GCE AS MARKING SCHEME

SUMMER 2019

AS
CHEMISTRY - COMPONENT 2
B410U20-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2019 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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COMPONENT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

SUMMER 2019 MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark, apart from extended response questions where a level of response mark scheme is applied.

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Extended response questions

A level of response mark scheme is applied. The complete response should be read in order to establish the most appropriate band. Award the higher mark if there is a good match with content and communication criteria. Award the lower mark if either content or communication barely meets the criteria.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Marking abbreviations

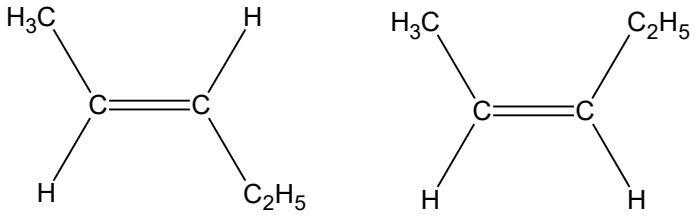
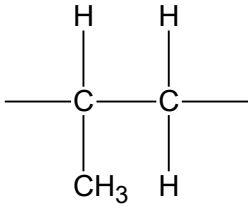
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

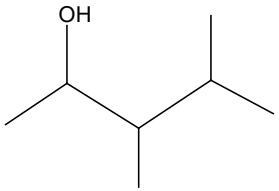
Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

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Section A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				award (1) for either *E*-isomer or *Z*-isomer 		1		1		
2					1			1		
3	*(a)*			award (1) for either of following • an electron deficient species • a species that can accept a pair of electrons	1			1		
	(b)			award (1) for any electrophile e.g. H^+ Br^+ (accept partial charges) Na^+ $C^{\delta+}$	1			1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*					1		1		
	(b)			award (1) for either of following —OH group attached to carbon joined to two other carbon atoms —OH group attached to carbon joined to one hydrogen atom	1			1		
5	*(a)*			the total enthalpy change for a reaction is independent of the route taken from the reactants to the products	1			1		
	(b)			20.4 kJ mol^{-1}		1		1	1	
6				carbon monoxide and water	1			1		
7				$2CH_3COOH + MgO \rightarrow (CH_3COO)_2Mg + H_2O$		1		1		
				Section A total	**6**	**4**	**0**	**10**	**1**	**0**

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Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*			**Indicative content** • types of mechanism - nucleophilic substitution and elimination • reaction conditions NaOH dissolved in water for nucleophilic substitution NaOH dissolved in ethanol for elimination • products - butan-1-ol and but-1-ene / equations • mechanism for nucleophilic substitution polarisation of C–Br curly arrow from OH^- curly arrow showing C–Br breaking / intermediate	6			6		

5-6 marks
Both reaction types described - mechanism, conditions and products; nucleophilic substitution mechanism drawn
The candidate constructs a relevant, coherent and logically structured method including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary is used accurately throughout.

3-4 marks
Reference to both reaction types; attempt at mechanism for nucleophilic substitution
The candidate constructs a coherent account including most of the key elements of the indicative content. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary are generally sound.

1-2 marks
Reference to one of the reactions
The candidate attempts to link at least two relevant points from the indicative content. Coherence is limited by omission and/or inclusion of irrelevant material. There is some evidence of appropriate use of scientific conventions and vocabulary.

0 marks
The candidate does not make any attempt or give an answer worthy of credit.

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		radical substitution accept photochlorination	1			1		
		(ii)		during the reaction ethyl radicals form (1) two of these radicals can combine to give butane (1)	2			2		
	(c)	(i)		award (1) for each product 1-bromo-3-methylbutane 2-bromo-3-methylbutane accept correct structures award (1) if Br in correct place but error in structures		2		2		
		(ii)		2-bromo-3-methylbutane since intermediate carbocation formed is more stable		1		1		
	(d)			CFCs are very stable and they do not break down easily in the lower atmosphere since the C—F and C—Cl bonds are strong / energy from uv light not strong enough to break C—F or C—Cl bond (1) in the upper atmosphere higher energy uv light breaks the C—Cl bond forming chlorine radicals (1)		1	1	2		
				Question 8 total	**9**	**4**	**1**	**14**	**0**	**0**

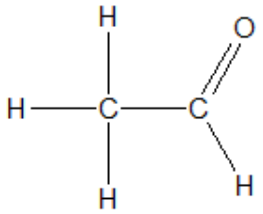
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	*(a)*			student not correct since a temperature change would occur on adding the catalyst which had nothing to do with the reaction			1	1		1
	(b)			moles H_2O_2 = 8.82 × 10^{-2} (1) concentration H_2O_2 = 8.82 × 10^{-1} (1)		2		2	2	
	(c)			$q = mc\Delta T$ = 3553 J (1) n = 4.41 × 10^{-2} mol (1) $\Delta H = -\frac{q}{n}$ (1) ΔH = –80.6 kJ mol^{-1} (1) **must** be to 3 sig figs	1	1 1	1	4	1 1 1	4
	(d)			mass of solution is used in expression to calculate amount of heat transferred			1	1		1
	(e)			award (1) for either of following • no more bubbles • colour of catalyst returns to amber		1		1		1

