GCE AS MARKING SCHEME

SUMMER 2024

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 2024 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.

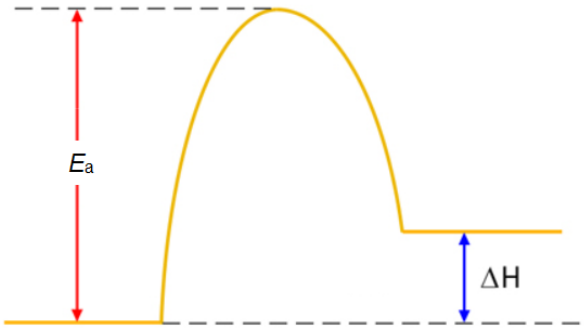
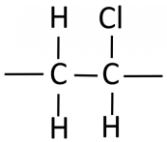
Marking abbreviations

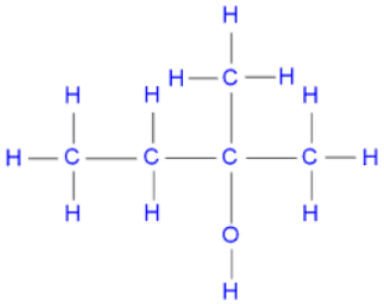
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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				2-methylpentane	1			1		
2				 award (1) for profile shape (products above reactants) award (1) for E_a and Δ*H* labelled – both needed	2			2		
3				molecular formula $C_6H_{10}O_2$ (1) empirical formula C_3H_5O (1)		2		2		
4	(a)			there are two hydrogen atoms on one of the carbons		1		1		
	(b)					1		1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5				$CH_3CHBrCH_3$ accept any unambiguous structure for 2-bromopropane	1			1		
6				 accept any unambiguous structure for 2-methylbutan-2-ol		1		1		
7				nickel	1			1		
				Section A total	**5**	**5**	**0**	**10**	**0**	**0**

SECTION B

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8				**Indicative content** use insulated container add known volume of HCl / known concentration excess to ensure that all CaO reacts measure initial temperature of HCl add known mass of CaO and stir well for rapid and complete reaction measure temperature change at intervals plot temperature change over time and extrapolate lines determine temperature increase repeat all steps using $Ca(OH)_2$ calculate number of moles of CaO / $Ca(OH)_2$ reacted n = $\frac{mass}{M_r}$ calculate enthalpy change ΔH_2 and ΔH_3 $\Delta H = -\frac{mc\Delta T}{n}$ use Hess's cycle to calculate ΔH_1 $\Delta H_1 = \Delta H_2 - \Delta H_3$	4		2	6	2	4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks Good description of method and steps in calculation *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** Basic reference to most steps in method and part of calculation *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** Reference to some steps in method or part of calculation *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 8 total	**4**	**0**	**2**	**6**	**2**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			award (1) for number of moles of carbon **and** hydrogen $\frac{85.7}{12.0}$ = 7 and $\frac{14.3}{1.01}$ = 14 ratio 7:14 ⇨ 1:2 empirical formula CH_2 (1)		2		2		
	(b)			n(NaOH) = $\frac{26.40 \times 0.100}{1000}$ = 2.64×10^{-3} (1) 2.64×10^{-3} mol of acid (in 25.0 cm^3) 1.06×10^{-2} mol of mol of acid (in 100 cm^3) (1) M_r = $\frac{0.93}{1.06 \times 10^{-2}}$ = 88 (1)		3		3	2	3
	(c)			**A** but-1-ene (1) **B** butan-1-ol (1) **C** butan-2-ol (1) **D** butanoic acid (1) ecf possible e.g. from incorrect alkene			4	4		
	(d)			acidified (potassium) dichromate(VI)		1		1		1
				Question 9 total	**0**	**6**	**4**	**10**	**2**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			weigh **6.21 g** of sodium thiosulfate (into a beaker) (1) credit each of the following points • dissolve (in deionised water) • transfer • 250 cm^3 volumetric flask • rinse beaker / funnel / stirring rod (with deionised water) • make up to the mark (with deionised water) • invert several times to mix solution well award (3) for all **six** points award (2) for any **four** points award (1) for any **two** points	3	1		4	1	4
	(b)	(i)		award (1) for either of following sulfur forms as solid precipitate of sulfur forms			1	1		1
		(ii)		time increased as less depth of solution (less sulfur formed over cross) OWTTE			1	1		1
	(c)	(i)		award (1) for range of volumes of thiosulfate – all lower than 40 cm^3 award (1) for volumes of water to give total volume 40 cm^3 (thiosulfate + water) **and** 10cm^3 volume of HCl (1)		2		2		2
		(ii)		s^{-1} ignore 1000		1		1		

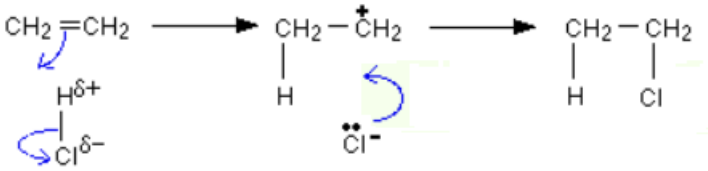
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		rate is directly proportional to volume of thiosulfate		1		1	1	
	(d)	(i)		rate at 30°C is 12 (1) time = $\frac{1000}{12}$ = 83 s (1) ecf possible	2			2	2	
		(ii)		this is true only to some extent here rate doubles when temperature goes from 20°C to 30°C (1) [also when temperature goes from 10°C to 20°C] rate <u>more than</u> doubles when temperature goes from 30°C to 40°C (1)			2	2	1	
		(iii)		particles have more energy (1) neutral answer – particles move faster more collisions exceed activation energy (1) neutral answer – more successful collisions	2			2		
				Question 10 total	**7**	**5**	**4**	**16**	**5**	**8**

