GCSE MARKING SCHEME

SUMMER 2023

GCSE
CHEMISTRY – UNIT 2

3410U20-1 AND 3410UB0-1

INTRODUCTION

This marking scheme was used by WJEC for the 2023 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCSE CHEMISTRY UNIT 2

CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY

SUMMER 2023 MARK SCHEME

GENERAL INSTRUCTIONS

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.

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

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

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

FOUNDATION TIER ONLY QUESTIONS

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		accept **either** of following • hand wash • drain cleaner accept blue / purple			1	1		1
		(ii)		battery fluid accept red			1	1		1
		(iii)		NaOH		1		1		
	(b)	(i)		**C** (1) accept sodium carbonate fizzing (1)			2	2		2
		(ii)		lighted / burning splint (1) do **not** accept <u>glowing</u> splint gives squeaky pop (1)	2			2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		**C** (1) accept sodium carbonate award (1) for **any** of following • lowest (temperature) increase • (temperature) increases less • (temperature) increases only a little • temperature <u>only</u> goes up by 5°C accept least energy given out neutral answer – lowest temperature			2	2		2
				Question 1 total	**2**	**1**	**6**	**9**	**0**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		heat accept ignition	1			1		
		(ii)		oxygen accept air	1			1		
				fuel	1			1		
	(b)			4		1		1	1	
	(c)	(i)		37		1		1	1	1
		(ii)		Which alcohol gives out the most heat energy? ✓ Which gases are produced when alcohols burn? Which alcohol has the lowest boiling point? Which alcohol burns for the longest?			1	1		1
	(d)			32 (2) if answer incorrect award (1) for any clear indication of the correct number of all atoms e.g. • 12 + 4 + 16 • C + 4H + O no ecf possible		2		2	2	
				Question 2 total	**3**	**4**	**1**	**8**	**4**	**2**

