GCSE MARKING SCHEME

SUMMER 2024

GCSE
SCIENCE (DOUBLE AWARD) – UNIT 3
PHYSICS
HIGHER TIER
3430UC0-1

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.

GCSE SCIENCE (DOUBLE AWARD) UNIT 3 – PHYSICS 1

HIGHER TIER

SUMMER 2024 MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response 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.

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 statement.

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

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		$\frac{38\,000\,000}{3\,750\,000}$ (1) Payback = 10.1 [years] (1) Accept 10 [years]		2		2	2	
		(ii)		Cost of {electricity / biomass / wood / energy} may change **OR** Energy use may change OWTTE Accept bills could change or savings could change		1		1		
	(b)			Growing trees (1) {removes / absorbs} CO_2 from the atmosphere (1) [so disagree] **Alternative:** A tree absorbs as much CO_2 (1) as it releases (1)			2	2		
	(c)	(i)		3 + 13.4 = 16.4 [MW] **or** 20.0 – 3.6 = 16.4 [MW]		1		1	1	
		(ii)		Efficiency = $\frac{16.4\ \textbf{ecf}}{20.0} \times 100$ (1) Efficiency = 82% (1) so disagree Conclusion must be present to award both marks **Alternative:** $\frac{15}{100}$ x 20 (1) Useful output = 3 M[W] (1) so disagree Conclusion must be present to award both marks			2	2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		Substitution: energy transfer = power × time i.e. 20 × 60 (1) Conversion i.e. 20 × 3600 (1) Energy transfer = 72 000 [MJ] (1) Award 2 marks for an answer of 1200 [MJ] Award 2 marks for an answer of 7.2×10^n except for when $n \neq 4$ Award 1 mark for an answer of 1.2×10^n except for when $n \neq 3$	1	1 1		3	3	
		(ii)		$\frac{72\,000\ \textbf{ecf}}{2880} = 25$ [tonnes]		1		1	1	
		(iii)		Substitution: volume = $\frac{25\ \textbf{ecf} \times 1000}{500}$ (1) Volume = 50 [m^3] Award 1 mark for answer of 0.05 [m^3]	1	1		2	2	
		(iv)		$\frac{50\ \textbf{ecf}}{5} = 10$		1		1	1	
				Question 1 total	**2**	**9**	**4**	**15**	**12**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			**Indicative content:** **Components:** Connect an ammeter in series to measure the current through the lamp. Connect a voltmeter in parallel with the lamp to measure the voltage across it. **Method:** 1. Adjust the variable resistor until the voltmeter reads e.g. 1 V. 2. Record the readings of voltage and current. 3. Repeat steps 1 to 2, increasing the voltage by e.g. 1 V each time, until the voltmeter reads 12 V **or** until the full range of the variable resistor has been used. **5–6 marks** Detailed description of both areas. *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** Detailed description of one areas **or** limited descriptions of both. *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.*	6			6		6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1–2 marks A limited description of one area. *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)			Equal increases in voltage give smaller increases in current **or** current is increasing at a decreasing rate **or** the gradient is decreasing (1) showing an increase in resistance (1) [so disagree] N.B. this mark is a follow on one from the 1st mark			2	2		2
				Question 2 total	**6**	**0**	**2**	**8**	**0**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		Substitution: $\frac{1}{R_{\text{total}}} = \frac{1}{10} + \frac{1}{10}$ (1) Total resistance = 5 [Ω] (1) Award 1 mark for answer only of 0.2 [Ω] **Alternative:** $\frac{100}{20}$ (1) = 5 [Ω] (1)	1	1		2	2	2
		(ii)		Substitution: $I = \frac{V}{R} = \frac{12}{5}$ (1) **ecf** I = 2.4 [A] (1) **Alternative:** $I = \frac{12}{10}$ = 1.2 [A] (1) × 2 = 2.4 [A] (1)	1	1		2	2	2
		(iii)		12 [V]	1			1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		Substitution: $I = \frac{V}{R} = \frac{12\,\textbf{ecf}}{10}$ (1) I = 1.2 [A] (1) **Alternative:** $I = \frac{2.4\,\textbf{ecf}}{2}$ (1) I = 1.2 [A] (1) N.B. Treat answer of 1 A as neutral	1	1		2	2	2
