

AS UNIT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS**MARK SCHEME****GENERAL INSTRUCTIONS**Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark, apart from questions where a banded 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

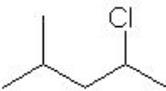
bod = benefit of doubt

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

AS UNIT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS

MARK SCHEME

Section A

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1.	(a)		$\Delta H_2 + \Delta H_3 - \Delta H_1$		1		1		
	(b)		$\frac{1}{2}\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{NO}(\text{g})$		1		1		
2.	(a)		$n(\text{C}) = 3.33$; $n(\text{H}) = 6.63$; $n(\text{O}) = 3.33$ (1) CH_2O (1)		2		2	2	
	(b)		$\text{C}_6\text{H}_{12}\text{O}_6$		1		1		
3.	(a)		due to the presence of two different groups on each carbon of the C=C bond	1			1		
	(b)		the bonds of the two isomers are identical / only the arrangement in space has changed between the two isomers		1		1		
4.					1		1		

GCE AS and A LEVEL CHEMISTRY SPECIMEN ASSESSMENT MATERIALS 118

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5.				damage to heart / liver etc. accept other sensible answers	1			1		
6.				$ \begin{array}{c} \text{H} \quad \text{CN} \\ \quad \\ \text{---C---C---} \\ \quad \\ \text{H} \quad \text{COOCH}_3 \end{array} $		1		1		
Section A total					2	8	0	10	2	0

Section B

Question			Marking details		Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)	(i)		$\text{CH}_2\text{Cl}_2 + \text{Cl}_2 \rightarrow \text{CHCl}_3 + \text{HCl}$		1		1		
		(ii)	I	2 pentyl radicals (1) combine to form decane / in termination reaction (1) credit 2 marks for correct equation e.g. $2 \cdot \text{C}_5\text{H}_{11} \rightarrow \text{C}_{10}\text{H}_{22}$		2		2		
			II	no C—Cl bond (1) at 650cm^{-1} (1)		2		2		
		(iii)		$n = \frac{pV}{RT} = \frac{105000 \times 0.001}{8.31 \times 308}$ (1) $M = 30.0$ (1) error carried forward (ecf) possible award (2) for correct answer only (cao) C_2H_6 / ethane (1)	1	1		3	1	1
	(b)			rate increases as bond gets weaker i.e. Cl to Br to I bond polarity (1) rate increases as bond gets more polar i.e. I to Br to Cl (1)			2	2		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(c)	(i)		bond energy (1) since data shows that rate increases from Cl to Br to I (1)			2	2		
		(ii)		any two for (1) each up to max 2 <ul style="list-style-type: none"> try an identical experiment with a different halogenoalkane e.g. halogenobutane repeat experiment try a control experiment 			2	2		2
Question 7 total					1	6	7	14	2	2

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
8.	(a)	(i)	labelled axes with units (1) at least 5 points plotted correctly – within half a small square (1) appropriate curve drawn (1)	1				1	
				1		1	3	1	3
		(ii)	colorimetry method (1) calibrate colorimeter with iodine solution of known concentration (1) measure light passing through to determine concentration at intervals (1)	1	1				
					1		3		3
		(iii)	more particles have an energy greater than the activation energy (1) greater fraction of collisions are effective (1)	2				2	
		(iv)	0.0102 mol dm ⁻³ (1) this is the end concentration of I ₂ and these species are present in a 1:1 ratio (1)					2	2
		(v)	0.005 (1) mol dm ⁻³ min ⁻¹ (1)	1	1			2	2
	(b)		activation energy for catalysed reaction marked to the left of E _a on plot (1) more particles have an energy greater than the activation energy / greater fraction of collisions are effective therefore rate increases (1)	2				2	
Question 8 total				8	3	3	14	4	6

