GCE AS MARKING SCHEME

AUTUMN 2020

AS
CHEMISTRY – COMPONENT 2
B410U20-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2020 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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GCE AS CHEMISTRY COMPONENT 2

ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

AUTUMN 2020 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.

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Marking abbreviations

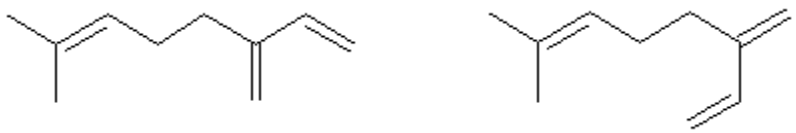
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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

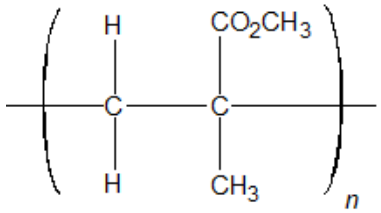
Credit should be awarded for correct and relevant alternative responses which are not recorded in the mark scheme.

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Section A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				2-bromobutan-2-ol	1			1		
2	*(a)*			C_5H_8		1		1		
	(b)			award (1) for either of following 		1		1		
	(c)			add bromine (water) (1) colour changes from brown/orange to colourless (1) accept alternative answer (acidified) potassium manganate(VII) (1) colour changes from purple to colourless (1)	2			2		
3				sulfur	1			1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4				 C atom in chain must clearly be bonded to C atom in ester group		1		1		
5				$2C_2H_5COONa + H_2O + CO_{2C}$		1		1		
6				carbon : nitrogen ratio of 3 : 1 (1) $\frac{0.0204}{3}$ = 0.068 mol of nitrogen 0.0952 (1)		2		2	1	
				Section A total	**4**	**6**	**0**	**10**	**1**	**0**

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Section B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*			(when biogas burns) there is no net change in atmospheric CO_2 levels (1) CO_2 released is equivalent to that absorbed in the growth of the bio-resource (1) do not accept biogas is renewable / carbon neutral unless qualified	2			2		
	(b)	(i)		$2C(s) + 3H_2(g) + ½O_2(g) \rightarrow C_2H_5OH(l)$ balanced equation (1) state symbols (1)	2			2		
		(ii)	I	energy released in forming bonds in products (4 × 743) + (6 × 463) = 2972 + 2778 = 5750 (1) energy needed to break bonds in reactants (5 × 412) + (1 × 348) + (C—O) + (1 × 463) + (3 × 496) 2060 + 348 + (C—O) + 463 + 1488 [(C—O) + 4359] (1) –1031 = [(C—O) + 4359] – 5750 (C–O) = –1031 – 4359 + 5750 = 360 (1)		3		3	2	
			II	average bond enthalpies used in calculation (rather than actual ones)	1			1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			80 mg per 100 cm^3 = 0.8 g dm^{-3} (1) concentration = $\frac{0.8}{46}$ = 0.0174 mol dm^{-3} (1)		2		2	1	
	(d)			carbon : fluorine $\frac{2.83}{12}$: $\frac{6.73}{19}$ (1) 0.236 : 0.354 mole ratio 2 : 3 or empirical formula C_2F_3 (1) molecular formula C_4F_6 (1)		3		3	2	
				Question 7 total	**5**	**8**	**0**	**13**	**5**	**0**

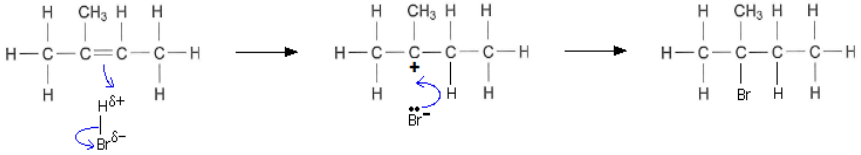
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*	(i)		separating funnel accept any answer that recognises the presence of two separate layers			1	1		1
		(ii)	I	award (1) for any of following small(er) bubbles form prevent large bubbles provide surface for bubbles to form		1		1		1
			II	accept any **two** from three possible changes/explanations (bulb of the) thermometer should be opposite the opening to the condenser (1) temperature of the vapour is measured (1) water should go in at the bottom of the condenser and out at the top (1) keeps condenser full of water / prevents 'air-lock' / allows better cooling (1) flask receiving condensed product should not be sealed (1) pressure could build inside a sealed system (1)			4	4		4

