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# GCSE MARKING SCHEME

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**SUMMER 2022**

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

## **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.

**GCSE SCIENCE (DOUBLE AWARD) – UNIT 3 – PHYSICS 1****HIGHER TIER****SUMMER 2022 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.

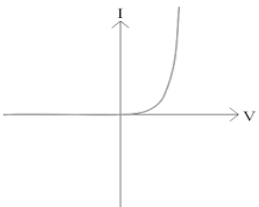
### Marking abbreviations

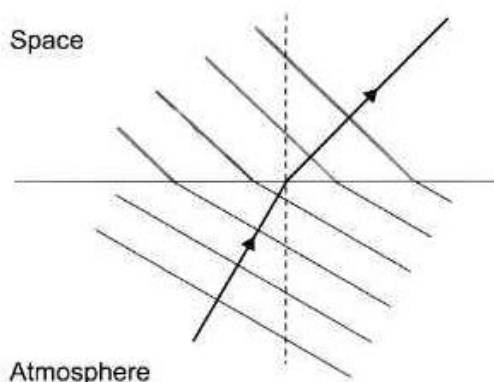
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	= correct answer only
ecf	= error carried forward
bod	= benefit of doubt

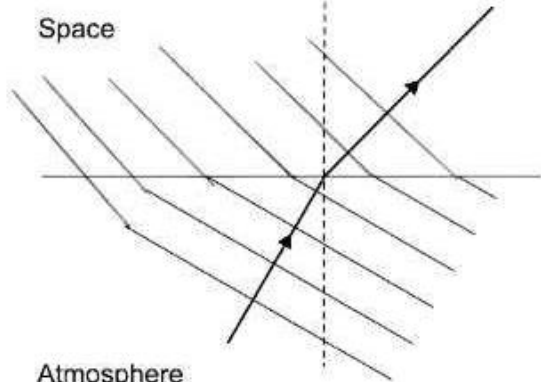
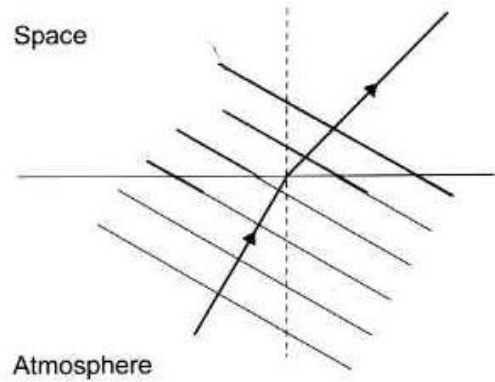
Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
1.	(a)		Variable resistor added in series with lamp (1) accept any size box with an arrow through it Voltmeter added in parallel with lamp (1)	2			2		2
	(b)	(i)	<p>When current is 0.5 [A] the voltage is <math>0.9 \pm 0.1</math> [V] (1)            When current is 1 [A] the voltage is <math>2.4 \pm 0.1</math> [V] (1)            Triple would give 2.7 [V] <b>or</b> this is not triple (1) so not true            To award 3 marks conclusion must be present</p> <p><b>Alternative 1:</b>            When the current doubles from 0.5 to 1 [A] (1)            The voltage changes from 0.9 to 2.4 [V] (1)            which is 2.7 times bigger <b>or</b> this is not triple (1) so not true            To award 3 marks conclusion must be present</p> <p><b>Alternative 2:</b>            When current is 1 [A] the voltage is <math>2.4 \pm 0.1</math> [V] (1)            When current is 2 [A] the voltage is <math>8.4 \pm 0.1</math> [V] (1)            Triple would give 7.2 [V] <b>or</b> which is 3.5 times bigger <b>or</b> this is not triple (1) so not true            To award 3 marks conclusion must be present</p> <p><b>Alternative 3:</b>            When the current doubles from 1 to 2 [A] (1)            The voltage changes from 2.4 to 8.4 [V] (1)            which is 3.5 times bigger <b>or</b> this is not triple (1) so not true            To award 3 marks conclusion must be present</p>			3	3		3

