



GCE A LEVEL MARKING SCHEME

SUMMER 2025

**A LEVEL
CHEMISTRY – UNIT 4
1410U40-1**

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.

WJEC GCE A LEVEL CHEMISTRY UNIT 4

SUMMER 2025 MARK SCHEME

GENERAL INSTRUCTIONS

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.

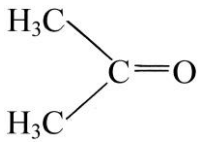
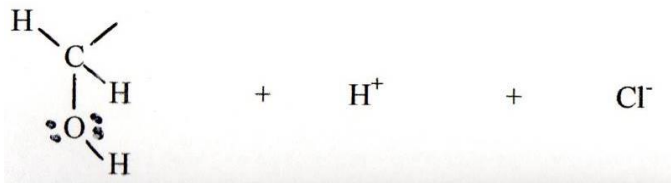
Marking abbreviations

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

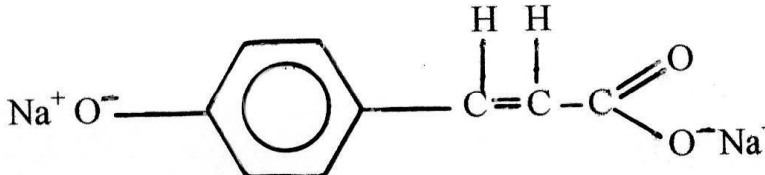
Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

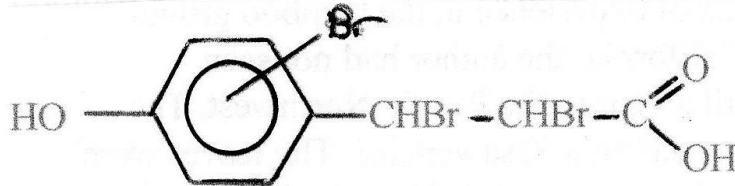
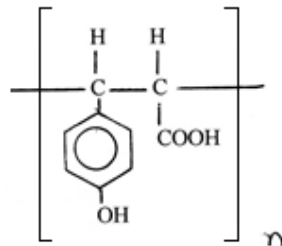
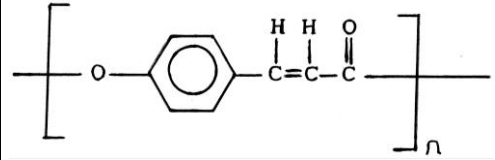
SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			(concentrated) nitric acid and (concentrated) sulfuric acid	1			1		1
	(b)			award (1) for either of following melting temperature will be lower it will melt over a range of temperatures	1			1		1
	(c)			moles of TNT = $\frac{1.00}{227} = 0.00441$ (1) moles of gaseous products = $\frac{15}{2} \times 0.00441 = 0.0331$ (1) ecf possible		2		2	1	
2	(a)			yellow solid / precipitate	1			1		1
	(b)				1			1		
3	(a)			108	1			1		
	(b)			 accept HCl in place of both ions			1	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			4-bromophenol is reacting as an acid / proton donor	1			1		
	(b)			award (1) for any of following - aromatic compounds are not susceptible to attack by nucleophiles - aromatic compounds do not undergo nucleophilic substitution - the aromatic C—Br bond is too strong	1			1		
				Section A total	7	2	1	10	1	3

SECTION B

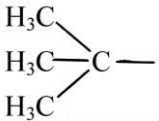
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			moles of sodium carbonate = $\frac{0.500 \times 25.00}{1000} = 0.0125$ (1) moles of compound E = $2 \times 0.0125 = 0.0250$ $M_r = \frac{\text{mass}}{\text{moles}} = \frac{4.10}{0.0250} = 164$ (1) must show method no ecf possible		2		2	1	
	(b)	(i)					1	1		
		(ii)		purple coloration / solution	1			1		1

Question				Marking details	Marks available						
					AO1	AO2	AO3	Total	Maths	Prac	
		(iii)		compounds E and F both have 9 carbon atoms representing 108 out of 164 (1) 108 represents 26.8% of the M_r of compound F $\Rightarrow M_r = 108 \times \frac{100}{26.8} = 403$ (1) $403 - 164 = 239 \Rightarrow$ suggests there are 3 bromine atoms (3×80) (1)  (1) credit possible for other structure if it follows from incorrect calculations		1		3	4	1	1
	(b)	(iv)	I			1		1			
			II			1		1			