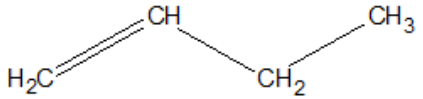
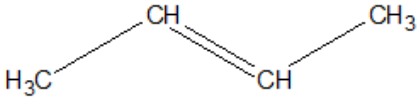
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			moles 1-chloropentane formed = 0.0152 (1) moles pentan-1-ol used = 0.0227 (1) mass pentan-1-ol used = 2.00 g ⇨ student incorrect (1) alternative answer moles pentan-1-ol = 0.0276 (1) moles 1-chloropentane = 0.0152 (1) percentage yield = 55% ⇨ student incorrect (1)		2	1 3	3	2	

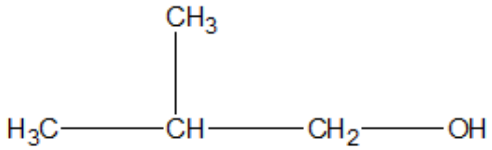
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		electrophilic addition	1			1		
		(ii)		2-bromo-2-methylbutane is formed from tertiary carbocation / 2-bromo-3-methylbutane is formed from secondary carbocation (1) tertiary carbocation is more stable (than secondary carbocation so more 2-bromo-2methylbutane forms) (1)	 1		1	 2		
		(iii)		 curly arrow from double bond in alkene (1) dipole and curly arrow in HBr (1) curly arrow from Br^- to carbocation (1)	3			3		

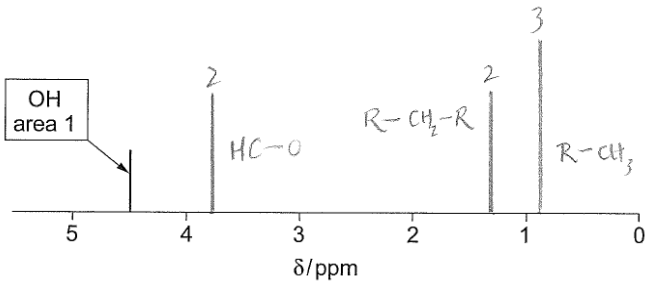
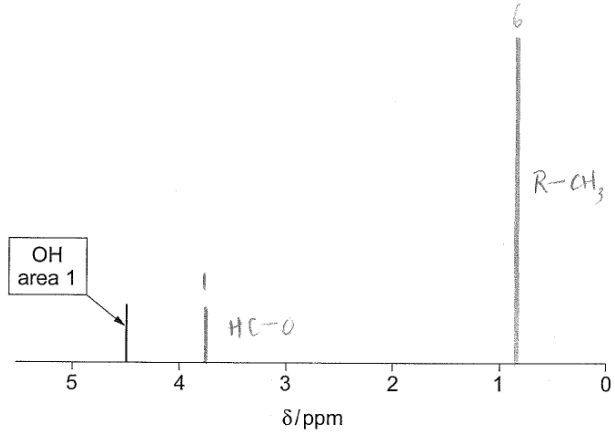
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		compounds with the same molecular formula but different structural formulae	1			1		
		(ii)		 (1)  (1)		1 1		2		
		(iii)		but-2-ene circled (or identified in any way) it has two <u>different</u> groups attached to <u>both</u> carbons in the double bond	1			1		
				Question 8 total	**7**	**5**	**7**	**19**	**2**	**6**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	*(a)*			accept any **five** of following for (1) mark each						
				reacts with potassium dichromate(VI) ⇨ can't be tertiary alcohol (1)		1				
				molecular ion peak at m/z 74 ⇨ M_r is 74 (1)		1				
				M_r of alkyl chain must be 57 ⇨ molecular formula is $C_4H_{10}O$ (1)			1			
				peak at m/z 43 ⇨ $C_3H_7^+$ / peak at m/z 31 ⇨ CH_2OH^+ (1)		1				
				secondary carbocation ⇨ $(CH_3)_2CH^+$ / branched chain (1)			1			
				only three peaks in ^{13}C NMR spectrum ⇨ only three carbon environments (1)				7		
				 (2)			2			
				accept any unambiguous structure showing 2-methylpropan-1-ol						

