



# **GCSE MARKING SCHEME**

**SUMMER 2023**

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

## **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 SCIENCE (DOUBLE AWARD) UNIT 3 – PHYSICS 1**

## **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

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			33 000 – 9 000 (1 for either figure given) = 24 000 [kilotonnes] (1) Award 1 mark for an answer of 24 [kilotonnes]		2		2	2	
	(b)			2008 <b>and</b> 2009		1		1	1	
	(c)			<b>Any 2 × (1) from:</b> <ul style="list-style-type: none"> <li>• <u>Decreased</u> climate change / extreme weather</li> <li>• <u>Reduction</u> in global warming / greenhouse gases</li> <li>• <u>Reduction</u> in rising sea levels / melting icecaps</li> <li>• <u>Less danger</u> to habitats / reduction in extinction of some species</li> </ul> N.B. Don't accept stop in any of the above Reference to pollution treat as neutral	2			2		
	(d)	(i)		Nuclear power stations <u>emit no CO<sub>2</sub></u> (1) so the line should be on 0 (1)			2	2		
		(ii)		Useful energy transferred = 185 (units) (1 – appearing anywhere) $= \frac{185}{500} [x 100] = 37\% (1) \text{ so disagree}$ <b>Alternative:</b> $\frac{315}{500} [x 100] = 63\%$ Efficiency = 100 – 63 (1) = 37[%] (1) so disagree <b>N.B.</b> Award 1 mark for an answer of 0.37			2	2	2	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<b>Alternative:</b> 63% of 500 = 315 (1) This is wasted energy (1) so disagree  <b>Award 2 marks for all of the following:</b> $\frac{315}{500} \times 100 = 63\%$ , but this is the inefficiency (2) so disagree <b>Conclusion must be present to award 2 marks</b>						
				<b>Question 1 total</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>9</b>	<b>5</b>	<b>0</b>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			At least 1 wave in deep water joining correctly to a shallow water wavefront (1) A minimum of 3 wavefronts shown perpendicular to wave direction by eye (1) Bigger wavelength in deep water must be consistent <b>and</b> a minimum of 3 wavefronts shown (1)		3		3		3
	(b)			The {wavelength increases / wave[front]s are further apart} in deeper water (1) Frequency is constant (1) and <u>with reference to <math>v = f\lambda</math></u> , speed increases so agree (1)			3	3		3
				<b>Question 2 total</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>0</b>	<b>6</b>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			<p>Units used = <math>200 \times 0.54 = 108</math> (1)  Cost = <math>108 \text{ ecf} \times £0.30 = £32.40</math> (1)</p> <p><b>Alternative:</b>  Cost of 1 wash = <math>0.54 \times £0.30 = £0.16[2]</math> (1)  Yearly cost = <math>200 \times £0.16[2] \text{ ecf} = £32.[40]</math> (1)</p> <p><b>Alternative:</b>  Cost of 200 units = <math>200 \times £0.30 = £60</math> (1)  Yearly cost = <math>0.54 \times £60 \text{ ecf} = £32.40</math> (1)</p> <p>Accept for 1 mark an answer of 3240</p>		2		2	2	
	(b)			$\frac{0.54}{4} = 0.135 \text{ [kW]}$		1		1	1	
				<b>Question 3 total</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>0</b>



Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Heat the ends of the rods [where they come together equally with a Bunsen flame] (1) Pin drops off (1)  <b>Either:</b> <u>And</u> {the best conductor / copper} is first (1)  <b>Or:</b> Vaseline melts first on copper (1)	3			3		3
		(ii)		Particles vibrate <u>faster</u> <b>and</b> collide with their neighbours (1) [Free] <u>electrons</u> move through the structure [passing on their energy] (1)	2			2		
	(b)	(i)		Hot water rises (1) Because it {is less dense / expands} (1) Accept converse argument. Treat as neutral any reference to purple crystals	2			2		2
		(ii)		Hot air {above the radiator / at the top of the room} rises (1) So the air below is not heated by <u>convection</u> (1)		2		2		
				<b>Question 4 total</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>9</b>	<b>0</b>	<b>5</b>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Orbit above the equator <b>Or</b> above the same point [on the ground]	1			1		
	(b)	(i)		Substitution: $\frac{36\,000\,000}{3 \times 10^8}$ (1) = 0.12 [s] (1) Doubling to 0.24 [s] (1) Award 2 marks for answer of $2.4 \times 10^n$ where $n \neq -1$ Award 1 mark for answer of $1.2 \times 10^n$ where $n \neq -1$  <b>Alternative:</b> $\frac{72\,000\,000}{3 \times 10^8}$ (1) = 0.24 [s] (1)	1	1 1		3	3	
		(ii)		Substitution: $3 \times 10^8 = f \times 0.002$ (1) Manipulation: $f = \frac{3 \times 10^8}{0.002}$ (1) = $1.5 \times 10^{11}$ [Hz] (1) Award 2 marks if the wrong wavelength is used i.e. 1 m then $f = 3 \times 10^8$ [Hz]	1	1 1		3	3	
		(iii)		Radio [waves]	1			1		
				<b>Question 5 total</b>	<b>4</b>	<b>4</b>	<b>0</b>	<b>8</b>	<b>6</b>	<b>0</b>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6				<p><b>Indicative content:</b>  <b>Apparatus used:</b>            Balance, measuring cylinder or displacement can</p> <p><b>Description of the method:</b>            Use a balance to weigh the [dry] rock and record its mass (in grams).            Fill a measuring cylinder with water up to 20 cm<sup>3</sup> (typically) and record its volume.            Gently place the rock into the measuring cylinder and record the new volume.</p> <p><b>OR</b>            Fill a displacement can to its spout and place a measuring cylinder beneath its spout.            Gently place the rock into the can, collect all displaced water and record the volume.</p> <p><b>Calculating the density:</b>            Calculate the volume of the solid by subtracting the original volume from the new volume (in cm<sup>3</sup>)</p> <p><b>OR</b>            Measure the volume of water in the measuring cylinder (in cm<sup>3</sup>) for the displacement can method.            Divide the mass by volume to find its density in g/cm<sup>3</sup>.</p> <p><b>5–6 marks</b>            Comprehensively describes all three aspects of the experiment.  <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>	6			6		6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p><b>3–4 marks</b> Comprehensively describes for 2 out of 3 aspects of the experiment <b>OR</b> limited description for all 3. <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> <p><b>1–2 marks</b> Comprehensively describes for 1 out of 3 aspects of the experiment <b>OR</b> limited description for 1 or 2. <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><b>0 marks</b> <i>No attempt made or no response worthy of credit.</i></p>						
				<b>Question 6 total</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>	<b>6</b>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		Substitution: $\frac{1}{R} = \frac{1}{12} + \frac{1}{6}$ (1) $\frac{1}{R} = \frac{1}{4}$ or 0.25 (1) accept 0.24 if decimals are used $R = 4 \text{ } [\Omega]$ (1) accept 4.2 $[\Omega]$	1	1 1		3	3	3
		(ii)		6 – 4 <b>ecf</b> = 2 $[\Omega]$		1		1		1
		(iii)		Substitution : $I = \frac{9}{6}$ (1) = 1.5 [A] (1)	1	1		2	2	2
		(iv)		Substitution: 1.5 <b>ecf</b> = $\frac{V}{2 \text{ ecf}}$ (1) Rearrangement: $V = 1.5 \times 2$ (1) = 3 [V] (1) <b>Alternative:</b> $2 \Omega = \frac{1}{3}$ of the total resistance (6 $\Omega$ ) (1) So $V = \frac{1}{3}$ of 9 V (1) = 3 [V] (1)	1	1 1		3	3	3

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			<p>Substitution: <math>P = VI = 9 \times 4.5</math>  <b>or</b> <math>P = I^2 R = 4.5^2 \times 2</math> <b>ecf from (a)(ii)</b> (1)  <math>= 40.5</math> [W] (1)</p> <p><b>Either for the 3<sup>rd</sup> mark:</b>  In 10 s, <math>E = P \times t = 40.5 \times 10 = 405</math> [J] so disagree  <b>Or:</b>  <math>P = \frac{E}{t} = \frac{45}{10} = 4.5</math> [W] so disagree</p> <p><b>Alternative:</b>  <math>P = \frac{45}{10}</math> (1)  <math>= 4.5</math> [W] (1)</p> <p><b>Either for the 3<sup>rd</sup> mark:</b>  <math>I = \frac{P}{V} = \frac{4.5}{9} = 0.5</math> [A] so disagree  <b>Or:</b>  <math>V = \frac{P}{I} = \frac{4.5}{4.5} = 1</math> [V] so disagree</p> <p>Conclusion must be present to award 3 marks</p>			3	3	3	3
				<b>Question 7 total</b>	<b>3</b>	<b>6</b>	<b>3</b>	<b>12</b>	<b>11</b>	<b>12</b>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			Unreliable / not always windy Don't accept reference to weather	1			1		
	(b)	(i)		Appliances are more efficient / more LED lamps being used / people reducing their energy costs / warmer year / homes more insulated	1			1		
		(ii)		Power output from hydro = 16 MW = 16 000 kW (1) for conversion No of homes supplied = $\frac{16\,000}{0.43}$ (1) = 37 209 [homes] (1) Accept 37 000, 37 200, 37 210 Award 2 marks for an answer of $3.7 \times 10^n$ where $n \neq 4$		3		3	3	
	(c)			Energy transferred is the same for both [pumping and generating] (1) But the energy out, is achieved in a shorter time <b>or</b> the energy in, is achieved in a longer time (1)			2	2		
				<b>Question 8 total</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>7</b>	<b>3</b>	<b>0</b>

## HIGHER TIER

### SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	Marks Available					
	AO1	AO2	AO3	Total	Maths	Prac
<b>1</b>	2	3	4	9	5	0
<b>2</b>	0	3	3	6	0	6
<b>3</b>	0	3	0	3	3	0
<b>4</b>	7	2	0	9	0	5
<b>5</b>	4	4	0	8	6	0
<b>6</b>	6	0	0	6	0	6
<b>7</b>	3	6	3	12	11	12
<b>8</b>	2	3	2	7	3	0
<b>Total</b>	<b>24</b>	<b>24</b>	<b>12</b>	<b>60</b>	<b>28</b>	<b>29</b>