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		as the (alkyl) chain length increases, the van der Waals forces between the molecules increase / there are more intermolecular forces (therefore more energy needed to separate the molecules)		1		1		
		(ii)		award (1) for any value in the range 222-234°C the difference between consecutive alkyl groups increases by about 23 / 24 / 25 each time (as the homologous series is ascended) and hexylbenzene contains 6 alkyl carbon atoms / 'has two increases' (1)			2	2		
		(iii)		4-ethylphenol can take part in hydrogen bonding but ethoxybenzene does not show hydrogen bonding (therefore more energy needed to separate molecules of 4-ethylphenol)		1		1		
				Question 5 total	1	7	6	14	2	2

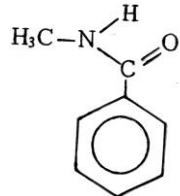
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		$\text{Cl}_2 \rightarrow 2\text{Cl}\bullet$	1			1		
		(ii)		$\bullet\text{CH}_2\text{Cl} + \bullet\text{CH}_2\text{Cl} \rightarrow \text{ClH}_2\text{C}-\text{CH}_2\text{Cl}$		1		1		
	(b)	(i)		$n = \frac{pV}{RT} \quad (1)$ $n = \frac{9.86 \times 10^4 \times 42.9 \times 10^{-6}}{8.31 \times 363} = 1.40 \times 10^{-3} \text{ mol} \quad (1)$ $M_r = \frac{0.168}{1.40 \times 10^{-3}} = 119.8 / 120 \quad (1)$ ecf possible		3		3	3	
		(ii)	I	award (1) for any of following • water cannot exceed 100°C • water boils at 100°C • water will not vaporise (all of) the sample neutral answers water bath not hot enough temperature not high enough			1	1		1
			II	use an oil bath / electrical heater / heating mantle	1			1		1
	(c)	(i)		$\text{CCl}_4 + \text{H}_2\text{O} \rightarrow \text{COCl}_2 + 2\text{HCl}$		1		1		
		(ii)		OCO ₂ fragment has relative mass 60 $\Rightarrow$ two alkyl groups R have relative mass $146 - 60 = 86 \quad (1)$ R has relative mass 43 $\Rightarrow$ R is C ₃ H ₇ / CH ₂ CH ₂ CH ₃ (1) credit possible for other formula if it follows from incorrect calculation		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Indicative content • add 5g of sodium benzoate to 10-100 cm³ of cold water • stir to dissolve the sodium benzoate ○ <i>as sodium benzoate is very soluble in cold water</i> • filter the solution ○ <i>to remove insoluble sand</i> • add hydrochloric acid to the filtrate • until no more benzoic acid is precipitated ○ <i>as benzoic acid is largely insoluble in cold water</i> • filter off the precipitated benzoic acid • wash the benzoic acid with (cold) water ○ <i>to remove soluble impurities</i> • add the benzoic acid to 100-200 cm³ of cold water and heat to boiling ○ <i>so that solid dissolves</i> • allow to cool to room temperature ○ <i>so that benzoic acid recrystallises</i> • filter off the benzoic acid and dry	2	2	2	6		6
				5-6 marks Essential stages of the preparation included with sensible volumes of water; clear reasoning for steps <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The information included in the response is relevant to the argument.</i> 3-4 marks Most stages of the preparation included; good attempt to explain some steps <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i> 1-2 marks Basic description of one or two steps <i>There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i> 0 marks No attempt made or no response worthy of credit.						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		moles of nitrogen = $\frac{823.5}{1000 \times 24.5} = 0.0336$ (1) 1:1 mole ratio therefore 0.0336 mol of V molar mass of V = $\frac{5.00}{0.0336} = 149$ (1) must show method no ecf possible		2		2	2	
		(ii)		alkyl group R contains 9 protons (1) award (1) for either of following - R has 4 carbon atoms (C_nH_{2n+1}) / molecular formula C_4H_9 - R has mass of 57 signal is a singlet therefore all alkyl protons are equivalent so R is  (1)			3	3		
		(iii)		2,6-dimethylphenol	1			1		
	(c)			compound S $\Rightarrow$ it is a carboxylic acid (1) compound U $\Rightarrow$ it has a carbonyl group but is not an aldehyde / (cannot be oxidised so) it is a ketone (1) compound R $\Rightarrow$ it is a methyl ester / it is an ester which is hydrolysed to give an alcohol (1)	1 1	1		3		3
				Question 7 total	5	5	5	15	2	9

