GCSE MARKING SCHEME

SUMMER 2023

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

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.

WJEC GCSE PHYSICS

UNIT 1 – ELECTRICITY, ENERGY AND WAVES

HIGHER TIER

SUMMER 2023 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

<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>1</td><td>(a)</td><td>(i)</td><td></td><td>Total of rank orders = 3 (1)
Which is the lowest total (1) [so agree]
OR
[Type B power stations] are ranked number 1 (1)
for all features (1) [and so agree]

Award 2 marks for all 3 named features:
[Type B power stations] have no emissions and the running cost is {nearly 0 / lowest} and the efficiency {is the best / rank number 1}
Award 1 mark for 2 named features e.g.
[Type B power stations] have no emissions and the running cost is {nearly 0 / lowest}
Don’t accept running cost is low or emissions are low</td><td></td><td></td><td>2</td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td><table><tr><th>Type A, B, C or D</th><th>Energy source</th></tr><tr><td>A</td><td>Fossil</td></tr><tr><td>B</td><td>Hydroelectric</td></tr><tr><td>C</td><td>Fossil</td></tr><tr><td>D</td><td>Nuclear</td></tr></table>
4 correct award 3 marks
2 or 3 correct award 2 marks
1 correct award 1 mark</td><td></td><td></td><td>3</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>Selection and substitution: $\frac{170\,000}{200\,000}$ [$\times$ 100] (1)
= 85 (1)
Answer of 0.85 award 1 mark only</td><td></td><td>2</td><td></td><td>2</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 1 total</td><td>0</td><td>2</td><td>5</td><td>7</td><td>2</td><td>0</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			At least 1 wave in shallow water joining correctly to a deep water wave (1) A minimum of 3 wavefronts shown perpendicular to wave direction by eye (1) Smaller wavelength in shallow water must be consistent and a minimum of 3 wavefronts shown (1)		3		3		3
	(b)	(i)	I	1.5		1		1		1
			II	10 [cm] **ecf**		1		1	1	1
		(ii)		Wavelength is less in region B (1) [Frequency is constant] so wave speed is also less in region B, <u>so disagree</u> (1) **Alternative:** {The waves are closer / there are more waves} in region B (1) because the waves have slowed down in the shallow water, <u>so disagree</u> (1)			2	2		2
	(c)	(i)		6 [cm]		1		1		1
		(ii)		Selection and substitution: $\frac{75}{50}$ (1) = 1.5 [cm] (1)		2		2	2	2