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			propan-1-ol  propan-2-ol  award (1) for approximate chemical shifts and (1) for peak areas for each spectrum			2 2	4		
				Question 9 total	**0**	**3**	**8**	**11**	**0**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	*(a)*	(i)		**Indicative content** <u>Method - apparatus and measurements</u> • measure excess acid using measuring cylinder/burette • transfer to polystyrene cup • measure temperature until constant and record value as initial temperature • add known mass of MgO and stir well • record temperature at regular timed intervals while mixture cools over time <u>Use of results</u> • plot temperature against time • extrapolate cooling curve back to time when solid added • find ΔT from graph at time when solid added • $q = mc\Delta T$ • $\Delta_r H = -\frac{q}{n}$ where n is moles of MgO	3		3	6		6

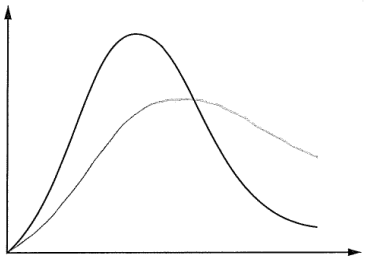
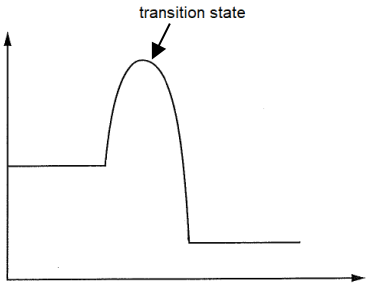
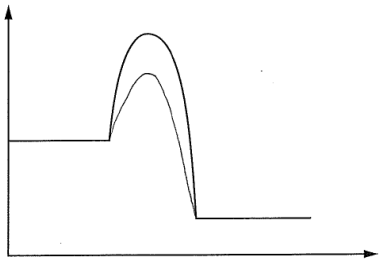
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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Detailed description of method; reference to extrapolation in finding ΔT; use of n to calculate enthalpy change *The candidate constructs a relevant, coherent 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** Basic description of method; reference to temperature change from graph and use of $mc\Delta T$ *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** Basic idea of method or how results should be used *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
		(ii)		n(MgO) = $\frac{0.900}{40.3}$ = 0.0223 n(HCl) = 2 × 0.05 = 0.100 (1) $-q$ = –115 000 × 0.0223 = –2564.5 (1) $\Delta T = \frac{2564.5}{4.18 \times 50}$ (1) ΔT = 12.3 °C (1)		4		4	3	
	(b)			n(HCl) = 5.00 × 10^{-3} (1) n(Zn) = 2.50 × 10^{-3} (1) mass Zn = 0.164 g (1)		3		3	1	
				Question 10 total	**3**	**10**	**0**	**13**	**4**	**6**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	*(a)*	(i)		 areas under peaks must be similar	1			1		
		(ii)	I		1			1		
			II		1			1		
		(iii)		248		1		1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		tangent drawn at t = 0 s (1) e.g. rate = $\frac{0.010 - 0.0085}{20}$ (1) 7.5×10^{-5} (1) accept range $6.2\text{-}9.0 \times 10^{-5}$ mol dm^3 s^{-1} (1)		3	1	4	3	
		(ii)		award (1) each for any **two** of following colorimetry / change in colour of bromine over time measure volume of CO_2 formed over time measure change in mass over time award (1) max if no reference to time			2	2		2
		(iii)	I	as reaction proceeds curve gets less steep	1			1		
			II	concentration of bromine / methanoic acid decreases (1) so fewer **successful** collisions per unit time (1)	2			2		
		(iv)		change in temperature affects the rate of reaction	1			1		
				Question 11 total	**7**	**4**	**3**	**14**	**3**	**2**

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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	4	6	0	10	1	0
7	5	8	0	13	5	0
8	7	5	7	19	2	6
9	0	3	8	11	0	0
10	3	10	0	13	4	6
11	7	4	3	14	3	2
Totals	26	36	18	80	15	14

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