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		electrophilic addition	1			1		
		(ii)		award (1) for any of following - the mechanism proceeds via the formation of a secondary carbocation which is more stable than a primary carbocation - the activation energy for the formation of the secondary carbocation is lower than the activation energy for the formation of a primary carbocation - the secondary carbocation is formed at a higher rate than the primary carbocation		1		1		
		(iii)		$\begin{array}{c} \text{Br} \\ \\ \text{H}_3\text{C}-\text{C}-\text{COOH} \\ \\ \text{H} \end{array} + 2\text{NH}_3 \rightarrow \begin{array}{c} \text{NH}_2 \\ \\ \text{H}_3\text{C}-\text{C}-\text{COOH} \\ \\ \text{H} \end{array} + \text{NH}_4\text{Br}$			1	1		
	(b)	(i)		$\begin{array}{c} \text{NH}_3^+ \\ \\ \text{H}_3\text{C}-\text{C}-\text{C} \\ \quad \diagup \quad \diagdown \\ \text{H} \quad \text{O} \quad \text{OH} \end{array}$		1		1		
		(ii)		$\begin{array}{c} \text{NH}_2 \\ \\ \text{R}-\text{C}-\text{C} \\ \quad \diagup \quad \diagdown \\ \text{H} \quad \text{O} \quad \text{OH} \end{array} \quad / \quad \text{RCH(NH}_2\text{)COOH}$	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		award (1) for either of following $\begin{array}{ccccccc} & \text{H}_2\text{N} & & \text{O} & & \text{H} & \\ & & & & & & \\ \text{CH}_3 - & \text{C} & - & \text{C} & - & \text{N} & - & \text{C} & - & \text{C} & = \text{O} \\ & & & & & & & & & & \text{OH} \\ & \text{H} & & & & \text{H} & & \text{H} & & & \end{array}$ $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{O} & & \text{H} & \\ & & & & & & & & \\ \text{CH}_3 - & \text{C} & - & \text{N} & - & \text{C} & - & \text{C} & - & \text{NH}_2 \\ & & & & & & & & & & \\ & \text{COOH} & & & & & & \text{H} & & & \end{array}$		1		1		
		(iv)		it is concerned with the way in which the amino acid chains are arranged e.g. as an α -helix or as a β -pleated sheet (with N—H / C=O hydrogen bonding)	1			1		
	(c)	(i)		asymmetric carbon atom / chiral centre	1			1		
		(ii)		D-dopa = $\frac{100(13+9)}{(2 \times 13)} = 85\%$ (1) L-dopa = 15% (1) ecf possible		2		2	1	
		(iii)	I	award (1) for any sensible answer e.g. - mucuna beans are a renewable resource / can be grown - makes only one of the enantiomers / doesn't make D-dopa - has no harmful side-products			1	1		
			II	12.5g		1		1		
		(iv)		$\text{C}_6\text{H}_5\text{CH}_3 + \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$			1	1		
				Question 8 total	4	6	3	13	1	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		alkaline potassium manganate(VII) / MnO_4^- / OH^-	1			1		1
		(ii)		oxidation	1			1		
		(iii)		phosphorus(V) chloride / benzoyl chloride reacts with water	1			1		1
		(iv)					1	1		
		(v)		reactant NH_3 product H_2O both needed for (1)		1		1		
		(vi)		no peak at 1661 cm^{-1} and one carbon atom less than benzamide $\Rightarrow$ C=O group is lost (1) compound Z could be $\text{C}_6\text{H}_5\text{NH}_2$ (1) this has m/z 93 (corresponding to $\text{C}_6\text{H}_5\text{NH}_2^+$) (1)			3	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			moles of $\text{H}_2\text{SO}_4 = 1.50 \times \frac{16.0}{1000} = 0.0240$ (1) mole ratio $\text{H}_2\text{SO}_4 : \text{NH}_3 : \text{RCONH}_2 \Rightarrow 1 : 2 : 2$ moles of $\text{NH}_3 / \text{RCONH}_2 = 0.0480$ (1) M_r of $\text{RCONH}_2 = \frac{3.50}{0.0480} = 73$ (1) 'M _r ' of the R group = $73 - 44 = 29$ R has the formula CH_3CH_2 (1) credit possible for other formula if it follows from incorrect calculations		4		4	2	
				Question 9 total	3	5	4	12	2	2

UNIT 4

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	7	2	1	10	1	3
5	1	7	6	14	2	2
6	3	9	4	16	5	4
7	5	5	5	15	2	9
8	4	6	3	13	1	0
9	3	5	4	12	2	2
Total	23	34	23	80	13	20