GCE A LEVEL MARKING SCHEME

SUMMER 2025

A LEVEL
CHEMISTRY – COMPONENT 3
A410U30-1

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 A LEVEL CHEMISTRY

COMPONENT 3: CHEMISTRY IN PRACTICE

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.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		white cream (pale) yellow all three needed	1			1		1
		(ii)	I	nucleophilic substitution	1			1		
			II	reaction rate increases from Cl to Br to I <u>because</u> the C—Hal bond becomes progressively weaker / has progressively lower bond enthalpy (so is more easily broken)	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		<u>for $CH_3(CH_2)_3Cl$</u> comparing **A** and **B** $[OH^-]$ constant and $[CH_3(CH_2)_3Cl]$ three times greater in **B** rate increases threefold ⇨ first order with respect to $CH_3(CH_2)_3Cl$ comparing **A** and **C** $[CH_3(CH_2)_3Cl]$ constant and $[OH^-]$ has doubled in **C** rate doubles ⇨ first order with respect to $[OH^-]$ (1) rate = $k[CH_3(CH_2)_3Cl][OH^-]$ (1) <u>for $(CH_3)_3CCl$</u> comparing **E** and **F** $[OH^-]$ constant and $[(CH_3)_3CCl]$ four times greater in **F** rate increases fourfold ⇨ first order with respect to $(CH_3)_3CCl$ comparing **E** and **G** $[(CH_3)_3CCl]$ increases threefold and $[OH^-]$ increases threefold rate increases threefold ⇨ zero order with respect to $[OH^-]$ (1) rate = $k[(CH_3)_3CCl]$ (1)			4	4	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		2.20		1		1	1	
		(iii)		$k = \frac{\text{rate}}{[CH_3(CH_2)_3Cl]\,[OH^-]}$ (1) k = 0.00015 (1) unit ⇨ $mol^{-1}\,dm^3\,s^{-1}$ (1) allow ecf from part (b)(i)		3		3	3	
				Question 1 total	**3**	**4**	**4**	**11**	**6**	**1**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td></td><td>• Record the initial volume (of hydrochloric acid) in the burette
• Add 3-5 drops of indicator (to the solution in the conical flask)
• Add acid whilst swirling the flask / washing the flask sides with deionised water
• When the indicator starts to change colour, add acid drop by drop until the first permanent colour change
• Record the final volume in the burette

5 marking points (4)
3 marking points (3)
2 marking points (2)
1 marking point (1)</td><td>4</td><td></td><td></td><td>4</td><td></td><td>4</td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Final burette reading / cm^3</td><td>23.95</td><td>25.30</td><td>22.35</td><td>23.75</td></tr>
<tr><td>Initial burette reading / cm^3</td><td>2.30</td><td>4.95</td><td>2.20</td><td>3.50</td></tr>
<tr><td>Titre / cm^3</td><td>21.65</td><td>20.35</td><td>20.15</td><td>20.25</td></tr>
</table>

award (1) for two correct burette readings to 2 dp

mean titre = 20.25 cm^3 (1)</td><td>2</td><td></td><td></td><td>2</td><td>1</td><td>2</td></tr>
<tr><td></td><td>(c)</td><td></td><td></td><td>award (1) for any of following

