GCE AS MARKING SCHEME

SUMMER 2025

AS
CHEMISTRY – COMPONENT 2
B410U20-1

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.

GCE AS CHEMISTRY

COMPONENT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

SUMMER 2025 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.

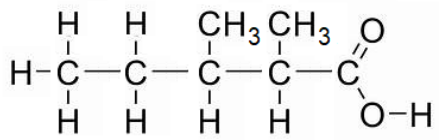
Marking rules
All work should be seen to have been marked.
Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.
Crossed out responses not replaced should be marked.

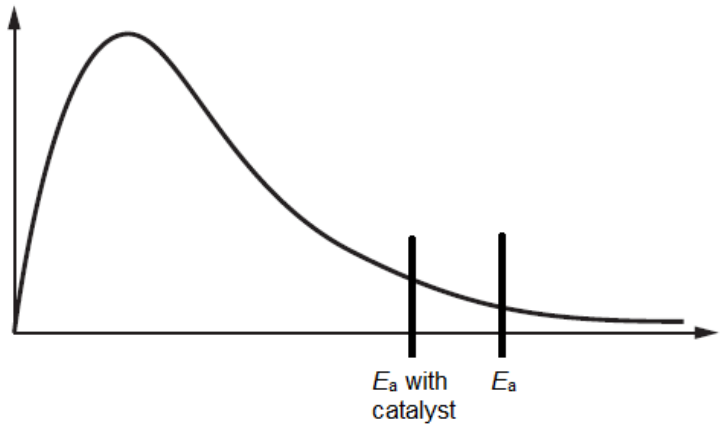
Marking abbreviations
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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.

SECTION A

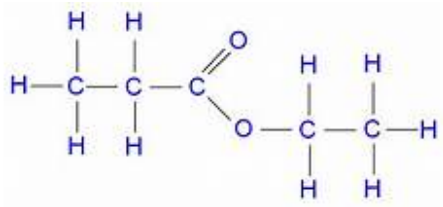
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				2-methylbut-1-ene		1		1		
2						1		1		
3				3-chlorohex-2-ene		1		1		
4	(a)			award (1) for either of following it contains / donates a lone pair of electrons it is electron rich	1			1		
	(b)			$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightarrow NH_3(g)$ award (1) for formulae and state symbols award (1) for stoichiometry	2			2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5				 lines showing E_a at a lower energy in the presence of a catalyst (1) (accept description) more molecules have energy greater than activation energy (1)	2			2		
6				n(CH_3COOH) = $\frac{25600}{60.0}$ = 427 (1) number of molecules = 427 × 6.02 × 10^{23} = 2.57 × 10^{26} (1)		2		2	1	
				Section A total	**5**	**5**	**0**	**10**	**1**	**0**

SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		add more / at least 1 cm^3 of nitric acid (1) there must be enough to neutralise the excess sodium hydroxide (1)			2	2		2
		(ii)		add dilute NH_3 (1) award (1) for **both** of following if halogen is chlorine ⇨ (white) precipitate would fully dissolve if halogen is bromine ⇨ (cream) precipitate would partially dissolve	2			2		2
	(b)			n(1-bromobutane) = $\frac{6.26}{137}$ = 0.0457 (1) expected mass of pentanenitrile = 0.0457 × 83.1 = 3.80 (1) percentage yield = $\frac{2.58}{3.80}$ × 100 = 67.9 % (1) **must** be given to 3 sig figs		3		3	2	
	(c)			in the upper atmosphere uv radiation causes (homolytic fission of) C—Cl bond to form Cl• (1) Cl• radicals deplete the ozone layer (1) letting uv rays reach the earth's surface (and causing skin cancer) (1) do not accept any reference to global warming / climate change	3			3		
				Question 7 total	**5**	**3**	**2**	**10**	**2**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			**C** **H** **O** **Cl** $\frac{33.2}{12}$ $\frac{4.6}{1.01}$ $\frac{29.5}{16}$ $\frac{32.7}{35.5}$ 2.77 4.55 1.84 0.92 (1) 3 5 2 3 empirical formula is $C_3H_5O_2Cl$ (1) two molecular ion peaks ⇨ two chlorine isotopes (1) molecular ions have M_r 108 and 110 ⇨ molecular formula is $C_3H_5O_2Cl$ (1) reacts with hydrogencarbonate ⇨ contains acid group (1) award (1) for **both** IR peaks peak at 3000 cm^{-1} ⇨ —OH in carboxylic acid peak at 1715 cm^{-1} ⇨ C=O three peaks in NMR spectrum ⇨ three hydrogen environments (1) award (1) for any **one** NMR peak peak at 2.8 δ ⇨ CH_2 next to C=O peak at 3.9 δ ⇨ HC—Cl peak at 11.5 δ ⇨ OH in —COOH credit up to **seven** of the eight available marks award (1) for correct compound name and (1) for correct structure **X** ⇨ 3-chloropropanoic acid CH_2ClCH_2COOH		7	2	9	2	1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		award (1) for any value in the range 300-350°C	1			1		
		(ii)		award (1) for suitable diagram with thermometer, bung and condenser to the side thermometer drawn with bulb opposite outlet to condenser (1) water in at the bottom of condenser and out at the top (1)	3			3		3
	(c)	(i)		sulfuric acid / aluminium oxide	1			1		
		(ii)		colour changes from orange to green	1			1		1
		(iii)	I	esterification / condensation	1			1		
			II			1		1		
	(d)			$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$	1			1		
				Question 8 total	**8**	**8**	**2**	**18**	**2**	**5**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		the mass of water is used (in expression to calculate amount of heat transferred)	1			1		1
		(ii)		award (1) for either of following to ensure that the (initial) temperature is constant difference between initial temperature and minimum temperature is used (in the expression to calculate amount of heat transferred)	1			1		1
		(iii)		suitable scale for y-axis (1) points plotted correctly - ±½ small square (1)		2		2	1	
		(iv)		two suitable straight lines (1) lines extrapolated to 3 minutes (1) max temp change = –8.4 ±0.2 (1)		3		3	2	3
		(v)		award (1) for either of following extrapolation gives an estimation of the temperature that would have been reached if the reaction occurred instantly extrapolation takes into account heat absorbed from the surroundings			1	1		1
		(vi)		$\frac{1.3}{20.5}$ × 100 = 6.3%		1		1	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		$-1126 = (-572 + 2\Delta_f H(SO_2)) - (-40.4)$ (1) $2\Delta_f H(SO_2) = -1126 + 572 - 40.4$ $\Delta_f H(SO_2) = -297$ kJ mol^{-1} (1)		2		2	2	
		(ii)		sulfur dioxide causes acid rain	1			1		
				Question 9 total	**3**	**8**	**1**	**12**	**6**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			**Indicative content** **Method and apparatus** • use measuring cylinder / pipette to add hydrogen peroxide solution • to a conical flask • immerse flask in water bath at 40°C • add manganese(IV) oxide to flask • connect flask to gas syringe • measure volume of oxygen at appropriate time intervals **Use of results** • plot a graph of volume of oxygen against time • draw a tangent at t = 0 • gradient of tangent = initial rate	3		3	6		6
				5-6 marks Complete description of the method (with key apparatus named) and how the results are used *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 the method (with gas syringe named) and reference to plotting a graph of results *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 a gas collection 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.*						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			overall rate is lower since as decomposition proceeds the concentration of H_2O_2 decreases (1) fewer H_2O_2 molecules present so fewer successful collisions (1)	2			2		
	(c)			heterogeneous	1			1		
	(d)			use same mass (moles) of catalyst / volume and concentration of H_2O_2 (1) measure volume of gas formed after a set time / time taken to produce a given volume of gas (1) better catalyst will have led to more gas being formed over that time / less time taken to produce the given volume of gas (1) alternative answer based on the method in part (a) measure volume of gas formed at appropriate time intervals and plot a graph of the data (1) better catalyst increases rate by more / gives steeper gradient (1)		2	1	3		3
				Question 10 total	**6**	**2**	**4**	**12**	**0**	**9**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)		**A** is pent-1-ene (1) **B** is (*E*)-pent-2-ene / (*Z*)-pent-2-ene / pent-2-ene (1) award (1) for either of following **B** has two different groups on each end of the C=C bond (as it shows *E*-*Z* isomerism) **A** has two groups the same on one end of the C=C bond (as it does not show *E*-*Z* isomerism) **C** is cyclopentane / methylcyclobutane / dimethylcyclopropane (1) **C** cannot be alkene / must be saturated (as it does not react with hydrogen) (1) **D** and **E** are 2-methylbut-1-ene and 2-methylbut-2-ene (1) it is not possible to distinguish between them (1) because both react with HBr to form 2-bromo-2-methylbutane / both react with H_2 to form 2-methylbutane (1)		5	3	8		
		(ii)		nickel	1			1		
		(iii)		electrophilic addition	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		$n = \frac{pV}{RT}$ (1) $n = \frac{1.01 \times 10^5 \times 5.2 \times 10^{-5}}{8.31 \times 383}$ (1) $n = 1.65 \times 10^{-3}$ mol (1) $M_r = \frac{0.142}{1.65 \times 10^{-3}}$ = 86.1 ⇨ this is the relative formula mass of hexane (so she is correct) (1) accept alternative methods e.g. showing that $\frac{0.142}{86.1}$ = 1.65 × 10^{-3} mol		4		4	4	
		(ii)		hexane is flammable			1	1		1
		(iii)		^{13}C spectrum is of no use since hexane and pentane would give spectra with 3 lines with chemical shift 5 to 40 (1) ^{1}H spectrum is useful since hexane and pentane would give spectra with different peak areas / heights (1) (although both would have 3 lines with chemical shift 0.1 to 2) hexane would have a peak area / height ratio of 3:2:2 and pentane would have a peak area / height ratio of 3:2:1 (1)			3	3		
				Question 11 total	**2**	**9**	**7**	**18**	**4**	**1**

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	5	5	0	**10**	**1**	**0**
7	5	3	2	**10**	**2**	**4**
8	8	8	2	**18**	**2**	**5**
9	3	8	1	**12**	**6**	**6**
10	6	2	4	**12**	**0**	**9**
11	2	9	7	**18**	**4**	**1**
Totals	**29**	**35**	**16**	**80**	**15**	**25**