ice bath [1]
suction filter off the product [1]

purification: recrystallise [1]
dissolves in a minimum volume of hot solvent [1]
filter (through a fluted filter paper) whilst hot [1]
allow to cool and crystallise [1]
suction/filtration [1]
dry crystals using a suitable method [1] max [8]

(iii) add iron(III) chloride/ferric chloride [1] [accept Mpt as alternative]
purple if salicylic acid impurities present [1]
remains yellow if no impurities [1] [3]

(b) moles of salicylic acid = 20.0/138 = 0.1445 mol
moles of aspirin formed = 0.1445 mol
theoretical yield = 0.145 × 180 = 26.08 g
percentage yield = 18.3/26.1 × 100 = 70.2%
(accept 70.1%) [4] 16

Total **100**