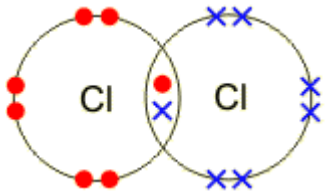
Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		conical flask	1			1		1
		(ii)		limewater (1) goes milky / cloudy (1)	2			2		2
		(iii)		the reaction is finished the yeast is used up the enzymes in the yeast are denatured ✓	1			1		1
	(b)	(i)		award (2) for **all** points plotted correctly tolerance ±½ square award (1) for **any** 4 correct suitable straight line drawn (with ruler) (1)		3		3	3	
		(ii)		15 accept any value in the range 14-16 ecf possible from incorrect graph		1		1	1	
		(iii)		accept any value in the range 160-172 no ecf possible		1		1	1	
				Question 3 total	**4**	**5**	**0**	**9**	**5**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		compound (1) lower (1) electrical (1) liquid (1)	4			4		
		(ii)		Al_2O_3		1		1		
		(iii)		carbon is more reactive than aluminium: iron is more reactive than aluminium: aluminium is more reactive than carbon: ✓	1			1		
	(b)			**Indicative content** **electrical wiring** • ductile – can be drawn into wires • good electrical conductor – current can pass through it **saucepans** • good thermal conductor – heat can pass through it • high melting point – can be heated to high temperatures • corrosion resistant – will not corrode • malleable – can be hammered into shape / shaped • non-toxic – safe to use for food	4		2	6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				water pipes • malleable – can be hammered into shape / shaped • corrosion resistant – will not corrode • non-toxic – safe for (drinking) water references to strength, durability, low/high density are not directly relevant to these uses **5-6 marks** Description of two relevant properties linked to all three uses *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3-4 marks** Description of one relevant property linked to all three uses *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** Identification of one relevant property linked to one or two uses *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
				Question 4 total	**9**	**1**	**2**	**12**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		<table><tr><td>crop growth on fields increases</td><td></td></tr><tr><td>fertilisers run into waterways</td><td>✓</td></tr><tr><td>plant growth in rivers and lakes increases</td><td>✓</td></tr><tr><td>aquatic animals do not have enough oxygen</td><td>✓</td></tr><tr><td>farmers' profits increase</td><td></td></tr></table> award (2) for **all** 3 correct award (1) for **any** 2 correct			2	2		
		(ii)		award (1) for statement that in general the larger the population, the more ammonia is used e.g. Asia has the largest population and the largest ammonia use / the largest population uses the most ammonia 'demand for food' is equivalent to population award (1) for recognising Africa as the exception e.g. Africa has the second largest population but the fourth largest ammonia use			2	2	2	
	(b)	(i)		ammonium sulfate do not accept ammonia sulfate		1		1		
		(ii)		<table><tr><td>plants use nitrogen to make sugar</td><td></td></tr><tr><td>plants use nitrogen to make water</td><td></td></tr><tr><td>plants use nitrogen to make oxygen</td><td></td></tr><tr><td>plants use nitrogen to make protein</td><td>✓</td></tr></table>	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		300 (2) if answer incorrect award (1) for $\frac{75}{15}$ / 5 / 0.3		2		2	2	
	(c)	(i)		$N_2 + \boxed{3} H_2 \rightleftharpoons \boxed{2} NH_3$		1		1		
		(ii)		award (1) for any of following • the reaction is reversible • the reaction goes in both directions • the reaction can go forwards or backwards do not accept equal both ways	1			1		
		(iii)	I	iron / Fe	1			1		
			II	award (1) for any of following • increases rate of reaction • makes the reaction go faster / it go faster • makes the ammonia more quickly • makes the product more quickly • process takes less time accept 'lowers the activation energy'	1			1		
				Question 5 total	**4**	**4**	**4**	**12**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		**D** and **E** both needed			1	1		
		(ii)		**B**			1	1		
		(iii)		**C**			1	1		
	(b)			 shared pair (1) octet (1) accept with all dots/crosses ignore any inner shells drawn		2		2		
	(c)	(i)		**V** 2+ (1) accept +2 **Y** 1– / – (1) accept –1 award (1) for **V** ⇨ positive **and Y** ⇨ negative		2		2		
		(ii)		**VY_2**		1		1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		83 (2) award (1) for correct answer not to nearest whole number e.g. 82.9 / 82.98 / 82.97 if answer incorrect award (1) for any of following 39 × 2 78 82 0.83 41		2		2	2	
				Question 6 total	**0**	**7**	**3**	**10**	**2**	**0**

COMMON QUESTIONS

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7/1	(a)	(i)		award (1) for any of following • leave to crystallise / evaporate / dry naturally • leave to dry for a few days / until next lesson • leave to dry in a warm place / on window sill / on radiator must have a 'process' and the idea that it happens over a period of time **OR** in a warm place neutral answer – leave to dry	1			1		1
		(ii)		no fizzing / bubbles / effervescence (with oxide) (1) because no carbon dioxide produced (1) alternative answer black powder (rather than green) would be left in the beaker when all the acid has reacted (1) because copper(II) oxide is black (not green) (1)			2	2		2
		(iii)		$CuSO_4 + H_2O$ award (1) for each correct product		2		2		

<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></td><td>(b)</td><td>(i)</td><td></td><td>
<table>
<tr><td>Part of the energy profile</td><td>Letter</td></tr>
<tr><td>energy change for the reaction</td><td>C</td></tr>
<tr><td>energy of the reactants</td><td>A</td></tr>
<tr><td>activation energy of the reaction</td><td>B</td></tr>
</table>

award (2) for all three correct
award (1) for any one correct</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>the (minimum) energy required for a reaction to happen / start

accept ‘the <u>minimum</u> energy required to activate the reaction’
neutral answer – the energy required to activate the reaction</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>award (1) for any of following