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(f)			credit any **two** responses award (1) for each improvement and (1) for justification plot a cooling curve - extrapolation gives the temperature that would have been reached if the reaction occurred instantly use a more precise/accurate thermometer - reduces percentage error in fairly small temperature rise place lid on the cup - prevents heat loss to the environment			4	4		4
	(g)			no change since catalysts do not effect enthalpy change	1			1		1
				Question 9 total	**2**	**5**	**7**	**14**	**5**	**12**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	*(a)*	(i)		$C_2H_5OH + [O] \rightarrow$  $+ H_2O$		1		1		
		(ii)		place acid in flask and add sodium dichromate(VI) until it has dissolved (1) (cool mixture) and add ethanol dropwise (shaking between additions) (1) set up distillation apparatus (1) heat gently until liquid boils over (1)	4			4		4
		(iii)		add sodium (hydrogen)carbonate (1) no effervescence (1) do **not** accept references to pH	2			2		2
	(b)			award (1) for either of following • ethanol has peak at 50-90 ppm, ethanal does not • ethanal has peak at 190-220 ppm, ethanol does not both contain two peaks / one other peak below 40 ppm (1)		2		2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		bonds broken (5 × 412) + (1 × 348) + (1 × 360) + (1 × 463) + (3 × 496) (1) bonds formed (4 × 743) + (6 × 463) (1) enthalpy change = 4719 – 5750 = –1031 kJ mol^{-1} (1)		3		3	2	
		(ii)		award (1) for either of following • large quantities of land needed to grow crops for biofuels • growing crops for biofuels needs large quantities of water (and fertilisers)	1			1		
	(d)			(due to the —OH group) ethanol forms hydrogen bonds with water (so it is soluble) (1) in hexan-1-ol since the carbon chain is longer the effect of the —OH group is now small (so it is insoluble) (1)	2			2		
				Question 10 total	**9**	**6**	**0**	**15**	**2**	**6**

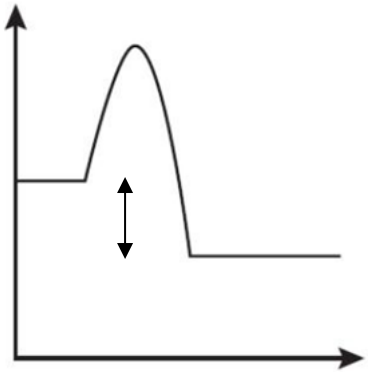
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11				• C H O $\frac{55.8}{12}\ \frac{7.00}{1.01}\ \frac{37.2}{16}$ (1) 4.65 : 6.93 : 2.325 ⇨ C_2H_3O (1)		2		10	2	
				• very broad peak 2500 to 3000 cm^{-1} so is a carboxylic acid / peak around 1700 cm^{-1} (C = O) and around 3000 cm^{-1} (O—H) so is carboxylic acid (1)		1				
				• pH < 7 so must be acid - must contain at least two oxygens (1)		1				
				• addition reaction with bromine so must contain C=C 1:1 molar ratio so only one double bond (1)			1			1
				• moles Br_2 = $\frac{3.71}{159.8}$ = 2.32×10^{-2} (1) M_r = $\frac{2}{2.32 \times 10^{-2}}$ = 86.2 (1)		2			2	
				molecular formula = $C_4H_6O_2$ (1)		1				
				• possible structures of **A** $H_2C{=}CHCH_2COOH$ $H_2C{=}C(CH_3)COOH$ *Z*-$CH_3CH{=}CHCOOH$ *E*-$CH_3CH{=}CHCOOH$ award (2) for all four correct or (1) for any two correct			2			
				Question 11 total	**0**	**7**	**3**	**10**	**4**	**1**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	*(a)*			axes labelled with values and units (1) all points plotted correctly (2) any six points plotted correctly (1) best fit line drawn (1)	1	3		4	1 1	
	(b)			tangent drawn at t = 20 s (1) rate = 1.4 ($cm^3\ s^{-1}$) (1) accept any value in range 1.4-1.7		1	1	2	2	2
	(c)			curve similar to original but 25-28 cm^3 lower (1) finishes around 92 s (1)			2	2		2
	(d)			moles of H_2 = 4.08×10^{-3} (1) mass Mg = 0.0992 g (1)		2		2	2	
	(e)			student is correct since mass of hydrogen would be very small (1) maximum mass lost would be 8.24×10^{-3} g so there would not be a detectable change on the balance to plot a graph (1)			2	2		2

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(f)			decrease the temperature of the acid (1) reactants collide with less energy (1) fewer molecules have the required **activation energy** (1) accept alternative based on surface area roll strip into a lump (1) lower surface area for reaction to occur (1) lower **chance / frequency** of successful collisions (1)	3			3		
	(g)			 exothermic plot (1) $\Delta_r H$ labelled (1)	2			2		
				Question 12 total	**6**	**6**	**5**	**17**	**6**	**6**

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COMPONENT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
Section A	6	4	0	10	1	0
8	9	4	1	14	0	0
9	2	5	7	14	5	12
10	9	6	0	15	2	6
11	0	7	3	10	4	1
12	6	6	5	17	6	6
Totals	32	32	16	80	18	25

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