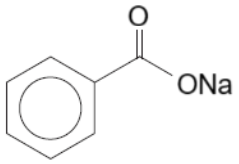
• end-point overshot (because it was a rough titration)
• the burette had been rinsed with water and this was not replaced entirely with hydrochloric acid
• flask not swirled adequately</td><td></td><td></td><td>1</td><td>1</td><td></td><td>1</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			n(NaOH) added initially = 2.80 × 0.1 = 0.280 mol (1) n(HCl) used in titration = 0.980 × $\frac{20.25}{1000}$ = 0.01985 mol ⇨ excess n(NaOH) in 250 cm^3 of solution = 0.1985 mol (1) n(NaOH) reacted = 0.280 – 0.1985 = 0.0815 mol ⇨ n(1-bromobutane) = 0.0815 mol (1) mass of pure 1-bromobutane = 0.0815 × M_r = 0.0815 × 137 = 11.170 g % purity = $\frac{11.170}{11.624}$ × 100 = 96.1% (1) ecf possible		4		4	4	
	(e)			take a sample of the <u>filtrate</u> and add aqueous silver nitrate (1) if no additional precipitate formed / solution remains clear (non-cloudy) then all the bromide has been precipitated (1)			2	2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(f)			n(AgBr) = $\frac{6.294}{187.9}$ = 0.0335 mol from 100 cm^3 of solution (1) 1 mol AgBr ≡ 1 mol 1-bromobutane n(1-bromobutane) in 250 cm^3 of solution = 0.0335 × 2.5 = 0.0837 (1) mass of pure 1-bromobutane = 0.0837 × M_r = 0.0837 × 137 = 11.470 g % purity = $\frac{11.470}{11.624}$ × 100 = 98.7% (1) ecf possible		3		3	3	
	(g)			award (1) for circling 'agree' for both award (1) for correct reasoning in both cases mass of silver bromide recorded is greater than the actual mass because it includes some residual water unreacted hydroxide ions would also react with silver ions to give a precipitate of silver hydroxide so the mass recorded is greater than the mass of silver bromide			3	3		3
				Question 2 total	**6**	**7**	**6**	**19**	**8**	**12**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			**Indicative content** **reaction 1** reagents ⇨ $LiAlH_4$ in ethoxyethane / H_2 with Ni catalyst intermediate product 1 ⇨ $CH_3CH_2CH_2NH_2$ $CH_3CH_2CN + 4[H] \rightarrow CH_3CH_2CH_2NH_2$ $CH_3CH_2CN + 2H_2 \rightarrow CH_3CH_2CH_2NH_2$ **reaction 2** reagents ⇨ PCl_5 / PCl_3 / $SOCl_2$ (dry conditions) intermediate product 2 ⇨ C_6H_5COCl $C_6H_5COOH + PCl_5 \rightarrow C_6H_5COCl + POCl_3 + HCl$ $3C_6H_5COOH + PCl_3 \rightarrow 3C_6H_5COCl + H_3PO_3$ $C_6H_5COOH + PCl_5 \rightarrow C_6H_5COCl + SO_2 + HCl$ **reaction 3** $C_6H_5COCl + CH_3CH_2CH_2NH_2 \rightarrow C_6H_5CONHCH_2CH_2CH_3 + HCl$ **or** $C_6H_5COCl + 2CH_3CH_2CH_2NH_2 \rightarrow C_6H_5CONHCH_2CH_2CH_3 + CH_3CH_2CH_2NH_3Cl$	2	2	2	6		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Correct reagents and conditions; both intermediate products and good attempt at all three equations *The candidate constructs a relevant, coherent and logically structured account including key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.* **3-4 marks** Some correct reagents; one intermediate product and attempt at two equations *The candidate constructs a coherent account including many 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 is generally sound.* **1-2 marks** One or two correct reagents and/or intermediate products *The candidate attempts to link 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.						
	(b)			dissolve solid in <u>minimum</u> volume of hot water (1) filter off any insoluble impurities whilst hot (1) allow to cool (to crystallise solid), filter and dry (1) credit only correct points in sequence i.e. if no reference to dissolving in <u>minimum</u> volume then no credit allow second and third mark if 'solvent' used rather than water with first mark not awarded	3			3		3

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			n(benzenecarboxylic acid) = $\frac{172.6}{122}$ = 1.41 mol n(N-propylbenzamide) = 1.41 × $\frac{52.6}{100}$ = 0.742 mol (1) mass of N-propylbenzamide = 0.742 × 163 = 120.9 g (1) ecf possible		2		2	2	2
	(d)			 + $CH_3CH_2CH_2NH_2$		1		1		
	(e)	(i)		2,4-DNPH orange-red precipitate formed reagent **and** observation needed			1	1		
		(ii)		nitric(III) acid / sodium nitrate(III) and hydrochloric acid bubbles of gas formed reagent **and** observation needed			1	1		1
		(iii)		award (1) for either of following reagent **and** observation needed bromine water decolourised **and** off-white precipitate formed or aqueous iron(III) chloride purple coloured solution formed			1	1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		aqueous sodium hydroxide and iodine / potassium iodide and sodium chlorate(I) solutions pale yellow solid formed reagent **and** observation needed			1	1		1
	(f)			**both** have a peak at 1650-1750 cm^{-1} due to C=O bond (1) **both** have a peak at 3300-3500 cm^{-1} due N—H bond (1) **only** compound **N** has a peak at 1620-1670 cm^{-1} due to C=C bond (1)		3		3		
				Question 3 total	**5**	**8**	**6**	**19**	**2**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			award (1) for conversion of units dm^3 to m^3 °C to K atm to Pa $n = \frac{pV}{RT} = \frac{1.01 \times 10^5 \times 3.87 \times 10^{-3}}{8.31 \times 294} = 0.160$ (1) ratio ⇨ 0.080 : 0.160 **b** = 2 (1)	1	1	1	3	3	
	(b)	(i)		$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$	1			1		
		(ii)		n(thiosulfate) = $0.682 \times \frac{17.60}{1000}$ = 0.0120 mol (1) n(Cu^{2+}) in 25.0 cm^3 of solution = 0.0120 mol n(Cu^{2+}) in 500 cm^3 = 0.0120 × 20 = 0.240 mol (1) ratio ⇨ 0.080:0.240 ⇨ 1:3 **a** = 3 (1) credit alternative methods		3		3	3	2
	(c)			55.3% of mass = 3 × A_r(Cu) = 190.5 M_r of azurite = $\frac{190.5}{55.3}$ × 100 = 344.5		1		1	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			344.5 – [(3 × 63.5) + (60 × 2)] = $(OH)_c$ (1) **c** = 344.5 – 310.5 = 34 **c** = $\frac{34}{17}$ = 2 (1) $Cu_3(CO_3)_2(OH)_2$ (1)			3	3	1	
				Question 4 total	**2**	**5**	**4**	**11**	**8**	**2**

COMPONENT 3: CHEMISTRY IN PRACTICE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL	MATHS	PRACTICAL
1	3	4	4	11	6	1
2	6	7	6	19	8	12
3	5	8	6	19	2	10
4	2	5	4	11	8	2
TOTALS	16	24	20	60	24	25