		(iii)		A quarter of 60 is 15 (1) so increases to 75 [cm/s] (1) A quarter of 75 is 18.75 so should increase to 93.75 cm/s [but it increases to 82 cm/s] (1) [so the rule is not generally true and Janet is not correct] **Alternative:** Increase = 75 - 60 = 15 [cm/s] (1) So $\frac{15}{60} = \frac{1}{4}$ (1) Increase = 82 – 75 = 7 [cm/s], so $\frac{7}{75}\left[\neq \frac{1}{4}\right]$ (1) [so the rule is not generally true and Janet is not correct] **Alternative:** 60×1.25 (1) = 75 [cm/s] (1) $75 \times 1.25 = 93.75$ [cm/s] (1) [so the rule is not generally true and Janet is not correct] N.B. 2 marks can be awarded for the first calculation comparison of wave speeds at 8 and 6 [cm] or at 6 and 4 [cm] and then 1 mark for a second calculation comparison			3	3	3	3
				Question 2 total	**0**	**8**	**5**	**13**	**6**	**13**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3				**Indicative content:** **Conduction** Atoms / particles gain energy and vibrate faster Energy is passed on by collisions Free electrons travel faster through the structure Transferring energy **Convection** Water molecules gain energy and move further apart Hot water is less dense and rises The rising water transports energy through the water. More dense colder water drops and the cycle continues. **5–6 marks** Detailed explanation of both conduction and convection. *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 explanation of either conduction or convection or partial description 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		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1–2 marks Partial explanation of either conduction or convection. *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 3 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Number of units = 7×8 (1) Cost = $56 \times 30 = 1680$ (1) = [£]16.80 (**ecf**) (1) **ecf** must apply to a power × time **Alternative:** 30×7 (1) $= 210 \times 8 = 1680$ (1) = [£]16.80 **ecf** (1) **ecf** must apply to a cost for 1 hour calculation **Alternative:** 30×8 (1) $= 240 \times 7 = 1680$ (1) = [£]16.80 **ecf** (1) **ecf** must apply to a power of 1 kW calculation	1	1 1		3	3	
	(b)	(i)		Requires 16 litres i.e. $\frac{240}{15}$ (1) Cost = 1.60×16 = [£]25.60 (1)		2		2	2	
		(ii)	I	$\frac{14400}{240} = 60$ (1) 25.60 **ecf** – 16.80 **ecf** = 8.80 so Difference in cost/y = £8.80 **ecf** × 60 **ecf** = [£]528 (1) **Alternative:** Petrol costs 25.60 **ecf** × 60 **ecf** = 1536 **and** electricity costs 16.80 × 60 **ecf** = 1008 (1) Difference = [£]528 (1)		2		2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
			II	Extra cost of car = £12 000 (1) Payback time = $\frac{12\,000}{528\ \textbf{ecf}}$ = 22.7 or 22.73 or 23 [years] (1) Don't accept 22.8 [years]		2		2	2	
	(c)			{Electricity / energy} must be used [for charging] (1) **For the 2nd mark** **EITHER** Likely to come from a fuel power station [which emits greenhouse gases] - so disagree **OR** comes from renewable or nuclear energy [which do not emit greenhouse gases] - so agree Conclusion must be present to award 2 marks			2	2		
				Question 4 total	**1**	**8**	**2**	**11**	**9**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			{Vibrations / oscillations} (1) Don't accept moves are perpendicular to {wave / energy transfer / propagation} direction in transverse waves **and** parallel to wave direction in longitudinal waves (1)	2			2		
	(b)	(i)		Total internal reflection / TIR	1			1		
		(ii)		Air has a lower density [than glass] **or** it moves [from a more dense] towards a less dense [material] (1) Accept moving towards a material in which it would travel faster Light hits the side above {the critical angle / 42º} (1)	2			2		
	(c)			S waves travel through solids but not liquids **or** S waves can only travel through solids (1) So the mantle is solid **and** the core is liquid (1) **Alternative:** S waves travel through the solid mantle (1) but not the liquid core (1) Reference to inner and outer treat as neutral	2			2		
				Question 5 total	**7**	**0**	**0**	**7**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Any 3 ×(1) from:** - The particles get closer together / less room to move around / more densely packed - They collide more frequently - Collide [more frequently] with the walls [of the container] - More collisions mean more force [on less area so more pressure]	3			3		
	(b)	(i)		**Any of the following calculations earns the 1st mark:** $\frac{20}{-223}$ = -0.09 $\frac{40}{-173}$ = -0.23 $\frac{80}{-73}$ = -1.1 **A second calculation plus 'do not agree' earns the 2nd mark** DO NOT penalise omission of – sign. **Award 2 marks for:** This is only true if the temperatures are in {kelvin / K}			2	2	2	2
		(ii)		Extend line back (1) Read the T when {V = 0 / where line crosses the T axis} (1)	2			2		2
	(c)			T_2 = 67 + 273 = 340 (1) Substitution: $\frac{2800}{280} = \frac{V_2}{340}$ **ecf** (1) Rearrangement: V_2 = 10 × 340 (1) = 3400 [cm^3] (1) Award 3 marks for an answer of 26 800 [cm^3] from use of 67^{o}C	1	1 1 1		4	4	
				Question 6 total	**6**	**3**	**2**	**11**	**6**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Ammeter in series (1) Voltmeter shown in parallel with the thermistor (1) N.B. correct symbol shown in a circle	2			2		2
	(b)			6 points plotted correctly to within <1 small square tolerance (1) 5 points or less plotted correctly to within <1 small square tolerance (0) Curve of best fit between 0-125 ^{o}C <1 small square tolerance from plotted points (1)		2		2	2	2
	(c)	(i)		Total resistance = 40 + 40 = 80 [Ω] (1) so $I = \frac{12}{80}$ = 0.15 [A] (1) Therefore V = 0.15 $\times$ 40 = 6 [V] (1) **Alternative:** Voltage shared equally (1) so $V = \frac{12}{2}$ (1) = 6 [V] (1)		3		3	3	3
		(ii)		As temperature increases, {the resistance of the thermistor decreases/ the resistance shown by the {graph / table} decreases (1) Total [series] resistance decreases, [so current increases] (1) [so agree]			2	2		2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		$I = \frac{3}{12}$ = 0.25 [A] (1) Rearrangement: $R = \frac{12}{0.25}$ **ecf** (1) = 48 [Ω] (1) **Alternative:** $I = \frac{3}{12}$ = 0.25 [A] (1) Rearrangement: $R = \frac{P}{I^2} = \frac{3}{0.25^2}$ **ecf** = 48 [Ω] (1)		3		3	3	3
		(ii)		[Total resistance decreases] because the {lamp / thermistor} is now in parallel **or** there is another path for the current (1) So the parallel resistance is lower [than the thermistor resistance on its own so the total resistance is lower] (1)	1	1		2		2
				Question 7 total	**3**	**9**	**2**	**14**	**8**	**14**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			Set up the apparatus with e.g. 100 turns on the primary and 20 turns on the secondary (1) Set the primary voltage to a {suitable value / 3 V / 6 V} **or** keep the primary voltage constant (1) Measure the secondary voltage (1) Repeat with different numbers of secondary turns [keeping the primary turns constant] (1)	4			4		4
	(b)			a.c. produces an {alternating / changing} magnetic field (1) which is required to induce {voltage / current} in the secondary coil (1)	2			2		
	(c)			They increase the voltage (1) reducing {current / heating / energy loss} [in cables] (1) Don't accept stop heating effect / no energy loss	2			2		
	(d)			Substitution: $\frac{230}{11.5} = \frac{600}{N_2}$ (1) Rearrangement: $N_2 = \frac{600}{230} \times 11.5$ (1) = 30 (1)	1	1 1		3	3	
				Question 8 total	**9**	**2**	**0**	**11**	**3**	**4**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	0	2	5	7	2	0
2	0	8	5	13	6	13
3	6	0	0	6	0	0
4	1	8	2	11	9	0
5	7	0	0	7	0	0
6	6	3	2	11	6	4
7	3	9	2	14	8	14
8	9	2	0	11	3	4
Total	**32**	**32**	**16**	**80**	**34**	**35**