



GCSE MARKING SCHEME

SUMMER 2022

**GCSE
PHYSICS – UNIT 1 (HIGHER TIER)
3420UA0-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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.

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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)		Alternating voltage [continuously] changes direction or switches between + and - / direct voltage never changes direction	1			1		
	(b)	(i)	Mower cuts through the cable (1) rccb (1) Accept: Live wire in kettle touches the neutral wire (1) Fuse / mcb (1) N.B. Safety device mark can only be awarded if the linked situation correctly identified			2	2		
		(ii)	Fast[er] acting (1) Accept more sensitive / acts at an exact value Can be reset / can be used again / can be turned on and off / doesn't need replacing / reusable (1) Don't accept renewable	2			2		
	(c)		The live wire carries <u>current</u> [to an appliance] at a <u>high voltage</u> (1) The neutral wire [completes the circuit and] carries <u>current</u> at <u>low / zero voltage</u> (1)	2			2		
			Question 1 total	5	0	2	7	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)			The vibrations / oscillations (1) are parallel to the direction of wave or travel or energy transfer (1)	2			2		
	(b)			Speeds of 9 OR 5 [km/s] OR 0.5×8 squares (1) Difference = 4 [km/s] (1)		2		2	1	
	(c)	(i)		[Maximum] speed in the mantle is greater than the speed in the outer core / greatest speed is in the mantle / 15 [km/s] and 13 [km/s] (1) Mantle acts like a solid / outer core is liquid (1) so Bob's claim is true. Conclusion must be included to award 2 marks			2	2		
		(ii)		Mean speed = $\frac{6\,300}{550}$ (1) = 11.45 (km/s) (1) This is the actual speed at depth of 1 200 km (or at 4 900 km) (1) [So Bob's statement is not true.] Alternative for third mark: [At 3 500 m] the speed is 10.0 [km/s] [So Bob's statement is not true.] Alternative: Speed at 3500 km is 10.0 [km/s] (1) Time = $\frac{6\,300}{10}$ (1) = 630 [s] (1) [So Bob's statement is not true.] Alternative: Speed at 3500 km is 10.0 [km/s] (1) Distance = 10×550 (1) = 5 500 [km] [So Bob's statement is not true.]			3	3	2	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		$2 \times 550 = 1\,100$ [s]		1		1	1	
		(ii)		P wave only shown i.e. one cycle (1) Size no bigger than wave at B (1) Position, the start of the wave must be within the correct 200 s range based on (d)(i) (expect 1 000 – 1 200) or apply an ecf (1) N.B. If drawn correctly but at station A or B apply a 1 mark penalty			3	3		
				Question 2 total	2	3	8	13	4	0