	(b)	(i)		Increases		1		1		1
		(ii)		Decreases		1		1		1
		(iii)	I	Decreases		1		1		1
			II	Voltage is shared in series **or** each gets 6 V		1		1		1
				Question 3 total	**4**	**7**	**0**	**11**	**6**	**11**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			<table><tr><td>Radio waves</td><td>Microwaves</td><td>Infra-red</td><td>Visible</td></tr><tr><td>4×10^{2} m</td><td>2×10^{-2} m</td><td>3×10^{-5} m</td><td>5×10^{-7} m</td></tr></table> All correct award 2 marks 2 or 3 correct award 1 mark 1 correct 0 marks		2		2		
	(b)	(i)		UV, X-rays, gamma [rays] – **all 3 needed**	1			1		
		(ii)		[Radiation that] has high energy / interacts with atoms / removes electrons from atoms / damages cells Don't accept causes cancer / mutations	1			1		
	(c)			Transfer energy / travel at the same speed [in a vacuum] / can travel through empty space Don't accept transmit information	1			1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			Correct substitution and rearrangement into the speed formula (1) $t = \frac{7.2 \times 10^7}{3 \times 10^8}$ = 0.24 [s] (1) $t = \frac{6.0 \times 10^6}{2 \times 10^8}$ = 0.03 [s] (1) So disagree Conclusion must be present to award all 3 marks **Alternative:** Speed of the signal to the satellite is 1.5 times faster than in the cable (1) The distance travelled to the satellite and back is 12 times greater than the cable (2) So disagree Conclusion must be present to award all 3 marks Award a maximum of 2 marks for answers of 0.48 [s] **and** 0.06 [s]			3	3	3	
				Question 4 total	**3**	**2**	**3**	**8**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Substitution: units used = power × time (1) i.e. power is {2400 **or** 2.4} **and** time is {2.5 **or** $\left(\frac{2.5}{60}\right)$ **or** (2.5 × 6) **or** $\left(\frac{15}{60}\right)$} Correct answer i.e. 0.6 [kWh] (1) Award 1 mark for answers only of 0.1, 6, 36, 100, 600, 6000 and 36 000	1	1		2	2	
		(ii)		Cost = 0.6 **ecf** × 7 × 34 (1) Cost = 142.8 [p] (1) accept 143 [p] Award 1 mark for answer of 20.4 [p] **or** 4.2	1	1		2	2	
		(iii)		Any calculation that shows that power × time is the same for both kettles (1) e.g. for kettle A: units used = $\frac{2}{60} \times 3 \times 6 = 0.6$ So cost is the same so Sophia is correct (1) Conclusion mark can only be awarded if the calculation is present and is consistent with (a)(i) **Alternative:** 3 × 0.033 × 6 = 0.594 [kWh] (1) The cost is similar so agree with Sophia **or** the cost is less so disagree with both of them (1) Conclusion mark can only be awarded if the calculation is present and is consistent with (a)(i)			2	2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		**Any 2 × (1) from:** – the cables can be made thinner – each part of the cable carries less current – sockets can be placed anywhere on the ring – [each socket has 230 V applied] they can be operated separately	2			2		
		(ii)		Faster [acting] (1) accept more sensitive Can be {reset / reused} **or** doesn't need replacing (1)	2			2		
		(iii)		Total power = 7750 W [so he is not correct]			1	1		
				Question 5 total	**6**	**2**	**3**	**11**	**6**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		This increases the voltage **or** decreases the current (1) reducing energy loss as heat [in the wires] **or** more efficient (1) Don't accept prevents heat loss	2			2		
		(ii)		$1800 \times 10^6 = I \times 400 \times 10^3$ (1) $I = \frac{1800 \times 10^6}{400 \times 10^3}$ (1) I = 4500 [A] (1) Award 2 marks for answers of 4.5×10^n where $n \neq 3$	1	1 1		3	3	
	(b)			Between 0:00 and 6:00 **or** 1:00 and 5:00 **or** 1:00 and 6:00 **or** 0:00 and 5:00 (1) when demand is lowest (1)		2		2		
				Question 6 total	**3**	**4**	**0**	**7**	**3**	**0**

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SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL	MATHS	PRAC
1	2	9	4	15	12	0
2	6	0	2	8	0	8
3	4	7	0	11	6	11
4	3	2	3	8	3	0
5	6	2	3	11	6	0
6	3	4	0	7	3	0
TOTAL	**24**	**24**	**12**	**60**	**30**	**19**