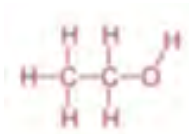
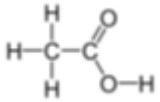
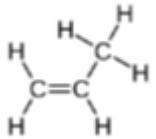
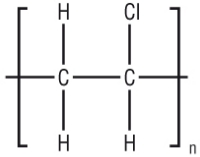
• the energy of the products is lower than the energy of the reactants
• the product line is below the reactant line / E is below A
• energy given out is greater than energy taken in / D is greater than B
• lower energy at the end than at the beginning

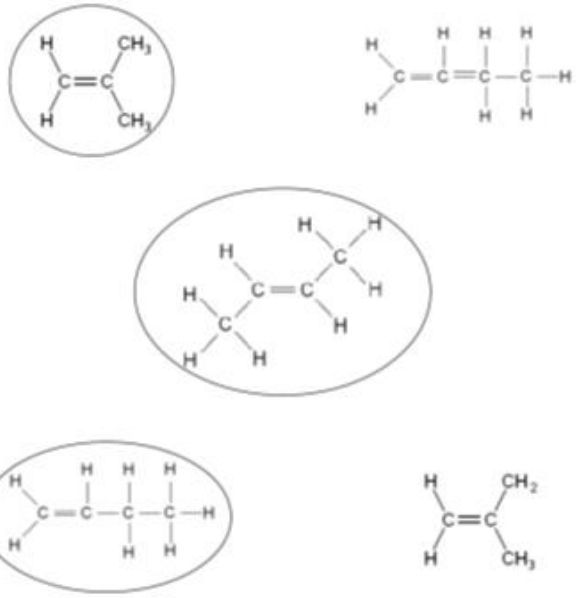
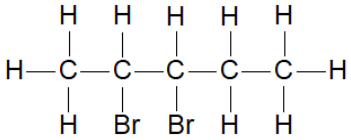
neutral answer – negative energy change</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 7/1 total</td><td>4</td><td>3</td><td>2</td><td>9</td><td>0</td><td>3</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8/2	(a)	(i)		**X** boiling / evaporation **Y** condensing / condensation **both** needed neutral answers – liquid to gas / gas to liquid	1			1		1
		(ii)		award (2) for statement linking boiling point and chain length e.g. the longer the chain length, the higher the boiling point award (1) for either of following different boiling points different chain lengths chain lengths and size of molecules are equivalent	2			2		
		(iii)		award (3) for 8300 award (2) for 8274 - answer not to two sig figs if answer incorrect award (1) for temperature rise of 19.7 ecf possible from incorrect temperature rise		3		3	3	3
	(b)	(i)		C_6H_{12} accept $2C_3H_6$		1		1		
		(ii)		award (1) for any two conditions • high temperature / heat • catalyst • high pressure accept 'high temperature and pressure'	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		award (1) for any of following • has double bond between two carbon atoms • has C=C bond • has carbon atoms which could bond with more hydrogen / more atoms • could undergo an addition reaction neutral answer – not completely surrounded by hydrogen atoms	1			1		
		(iv)		C_8H_{18} (one of the compounds) present in petrol / good fuel (1) neutral answer – used in cars C_2H_4 used to make plastics / polymers / polythene / ethanol (1) neutral answer – fuel	2			2		
				Question 8/2 total	**7**	**4**	**0**	**11**	**3**	**4**

