GCE AS MARKING SCHEME

SUMMER 2025

AS
CHEMISTRY – UNIT 2
2410U20-1

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 AS CHEMISTRY UNIT 2

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.

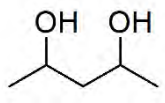
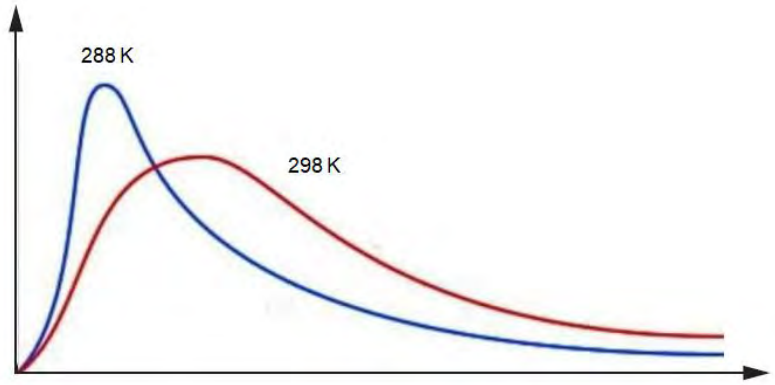
Marking abbreviations

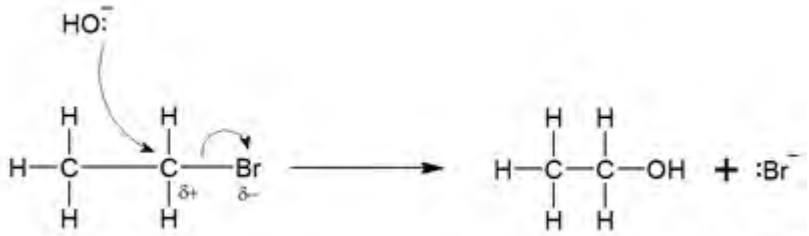
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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

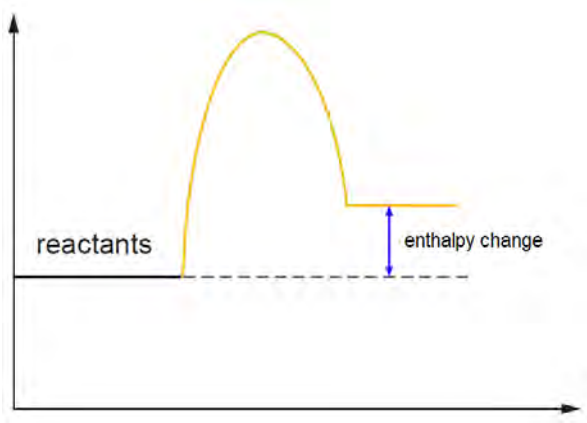
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1				 do not accept CH_3 groups on the ends of the chain		1		1		
2				octane		1		1		
3	(a)			 curve of similar shape with higher peak **and** to the left of the original	1			1		
	(b)			provides an alternative reaction pathway with a lower activation energy	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4				 C—Br dipole (1) curly arrows (1) do not award dipole mark if additional incorrect dipoles / charges included do not award curly arrows mark if additional incorrect arrows included	2			2		
5				*Z*-2,4-dimethylhex-3-ene (2) accept *Z*-3,5-dimethylhex-3-ene award (1) for any of following *E*-2,4-dimethylhex-3-ene 2,4-dimethylhex-3-ene 3,5-dimethylhex-3-ene		2		2		
6	(a)			275	1			1		
	(b)			–115		1		1	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)		(free) radical substitution	1			1		
		(ii)		initiation $Cl_2 \rightarrow 2Cl\bullet$ (1) propagation $Cl\bullet + CH_4 \rightarrow HCl + \bullet CH_3$ (1) $\bullet CH_3 + Cl_2 \rightarrow CH_3Cl + Cl\bullet$ (1)	3			3		
	(b)	(i)		award (1) for either of following two methyl radicals combine (in a termination reaction) $\bullet CH_3 + \bullet CH_3 \rightarrow C_2H_6$	1			1		
		(ii)		free radical substitution / chain reaction continues / $CH_3Cl + Cl\bullet \rightarrow \bullet CH_2Cl + HCl$ (1) chloromethyl radical / $\bullet CH_2Cl$ reacts with Cl_2 / $Cl\bullet$ (forming dichloromethane / CH_2Cl_2) / $\bullet CH_2Cl + Cl_2 \rightarrow CH_2Cl_2 + Cl\bullet$ / $\bullet CH_2Cl + Cl\bullet \rightarrow CH_2Cl_2$ (1)		2		2		