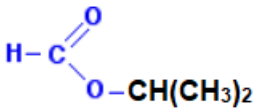
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			(warm with) aqueous sodium hydroxide (1) add (dilute nitric) acid (to neutralise the solution) (1) add aqueous silver nitrate (1) award (1) for **all three** precipitate colours white precipitate shows that the halogen is chlorine cream precipitate shows that the halogen is bromine yellow precipitate shows that the halogen is iodine accept correct observations for solubility of precipitates in ammonia solution (as an alternative to the mark for colours) precipitate soluble in aqueous ammonia shows that the halogen is chlorine precipitate partially soluble in aqueous ammonia / soluble in concentrated ammonia solution shows that the halogen is bromine precipitate insoluble in aqueous/concentrated ammonia shows that the halogen is iodine	4			4		4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			**Mass spectrum** molecular ion peak(s) ⇨ M_r = 92/94 (1) ratio of peak heights 3:1 for molecular ion peaks ⇨ Cl present (1) [accept also for atomic peaks at 35/37] award (1) for any correct fragment on mass spectrum e.g. peak at 15 ⇨ CH_3 peak at 29 ⇨ C_2H_5 **^{13}C NMR spectrum** 4 peaks ⇨ 4 carbon environments (1) molecular formula ⇨ C_4H_9Cl (1) **^{1}H NMR spectrum** 4 peaks ⇨ 4 hydrogen environments (1) award (1) for any one peak identified peak at 4.0 ⇨ **H**C—Cl peak at 1.5 ⇨ —C**H_3** peak at 1.3 ⇨ R—C**H_2**—R peak at 0.9 ⇨ R—C**H_3** award (1) for number of hydrogens in each environment linked to peak heights award maximum of 7 out of these 8 marks final mark reserved for correct structure of **X** ⇨ 2-chlorobutane (1)	1 1	3	3	8		
				Question 11 total	**6**	**3**	**3**	**12**	**0**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			(enthalpy change) when 1 mol (of substance) is burned (1) in excess oxygen (1)	2			2		
	(b)	(i)	I	n(propanol) = $\frac{0.14}{60}$ = 0.00233		1		1	1	1
			II	ΔT = 12.5 (1) energy = $mc\Delta T$ = 100 × 4.18 × 12.5 = 5225 J (1) $\Delta H = -\frac{5.225}{0.00233}$ = – 2242 kJ mol^{-1} (1)		3		3	3	2
		(ii)		credit possible for agree / disagree award (1) for any of following agree – because the temperature rise will be greater (making the percentage error lower) agree – because greater mass of fuel burned (making the percentage error lower) disagree – because more heat will be lost to the surroundings (making ΔT value less accurate)			1	1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			bonds broken 3(C—C) + 9(C—H) + (C—O) + (O—H) + 6(O=O) 1044 + 3708 + (C—O) + 463 + 2976 8191 + (C—O) (1) bonds formed 8(C=O) + 10(O—H) 6440 + 4630 11070 (1) enthalpy change 8191 + (C—O) – 11070 = –2676 (1) (C—O) = –2676 – 8191 + 11070 (C—O) = 203 (1) ecf possible throughout		4		4	2	
				Question 12 total	**2**	**8**	**1**	**11**	**6**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)	(i)		radical substitution (1) (electrophilic) addition (1)	2			2		
		(ii)		award (1) for either of following because only one product is formed because the reaction between ethane and chlorine / radical substitution has lots of possible products			1	1		
		(iii)		 dipole and curly arrow on H—Cl molecule (1) curly arrow from the double bond **and** from the lone pair/negative charge (1) carbocation structure (1) product formed on right hand side (1)		4		4		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		$n(CH_3COOH) = \frac{25}{60} = 0.417$ mol (1) $n(CH_3COOCH_3) = \frac{34}{100} \times 0.417 = 0.142$ mol (1) mass of $CH_3COOCH_3 = 0.142 \times 74 = 10.5$ g (1)		3		3	2	
		(ii)		bulb of thermometer near exit to condenser (1) water flow from bottom to top of condenser (1)	2			2		2
		(iii)		award (1) for either of following sulfuric acid (is a dehydrating agent and) removes water (from the right-hand side of the equation) sulfuric acid increases H^+ concentration (on the left-hand side of the equation) the equilibrium position shifts to the right-hand side (to oppose the change) (1)			2	2		
	(c)					1		1		
				Question 13 total	**4**	**8**	**3**	**15**	**2**	**2**

UNIT 2

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	5	5	0	10	0	0
8	4	0	2	6	2	4
9	0	6	4	10	2	4
10	7	5	4	16	5	8
11	6	3	3	12	0	4
12	2	8	1	11	6	4
13	4	8	3	15	2	2
Total	28	35	17	80	17	26