HIGHER TIER ONLY QUESTIONS

<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>3</td><td>(a)</td><td>(i)</td><td></td><td>
<table>
<tr><th>Name</th><th>Molecular formula</th><th>Structure</th><th>Homologous series</th></tr>
<tr><td>ethanol</td><td>C_2H_5OH</td><td>  </td><td>alcohols</td></tr>
<tr><td>ethanoic acid</td><td>CH_3COOH</td><td>  </td><td>carboxylic acids</td></tr>
<tr><td>propene</td><td>C_3H_6</td><td>  </td><td>alkenes</td></tr>
</table>
award (1) for each correct answer</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>C_7H_{14}</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>  repeat unit (1)
n and side bonds (and brackets) (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			 all three correct (2) any two correct (1)	2			2		
	(d)					1		1		
				Question 3 total	**7**	**2**	**0**	**9**	**1**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			sodium zinc iron lead			1	1		1
	(b)	(i)		award (2) for **all** points plotted correctly tolerance ± ½ square award (1) for **any** 4 correct (1) suitable straight line drawn (with ruler) (1)		3		3	3	
		(ii)		award (1) for either of following • order of reactivity is Mg > Al > Zn > Cu • magnesium and aluminium are more reactive than zinc and copper is less reactive than zinc – must refer to all four metals award (1) for any of following • copper does not react with zinc chloride / does not displace zinc • temperature doesn't change/increase with copper • aluminium and magnesium react with zinc chloride / displace zinc award (1) for any of following • reaction between magnesium and zinc chloride is more exothermic than that between aluminium and zinc chloride • magnesium reaction more exothermic than aluminium • temperature increases more with magnesium than aluminium • magnesium most exothermic			3	3		3
				Question 4 total	**0**	**3**	**4**	**7**	**3**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		 four shared pairs (1) both octets (1)		2		2		
		(ii)		intermolecular forces are weak / forces between molecules are weak (1) accept bonds / interactions / attractions require little energy to overcome / break forces (1) accept doesn't take much heat to overcome / break forces neutral answer - simple molecular do not award any credit if explanation involves covalent bonds	2			2		
	(b)	(i)		 (1)  (1)		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		(in magnesium oxide) the ions have higher charges (1) electrostatic attraction is greater / attraction between ions is greater / ionic bonds are stronger (1) accept converse for both marks	1	1		2		
		(iii)		88 (3) accept 87.5 if answer incorrect credit each correct step in method $\frac{4.12}{58.5}$ = 0.0704 (1) $\frac{0.0704}{0.080}$ = 0.88 (1) 0.88 × 100 = 88 (1) alternative method 0.080 × 58.5 / 4.68 (1) $\frac{4.12}{4.68}$ = 0.88 (1) 0.88 × 100 = 88 (1)		3		3	3	
				Question 5 total	**3**	**8**	**0**	**11**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Indicative content** **X** identified as hydrochloric acid **Y** identified as sodium chloride **Z** identified as ethanoic acid **X** is the stronger acid – more vigorous reaction / produces hydrogen more quickly; greater temperature increase / more exothermic **Y** does not react so cannot be an acid / must be sodium chloride **Y** must be sodium chloride – magnesium less reactive than sodium so can't displace it **Z** is the weaker acid – less vigorous reaction / produces hydrogen less quickly; smaller temperature rise / less exothermic magnesium + hydrochloric acid → magnesium chloride + hydrogen $Mg + 2HCl \rightarrow MgCl_2 + H_2$ magnesium + ethanoic acid → magnesium ethanoate + hydrogen $Mg + CH_3COOH \rightarrow (CH_3COO)_2Mg + H_2$ **5-6 marks** All three identified; clear reasoning; good attempt at equation *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.*	2		4	6		4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				3-4 marks At least two identified; some reasoning; reference to named salt and/or hydrogen as products *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** At least one identified; reference to gas/hydrogen as product *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
	(b)			iron(II) ions will produce a green precipitate (1) iron(III) ions will produce a brown precipitate (1) if no reference to precipitate award (1) for iron(II) green **and** iron(III) brown award (1) if correct precipitate colours given but assigned to incorrect ions	2			2		2
				Question 6 total	**4**	**0**	**4**	**8**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			435 (3) if answer incorrect credit each correct step in method 2340 – 94 = 2246 (1) 2246 – 941 = 1305 (1) H—H = 435 (1) alternative method 2340 – 94 = 2246 (1) N≡N + 3(H—H) = 2246 (1) H—H = 435 (1)			3	3	3	
	(b)			yield is lower / is too low / less ammonia is formed (1) reaction rate is lower / too low reaction is slower / is too slow (1)	2			2		
	(c)			$HNO_3 + NH_3 \rightarrow NH_4NO_3$ reactants (1) product (1)		2		2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			accept any of the following approaches but the second point must directly follow from the first for both marks (leads to) high numbers of algae / microorganisms (1) ⇨ decomposition of algae depletes oxygen (1) stops sunlight reaching plants below the surface (1) ⇨ plants unable to photosynthesise (1) plants unable to photosynthesise (1) ⇨ reduction in oxygen content of water (1) excessive plant growth stops obsorption of oxygen (from air) ⇨ not enough oxygen for fish (1)	2			2		
				Question 7 total	**4**	**2**	**3**	**9**	**3**	**0**