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9.	(a)	(i)		$M_r(\text{C}_9\text{H}_{20}) = 128$ (1) $1.563 \times 10^{-3} \text{ mol}$ (1)		2		2	1	
		(ii)		temperature increase = 30.7°C (1) $50 \times 4.18 \times 30.7$ (1) $\Delta H = -4105 \text{ kJ mol}^{-1}$ (1)	1	1		3	1	3
		(iii)		heat loss (1) can be reduced by increasing insulation e.g. lagging calorimeter or putting lid on it (1)		1		2		2
	(b)	(i)		14 O_2 9 CO_2 $10 \text{ H}_2\text{O}$ all must be correct		1		1		
		(ii)		bonds broken = $2784 + 8240 + 6944 = 17968$ bonds formed = $13374 + 20(\text{O—H})$ (1) both required $4666 = [13374 + 20(\text{O—H})] - 17968$ (1) $(\text{O—H}) = 463 \text{ kJ mol}^{-1}$ (1)		3		3	3	
		(iii)		the enthalpy of the O—H bond in other compounds is slightly different	1			1		
Question 9 total					2	9	1	12	6	5

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
10.	(a)	(i)	NaOH in ethanol (1) propene (1)	2			2		2
		(ii)	sodium / potassium dichromate(VI) (1) oxidation (1)	2			2		2
	(b)	(i)	n(C) = 5.18; n(H) = 10.2: n(O) = 1.73 (1) ratio = 3:6:1 which is consistent with formula (ratio = 6:12:2) (1)		1	1	2	2	

GCE AS and A LEVEL CHEMISTRY SPECIMEN ASSESSMENT MATERIALS 124

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
10.	(b)	(ii)	<p>Indicative content</p> <ul style="list-style-type: none"> • δ 1.3 = R-CH₂-R δ 2.1 = -CH₂-C=O δ 4.0 = -CH₂-O • IR peaks for C-H and C=O but not O-H • sweet smelling suggests ester • 2 compounds from part (a) are propan-1-ol and propanoic acid • structure is CH₃CH₂COOCH₂CH₂CH₃ <p>5-6 marks Correct structure given; reference to all information provided <i>The candidate constructs a relevant, coherent and logically structured account including all key elements of the indicative content. A sustained and substantiated line of reasoning is evident and scientific conventions and vocabulary are used accurately throughout.</i></p> <p>3-4 marks Spectral data interpreted correctly; structure given fits interpretation <i>The candidate constructs a coherent account including most of the key elements of the indicative content and little irrelevant material. Some reasoning is evident in the linking of key points and use of scientific conventions and vocabulary is generally sound.</i></p> <p>1-2 marks Two correct conclusions drawn from spectral data or other information provided <i>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.</i></p> <p>0 marks <i>The candidate does not make any attempt or give an answer worthy of credit.</i></p>		3	3	6		1
		(iii)	<p>distillation (1)</p> <p>boiling temperature of product much lower than either reactant (1) no hydrogen bonding in product (present in both reactants) (1)</p>	1					
			Question 10 total	5	6	4	15	2	8

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
11.	(a)	(i)	dipoles marked (1) electron movement from H–Br onto Br and electron movement from C=C to H ⁺ (1) correct carbonium ion formed (1) electrophilic addition (1)	4			4		
		(ii)	atom of Br can be added to either carbon of C=C (1) secondary carbonium ions are more stable than primary carbonium ions (1)	2			2		
	(b)		IR 1715 cm ⁻¹ due to C=O (1) δ 9.8 due to R–CHO (1) molecule must be propanal (1) arises from compound C as aldehydes formed from primary alcohols only (1)		1 1	1	4		
	(c)	(i)	orange/brown to colourless (1) 1,2,3-tribromobutane (1) either order	1	1		2		1
		(ii)	I white precipitate due to the use of HCl			1	1		1
			II (warm) with aqueous NaOH (1) acidify with HNO ₃ then add aqueous AgNO ₃ (1)	2			2		2
Question 11 total				9	3	3	15	0	4

AS UNIT 2: ENERGY, RATE AND CHEMISTRY OF CARBON COMPOUNDS**SUMMARY OF ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	2	8	0	10	2	0
7.	1	6	7	14	2	2
8.	8	3	3	14	4	6
9.	2	9	1	12	6	5
10.	5	6	4	15	2	8
11.	9	3	3	15	0	4
TOTAL	27	35	18	80	16	25