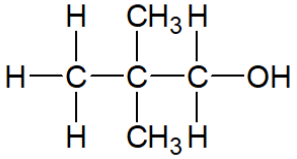
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		award (1) for either of following shorter exposure time to UV limits reaction time fewer chlorine radicals produced accept suggestion that methane/chlorine may react with aluminium in the original method			1	1		
		(ii)		3 $cm^3 s^{-1}$ (1) do not credit second mark if incorrect flow rate given award (1) for any indication that this flow rate gives enough time for most of the reactants to be used up **or** not enough time for chloromethane to react to form side-products			2	2		
				Question 7 total	**5**	**2**	**3**	**10**	**0**	**0**

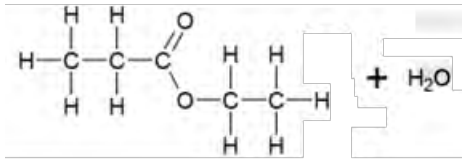
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			 energy level of products above the level of the reactants **and** enthalpy change clearly labelled	1			1		
	(b)	(i)		enthalpy change for the formation of 1 mol of a substance (1) from its constituent elements with everything in its standard state under standard conditions (1)	2			2		
		(ii)		$\Sigma\Delta_f H^\theta$ $_{\text{products}}$ = –3840 (1) $\Sigma\Delta_f H^\theta$ $_{\text{reactants}}$ = –3978 (1) $\Delta_r H^\theta = \Sigma\Delta_f H^\theta$ $_{\text{products}}$ – $\Sigma\Delta_f H^\theta$ $_{\text{reactants}}$ $\Delta_r H^\theta$ = –3840 – (–3978) = 138 (1) ecf possible		3		3	3	