Question			Marking details			Marks Available					
						AO1	AO2	AO3	Total	Maths	Prac
3.	(a)			Geosynchronous satellite	Geostationary satellite	4			4		
		Stays above the same point on Earth at all times	(x)	✓							
		Orbits Earth once in 24 hours	✓	✓							
		Orbits above the equator	x	✓							
		Must pass over the North pole and South pole	x	x							
Award 1 mark for each correct row											
	(b)	(i)	Substitution into: $v = f\lambda$ so $3 \times 10^8 = f \times 0.08$ (1) Rearrangement: $f = \frac{v}{\lambda} = \frac{3 \times 10^8}{0.08}$ (1) Frequency = 3.75×10^9 (1) Answer of 3.75×10^n where n is not = to 9 award 2 marks Unit = Hz (1) accept Hertz			1					
						1	1 1		4	3	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Substitution into: $\text{speed} = \frac{\text{distance}}{\text{time}}$ so $3 \times 10^8 = \frac{\text{distance}}{0.24}$ (1) Distance = 7.2×10^7 [m] (1) Distance to satellite = half calculated distance = 3.6×10^7 [m] (1) Answer of 7.2×10^n where n is not = to 7 award 1 mark Answer of 14.4×10^7 [m] award 2 marks OR: Halve time to 0.12 s (1) Substitution into: $\text{speed} = \frac{\text{distance}}{\text{time}}$ so $3 \times 10^8 = \frac{\text{distance}}{0.12}$ (1) = 3.6×10^7 [m] (1) Answer of 3.6×10^n where n is not = to 7 award 2 marks	1	1 1		3	3	
				Question 3 total	7	4	0	11	6	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)			Increases in mass values are equal to the increases in volume values / every 10 [cm ³] increases the mass by 10 [g] [so correct] Accept correct calculation so $\frac{10}{10} = 1$ Accept when one increases by 10 the other goes up by 10 or they both go up in equal steps			1	1	1	1
	(b)	(i)		Accept in the range 40 - 50 [cm ³]		1		1		1
		(ii)		The mass values stop increasing by 10 [after 40 cm ³] or increases in mass changes [beyond 40 cm ³]		1		1	1	1
	(c)			Density = $\frac{79}{10}$ or $\frac{158}{20}$ or $\frac{237}{30}$ etc or $\frac{(424 - 108)}{(80 - 40)}$ (1) 7.9 [g/cm ³] (1) Award 1 mark for correct substitution of mass and linked volume from the table N.B. volume must be above 40		2		2	2	2
	(d)			Better resolution on the measuring cylinder (1) Balance with better resolution / to more dp's (1) Accept smaller ball bearings or more precise balance / measuring cylinder Don't accept repeat the experiment or more accurate equipment			2	2		2
				Question 4 total	0	4	3	7	4	7

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5.			<p>Indicative content:</p> <p>Conduction: Gas (accept vacuum) in the space between the two panes is a poor conductor which reduces conduction through the window. Laying fibreglass insulation on the attic floor has pockets of air trapped in it that reduce heat loss by conduction (air is a good insulator).</p> <p>Convection: Fibreglass insulation reduces the heat energy getting into the loft which reduces convection currents in there.</p> <p>Radiation: The reflective coating on the glass reduces heat energy loss by radiation either by reflection or emission. The surfaces of the insulation are shiny to reflect radiant heat back into the house and to reduce heat radiated into the loft.</p> <p>5–6 marks Comprehensively describes the reduction in heat loss by all heat transfer methods for either improvement. <i>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.</i></p> <p>3–4 marks Comprehensively describes the reduction in heat loss by two of the heat transfer methods for either improvement or gives a limited description of all heat transfer methods. <i>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.</i></p>	6			6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>1–2 marks Gives a limited description of the reduction in heat loss by one or two of the heat transfer methods for either improvement. <i>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.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit.</i></p>						
				Question 5 total	6	0	0	6	0	0

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
6.	(a)			There would be zero resistance / a short circuit / resistance would get too low (1) producing a [very] high current / safety resistor reduces the current through the ammeter / overload the ammeter (1) N.B. Treat as neutral reference to voltage		2		2			2
	(b)	(i)		0.400 Accept 0.4		1		1	1		1
		(ii)		10 [Ω]		1		1			1
		(iii)		20 [Ω]		1		1	1		1
		(iv)		Horizontal scale of 0 to 10 in 2 (A^{-1}) per 2 cm square (1) 5 points plotted correctly < 1 small square tolerance (1) 4 or fewer points plotted correctly < 1 small square tolerance award 0 marks Straight line of best fit from the plotted points < 1 small square tolerance (1) N.B. doesn't need to extend to the origin	1	1		3	3		3
	(c)			$R = 70$ [Ω] or their answer from (b)(iii) ecf $\times 3 + r$ ecf (1) accept 60 [Ω] 5.8 ± 0.2 (value taken from graph) (1) Accept 5 ± 0.2 Current = $\frac{1}{5.8} = 0.17$ [A] (accept 0.18 - 0.21 [A]) (1)			3	3	3		3