Question				Marking details		Marks available					
						AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		as pH increases, citric acid content decreases and sugar content increases ✓ as acidity decreases, ascorbic acid content decreases and water content decreases tomatoes are a good source of vitamin C and citric acid citrus fruits contain ascorbic acid and a natural preservative ✓				2	2	2	
		(ii)		award (1) for **any** of following • the values for ascorbic acid are bigger but the unit is 1000 times smaller • mg/100g is a smaller unit than % • citric acid is measured in % but ascorbic acid is measured in mg/100g • there is much more citric acid (than ascorbic acid) present				1	1	1	
	(b)	(i)		$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ formulae (1) state symbols (1)		2			2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)	I	0.35 × 0.021 = 0.00735		1		1	1	1
			II	0.588 / 0.59 (2) if answer incorrect credit each correct step in method 0.00735 × 2 = 0.0147 (1) $\frac{0.0147}{0.025}$ = 0.588 / 0.59 (1) ecf possible from part (i)		2		2	2	2
		(iii)		1.2×10^{22} (2) accept 12×10^{21} / 0.12×10^{23} if answer incorrect credit each correct step in method but do not award any marks for multiplying mass 0.36 by N_A $\frac{0.36}{18}$ = 0.020 (1) $0.020 \times 6.0 \times 10^{23} = 1.2 \times 10^{22}$ (1)		2		2	2	
				Question 8 total	**2**	**5**	**3**	**10**	**8**	**3**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			aluminium ions gain electrons therefore are reduced (1) accept $Al^{3+} + 3e^- \rightarrow Al$ ⇨ reduction oxide ions lose electrons therefore are oxidised (1) accept $2O^{2-} \rightarrow O_2 + 4e^-$ ⇨ oxidation neutral answer – oxidation is loss, reduction is gain	2			2		
	(b)	(i)		$\frac{36}{100}$ × 500 = 180 tonnes of Al_2O_3		1		1	1	
		(ii)		95.3 / 95 (3) if answer incorrect credit each correct step in method 102 tonnes Al_2O_3 produces 54 tonnes of Al (1) 1 tonne Al_2O_3 produces $\frac{54}{102}$ tonnes of Al (1) 180 tonnes Al_2O_3 produces 95.3 tonnes of Al (1) ecf possible from part (i)		3		3	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				alternative method $\frac{180}{102}$ = 1.765 (1) 1.765 × 2 = 3.530 (1) 3.530 × 27 = 95.3 (1) ecf possible from part (i)						
				Question 9 total	**2**	**4**	**0**	**6**	**4**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	1	6	**9**	0	8
2	3	4	1	**8**	4	2
3	4	5	0	**9**	5	4
4	9	1	2	**12**	0	0
5	4	4	4	**12**	4	0
6	0	7	3	**10**	2	0
7	4	3	2	**9**	0	3
8	7	4	0	**11**	3	4
TOTAL	**33**	**29**	**18**	**80**	**18**	**21**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	3	2	**9**	0	3
2	7	4	0	**11**	3	4
3	7	2	0	**9**	1	0
4	0	3	4	**7**	3	4
5	3	8	0	**11**	3	0
6	4	0	4	**8**	0	6
7	4	2	3	**9**	3	0
8	2	5	3	**10**	8	3
9	2	4	0	**6**	4	0
TOTAL	**33**	**31**	**16**	**80**	**25**	**20**