GCE AS MARKING SCHEME

SUMMER 2024

AS
CHEMISTRY – COMPONENT 2
B410U20-1

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About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

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GCE AS CHEMISTRY

COMPONENT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

SUMMER 2024 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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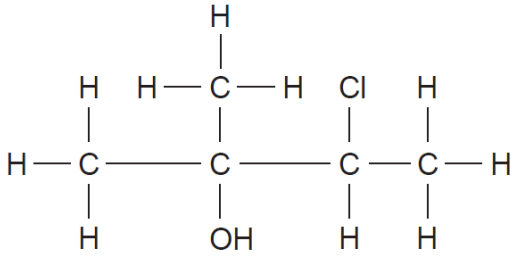
SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				homolytic	1			1		
2	(a)			pent-2-ene	1			1		
	(b)			award (1) for any sensible answer e.g. reduce amount of waste produced carbon neutral use less energy in their manufacture neutral answers – good for the environment / can be recyled	1			1		
3						1		1		
4				award (1) for either of following —OH attached to carbon bonded to three other carbon atoms —OH attached to carbon which has no hydrogen atoms bonded to it	1			1		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			$C_{10}H_{16}O_2$		1		1		
	(b)			add bromine (water) (1) goes from orange-brown to colourless / is decolourised (1) alternative answer acidified potassium manganate(VII) (1) goes from purple to colourless (1)	2			2		2
6				mass of Mg = 0.01 × 24.3 (1) 243 mg (1) **must be in mg**		2		2	1	
				Section A total	**6**	**4**	**0**	**10**	**1**	**2**

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SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$		1		1		
		(ii)		2,2,3-trimethylbutane		1		1		
		(iii)		award (1) for correct boiling temperatures heptane 98°C triptane 81°C decane 174°C decane has the highest boiling temperature because it has the longest chain therefore more van der Waals forces between the molecules (1) triptane has a lower boiling temperature than heptane because it has more branches therefore less surface area for contact between molecules (1)			3	3		
		(iv)		$C_{10}H_{22} \rightarrow C_2H_4 + C_8H_{18}$		1		1		

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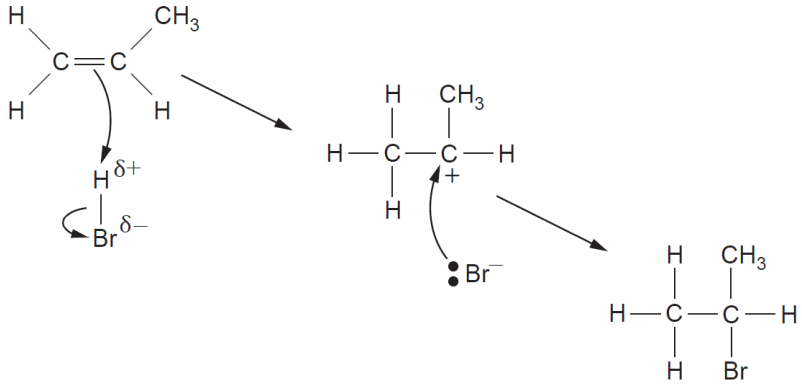
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		 curly arrow from double bond in propene (1) dipole and curly arrow in HBr (1) curly arrow from $:Br^-$ to secondary carbocation (1)	3			3		
		(ii)		but-1-ene gives a major and minor product but-2-ene does not (accept named products) (1) award (1) for either of following • but-1-ene can form a secondary or primary carbocation (as intermediate) but but-2-ene can only form a secondary carbocation • but-1-ene is non symmetrical and but-2-ene is symmetrical			2	2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			carbon : hydrogen : chlorine $\frac{24.1}{12} : \frac{4.10}{1.01} : \frac{71.8}{35.5}$ 2.01 : 4.06 : 2.02 (1) simplest ratio 1:2:1 ⇨ empirical formula CH_2Cl (1) M_r is 98 ⇨ molecular formula $C_2H_4Cl_2$ (1)		3		3	2	
				Question 7 total	**3**	**6**	**5**	**14**	**2**	**0**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		nucleophilic substitution	1			1		
		(ii)		award (1) for either of following $K_2Cr_2O_7$ and H^+ $KMnO_4$ and H^+	1			1		1
		(iii)		add Na_2CO_3 / $NaHCO_3$ (1) effervescence / bubbles (of CO_2) seen (1)	2			2		2
		(iv)		moles of AgBr = $\frac{0.973}{187.9}$ = 5.18×10^{-3} (1) M_r of compound **B** = $\frac{0.564}{5.18 \times 10^{-3}}$ = 108.9 (1) M_r of compound **A** = 108.9 – (1.01 + 79.9) = 28 ⇨ compound **A** is ethene / C_2H_4 (1)		3		3	2	
		(v)	I	phosphoric acid	1			1		
			II	yield of compound **C** increases as the (position of) equilibrium moves to the right (1) award (1) for either of following • because the system will try to minimise the effect of increasing pressure by going to the side with the fewer gas molecules • the pressure will decrease if the system contains fewer gas molecules		2		2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			compound **E** is an alcohol since it contains O—H bond due to peak at 3400 cm^{-1} but not C=O bond since no peak at 1700 cm^{-1} (1) compound **F** is an alkene (due to dehydration reaction) M_r of **F** = $\frac{17.5}{0.25}$ = 70 ⇨ **F** is C_5H_{10} (1) **F** shows *E-Z* isomerism ⇨ must be pent-2-ene (1) **F** is the only product of dehydration of **E** ⇨ **E** must be pentan-3-ol (1)		1	3	4		
				Question 8 total	**5**	**6**	**3**	**14**	**2**	**3**