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)	Voltage = gradient = $\frac{24}{2}$ or $\frac{48}{4}$ etc (taken from the graph) (1) = 12 [V] (1) Accept correct substitution into $V = IR$ and correct answer		2		2	2	2
		(ii)	Take corresponding values of resistance and mean current from the table (1) Use of $V = IR$ to find V / multiply them (1) Accept use of $P = IV$ for 1 mark Don't accept use a voltmeter	1	1		2		2
			Question 6 total	2	10	3	15	10	15

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7.	(a)		<p><u>First finger</u> [in direction of magnetic] field / left to right / N to S (1) accept pointing finger</p> <p><u>Second (middle) finger</u> [points in direction of] current / from B to A (1)</p> <p><u>Thumb</u> [will give direction of] motion / up / force (1)</p>	3			3		
	(b)		<p>Gives a change of direction of current in the coil every half turn (1)</p> <p>So the force on the left is always up or the force on the left is in the same direction or the force on AB is upwards for half a turn and downwards for the other half turn (1)</p> <p>Award 1 mark for if not split ring it will only make half a turn</p>	2			2		
	(c)	(i)	<p>Selection of length of 6 (cm) (1)</p> <p>$F = 0.04 \times 0.7 \times 6 \times 10^{-2}$ (1 – conversion to m)</p> <p>$= 1.68 \times 10^{-3}$ [N] (1)</p> <p>Award 2 marks for an answer of 1.68×10^n or 3.36×10^{-3} [N]</p> <p>If length of 3 cm used answer of 8.4×10^{-4} [N] award 2 marks</p> <p>Award 1 mark for an answer of 8.4×10^n or 3.36×10^n [N]</p>		3		3	2	
		(ii)	<p>Reference to doubling (1)</p> <p>Reference to doubling again or four times the force (2)</p>	1	1		2	1	
			Question 7 total	6	4	0	10	3	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
8.	(a)	(i)	Motion of molecules remains unchanged (1) Collisions occur more often (1) Don't accept more collisions	2			2		2
		(ii)	It / volume decreases (1) to half or 9 cm ³ (1) Award 2 marks for inversely proportional so it halves		2		2	2	2
	(b)	(i)	300 [K]		1		1	1	1
		(ii)	Substitution: $\frac{2.4 \times 10^5}{300 \text{ ecf}} = \frac{3.0 \times 10^5}{T_2}$ (1) in any correct arrangement $T_2 = \frac{300 \text{ ecf} \times 3.0 \times 10^5}{2.4 \times 10^5} = 375 \text{ [K]} (1) (= 102^\circ\text{C})$ Temp rise = 375 – 300 ecf = 75 [K] or 75 °C (1) Alternative: $\frac{p_1}{p_2} = \frac{2.4 \times 10^5}{3.0 \times 10^5} = 0.8 (1)$ $\frac{T_1}{T_2} = 0.8$ so $T_2 = \frac{300 \text{ ecf}}{0.8} = 375 \text{ [K]} (1)$ Temp rise = 375 – 300 ecf = 75 [K] or 75 °C (1)	1					
					1		3	3	3

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
	(c)			Substitution into $Q = mc\Delta\theta$ to give $105.5 = 5 \times 10^{-3} \times c \times 21$ (1) Rearrangement: $c = \frac{105.5}{5 \times 10^{-3} \times 21}$ (1) $= 1004.8$ [J/kg °C] (1) Accept 1 000 [J/kg °C] Don't accept 1 004 [J/kg °C] Award 2 marks for 1.005 or 1 [J/kg °C]	1						
					1	1		3	3	3	
				Question 8 total	4	7	0	11	9	11	

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	Marks Available					
	AO1	AO2	AO3	Total	Maths	Prac
1	5	0	2	7	0	0
2	2	3	8	13	4	0
3	7	4	0	11	6	0
4	0	4	3	7	4	7
5	6	0	0	6	0	0
6	2	10	3	15	10	15
7	6	4	0	10	3	0
8	4	7	0	11	9	11
Total	32	32	16	80	36	33