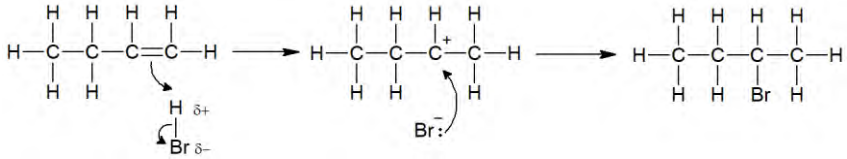
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		all points plotted correctly (2) any seven points plotted correctly (1) line of best fit drawn back to time = 60 s (1) temperature change = 45°C (1) accept any value in the range 44-45.5°C	2	2		4	3	4
		(ii)		$n(Ba(OH)_2.8H_2O) = 0.100$ mol (1) $n(H_2O) = 8 \times 0.100 = 0.800$ mol (1) mass of $H_2O = 0.800 \times 18.02 = 14.4$ g (1) **must** be given to 3 sig figs ecf possible		3		3	2	
		(iii)		$\Delta H = -\frac{mc\Delta T}{n}$ (1) $\Delta H = -\frac{14.4 \times 1.13 \times (-45)}{0.100} = 7322$ J mol^{-1} $\Delta H = 7.32$ kJ mol^{-1} (1) ecf possible e.g. from incorrect temperature change from graph if incorrect award (1) for q = –732 J		2		2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		heat is transferred from the surroundings into the beaker (making the temperature decrease smaller than it should be) do not accept 'heat lost to the surroundings'	1			1		1
		(ii)		award (1) for any of following use a polystyrene cup / insulated calorimeter insulate the beaker put a lid on the beaker	1			1		1
				Question 8 total	**7**	**10**	**0**	**17**	**10**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			**elemental analysis** hydrogen ⇨ 13.75% (1) **C** **H** **O** $\frac{68.09}{12}$ $\frac{13.75}{1.01}$ $\frac{18.16}{16}$ 5.67 13.6 1.14 (1) 5 12 1 empirical formula ⇨ $C_5H_{12}O$ (1) ecf possible e.g. from incorrect hydrogen percentage **mass spectrum** molecular ion peak at 88 ⇨ molecular formula is $C_5H_{12}O$ (1) award (1) for any correct fragment e.g. peak at 15 ⇨ CH_3^+ peak at 17 ⇨ OH^+ peak at 71 ⇨ $C_5H_{11}^+$ **IR spectrum** peak at 3350 ⇨ —OH group present (1) **^{1}H NMR spectrum** 3 peaks ⇨ 3 hydrogen environments (1) peak heights / ratio 1:2:9 ⇨ ratio of hydrogens in each environment (1) award (1) for any one peak identified peak at 4.5 ⇨ O—**H**	2	4	4	10	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				peak at 3.3 ⇨ **H**C—O peak at 0.9 ⇨ R—C**H$_3$** **^{13}C NMR spectrum** 3 peaks ⇨ 3 carbon environments (1) award (1) for any one peak identified peak at 73 ⇨ C—O peak at 33 ⇨ C—C peak at 26 ⇨ CH_3 **award maximum of 9 out of these 11 marks** award (1) for correct identification 2,2-dimethylpropan-1-ol 						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		award (1) for either of following solutions potassium dichromate(VI) / $K_2Cr_2O_7$ potassium manganate(VII) / $KMnO_4$	1			1		1
		(ii)		$CH_3CH_2CH_2OH + 2[O] \rightarrow CH_3CH_2COOH + H_2O$		1		1		
		(iii)		$2Cl^- \rightarrow Cl_2 + 2e^-$ if incorrect award (1) for equation with Cl^- on left hand side and Cl_2 on right hand side		2		2		
		(iv)	I	 award (1) for each product must clearly show structure of ethyl propanoate		2		2		
			II	ethyl propanoate		1		1		
			III	award (1) for any of following catalyst to increase the rate of the reaction to shift the equilibrium to the right dehydrating agent	1			1		1
				Question 9 total	**4**	**10**	**4**	**18**	**2**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		dissolved in alcoholic / ethanol (1) reflux / heat (1)	2			2		2
		(ii)		hydrogen bromide / HBr			1	1		
		(iii)		 both reactant structures with labelled dipole (1) carbocation structure and bromide ion with charges (1) all curly arrows (1) no mark for product structure penalise 1 mark if mechanism leads to 1-bromobutane		3		3		
	(b)	(i)		 intermediate **Y** intermediate **Z** award (1) for each structure award total (1) if they are the wrong way round		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		**B** (1) it has the most stable carbocation (1) because it is tertiary / it has carbon atom bonded to three alkyl groups / it has carbon atom bonded to most alkyl groups (1) accept converse argument accept alternative answer **B** because it is formed by addition of HBr to both intermediates (2)			3	3		
				Question 10 total	**2**	**5**	**4**	**11**	**0**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)		award (1) each for any two of following • halide ions react with Ag^+ ions / silver halide forms • precipitate forms / silver halides are insoluble • so the amount of light passing through the mixture decreases over time	1		1	2		2
		(ii)		**A** (1) this reaction has the highest rate / finishes first (1) C—I is the weakest bond / has the lowest bond enthalpy (of the C—Hal bonds) (1)	1		2	3		2
		(iii)		$\frac{850}{100}$ = 8.5 (1) accept any sensible values from graph lux s^{-1} (1) accept lux / s	1		1	2	1	
		(iv)		award (1) for either of following light intensity does not start at the same level for all reactions each precipitate has different ability to block light			1	1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			**Indicative content** • mix appropriate volumes of iodide and thiosulfate • add starch solution (as an indicator) • add persulfate solution of appropriate concentration and begin timing • stop the clock when the solution turns blue/black • repeat the method with different concentrations of persulfate solution • volume and concentration of all other solutions kept constant • 40 cm^3 of stock persulfate solution is diluted with 10 cm^3 of deionised water for the second run, 30 cm^3 diluted with 20 cm^3 of water for the third and so on • total volume of reaction mixture kept constant • temperature kept constant • calculate the (mean) rate using rate = $\frac{1}{\text{time}}$	3	3		6		6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Good description of the method; reference to total volume being constant; indication of how rate is determined *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.* **3-4 marks** Some key steps of the method; attempt at dilution *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.* **1-2 marks** Some indication of measuring the time taken for colour change to be seen *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.* **0 marks** No attempt made or no response worthy of credit.						
				Question 11 total	**6**	**3**	**5**	**14**	**1**	**11**

UNIT 2

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
SECTION A	5	5	0	**10**	**1**	**0**
7	5	2	3	**10**	**0**	**0**
8	7	10	0	**17**	**10**	**6**
9	4	10	4	**18**	**2**	**2**
10	2	5	4	**11**	**0**	**2**
11	6	3	5	**14**	**1**	**11**
TOTAL	**29**	**35**	**16**	**80**	**14**	**21**