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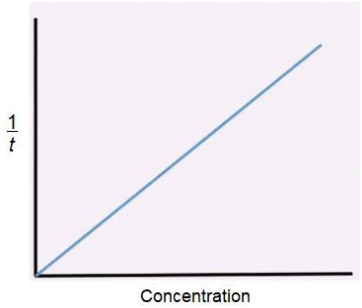
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			**Indicative content** **Method** • put conical flask over piece of paper marked with a cross • add known volume of thiosulfate to flask • add known volume of acid to flask • start stopwatch • stop the watch when cross can no longer be seen and record time taken • repeat experiment four/five times with same volume but different concentrations of thiosulfate • keep temperature, volume and concentration of acid the same **Analysis** • rate is proportional to $\frac{1}{t}$ • calculate $\frac{1}{t}$ for each concentration • plot $\frac{1}{t}$ (y-axis) against thiosulfate concentration (x-axis) • sketch should be straight line starting at 0,0 (accept upwards curve)  	2	2	2	6		4

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Good description of method; clear understanding of analysis *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; some knowledge of steps in analysis *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** Simple knowledge of parts of method *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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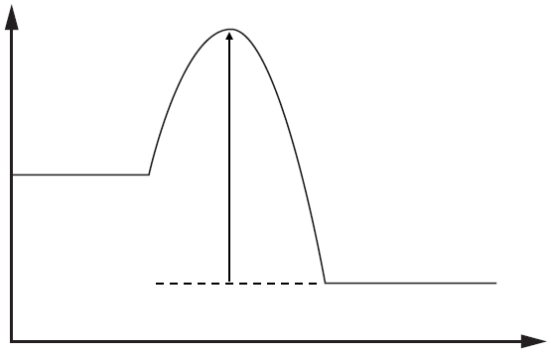
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			as concentration increases there are more molecules in a given volume (1) award (1) for any of following: • more effective/successful collisions (between molecules) per second • greater chance of effective/successful collisions (between molecules) per second • higher frequency of effective/successful collisions (between molecules)	2			2		
	(c)	(i)			1			1		
		(ii)		rate increases increase in temperature increases rate of all reactions / more particles will reach activation energy	1			1		
				Question 9 total	**6**	**2**	**2**	**10**	**0**	**4**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		$CH_3CH_2OH + 2[O] \rightarrow CH_3COOH + H_2O$		1		1		
		(ii)	I	reflux	1			1		1
			II	credit any two of following three changes heat using water bath / micro burner (1) ⇨ ethanol is very flammable (1) condenser must be open at the top (1) ⇨ to stop pressure from building up (1) add anti-bumping granules (1) ⇨ so that mixture boils smoothly (1)	1 1		1 1	4		4
	(b)			moles of ethanoic acid = $\frac{8.23}{60.04}$ = 0.137 (1) moles of ethanol = $\frac{0.137}{0.80}$ = 0.17125 (1) mass of ethanol = 0.17125 × 46.06 = 7.89 g (1) volume of ethanol = $\frac{7.89}{0.789}$ = 10.0 cm^3 (1)		4		4	3	
	(c)			$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$		1		1		
	(d)	(i)		the enthalpy change when 1 mol of ethanol is formed (1) from its constituent elements in their standard states under standard conditions (1)	2			2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		award (1) for any sensible answer e.g. • if carbon, hydrogen and oxygen are reacted other products (apart from ethanol) would form • carbon, hydrogen and oxygen do not react to form ethanol	1			1		
	(e)			2-methylpropan-1-ol (1) it is the only isomer with 3 different carbon environments (1)		2		2		
				Question 10 total	**6**	**8**	**2**	**16**	**3**	**5**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			zinc is in excess / not all of the zinc is used			1	1		1
	(b)			award (1) for any of following: • to ensure that the (initial) temperature is constant • to ensure that the solution is at the same temperature as surroundings	1			1		1
	(c)			to allow for cooling correction / compensate for heat loss	1			1		1
	(d)			award (2) if all points plotted correctly award (1) if any eight correct		2		2	1	
	(e)			two suitable lines of best fit (1) cooling line extrapolated to 3½ minutes (1) maximum temperature change = **70.5** – 22.2 = 48.3°C (1) accept other **maximum temperature** correctly read from graph (should be in the range 71.0 ± 1°C)		3		3	2	3

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(f)			award (1) for opinion with simple statement and (1) for additional comment/explanation e.g. the lines **can be** extrapolated with confidence since an obvious smooth curve / straight line can be drawn (1) ⇨ because the line passes through all the points / all the points are close to the line / there are no anomalous points (1) the lines **can't be** extrapolated with confidence because accuracy of thermometer is greater than resolution of scale on graph (1) ⇨ it is difficult to plot values to the nearest 0.1 or 0.2°C on the graph (1)			2	2		2
	(g)			moles of $CuSO_4$ = 0.0250 so moles of Zn = 0.0250 (1) mass of Zn = 0.0250 × 65.4 = 1.635 g (1)		2		2	1	
	(h)			$\Delta H = \frac{-mc\Delta T}{n}$ (1) $\Delta H = \frac{-25.0 \times 4.18 \times 48.3}{0.0250}$ (1) [ΔT from part (e) to be used] ΔH = –201984 J mol^{-1} (1) ΔH = –202 kJ mol^{-1} (1)	1	2	1	4	3	4
				Question 11 total	**3**	**9**	**4**	**16**	**7**	**12**

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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	2
7	3	6	5	14	2	0
8	5	6	3	14	2	3
9	6	2	2	10	0	4
10	6	8	2	16	3	5
11	3	9	4	16	7	12
Totals	29	35	16	80	15	26

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