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
			<p><b>N.B. 1</b> When current is 0.5 [A] the voltage is 0.8 [V] (1) When current is 1 [A] the voltage is 2.4 [V] (1) This is 3 times bigger <b>or</b> this is triple (1) so true To award 3 marks conclusion must be present</p> <p><b>N.B. 2</b> When voltage triples from 2 [V] to 6 [V] (1) Current changes from 0.9 [A] to 1.7 [A] (1) This is not double (1) so not true To earn credit voltages must be within the range of 0.9 V to 8.4 V</p> <p><b>N.B.3</b> A correct conclusion based on incorrect voltage readings taken from the graph award 1 mark.</p>						
		(ii)	<p>Voltage = 12 [V] (1) Current = <math>2.25 \pm 0.05</math> [A] (1) both readings from graph Power = 27 [W] <b>or</b> 26.4 [W] <b>or</b> 27.6 [W] (1)</p>		3		3	3	3
(c)	(i)		<p>Substitution: <math>\frac{12}{6}</math> (1) = 2 [A] (1)</p>	1	1		2	2	2
		(ii)	<p>Straight line from origin through (12,2 <b>ecf</b>)</p>		1		1	1	1

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)	<p>Connect in series one way <b>and</b> see if lamp lights <b>or</b> the resistance will be low <b>or</b> current will be high (1)            Reverse the cell / battery / + and - / connection / box (1)            See if the lamp still lights <b>or</b> the resistance will be much higher <b>or</b> diode only lets current flow one way <b>or</b> current will be zero (very small) (1)</p> <p><b>Alternative:</b>            Replace lamp with sealed box / add in series [with lamp] (1)            Vary <math>R</math> and take series of reading of current and voltage (1)            Reverse box / polarity of cell and repeat step 2 (1)</p>			3	3		3
		(ii)	 <p>Don't accept S shapes or curve with a decreasing gradient</p>	1			1		1
			<b>Question 1 total</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>15</b>	<b>6</b>	<b>15</b>

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2.	(a)	(i)	Wavelength = 6 [cm]		1		1	1	
		(ii)	Conversion to m = 0.06 m (1) Substitution and manipulation: $f = \frac{3 \times 10^8}{0.06 \text{ ecf}}$ (1) $f = 5 \times 10^9$ [Hz] (1)  Award 2 marks If no conversion, answer of $f = 5 \times 10^7$ [Hz] Award 2 marks for answers of $5 \times 10^n$ where $n$ is not 9		3		3	3	
	(b)		Wavefronts perpendicular to direction (1) Longer wavelengths (1) 3 or more wavefronts joined at boundary (1) To earn any credit wavefronts must be travelling towards the top right corner  <b>Examples</b>  <b>3 marks</b>		3		3		



		 <p>Space</p> <p>Atmosphere</p> <p><b>3 marks</b> Only consider additions to the 4 wavefronts in contact with the boundary</p>						
		 <p>Space</p> <p>Atmosphere</p> <p><b>1 mark</b></p>						

			<p style="text-align: center;"><b>No marks</b></p>						
	(c)	(i)	<p>Satellite orbits in the same time / 24 hours (1) that it takes the earth to spin once (1) Accept for 1 mark they both orbit in 24 hours</p>	2			2		
		(ii)	<p>Total distance = <math>4 \times (1)</math> [<math>3.6 \times 10^7 = 14.4 \times 10^7</math> [m]] Substitution: <math>3 \times 10^8 = \frac{14.4 \times 10^7 \text{ ecf}}{\text{time}}</math> (1) Time = 0.48 [s] (1) Award 2 marks for answers of <math>48 \times 10^n</math> <b>or</b> 0.24 [s] Award 1 mark for answers of <math>24 \times 10^n</math> <b>or</b> 0.12 [s]</p>	1	1		3	3	
		(iii)	<p>Distance travelled would be the same <b>or</b> both have 4 steps <b>or</b> still use 2 satellites [so disagree]</p>			1	1		
			<b>Question 2 total</b>	<b>3</b>	<b>9</b>	<b>1</b>	<b>13</b>	<b>7</b>	<b>0</b>

Question		Marking details		Marks Available						
				AO1	AO2	AO3	Total	Maths	Prac	
3.	(a)			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) Earth wire is for protection (or <u>prevents</u> shocks or electrocution) [if live wire touches the metal casing of an appliance] <b>or</b> provides a [low resistance] path to ground <b>or</b> takes current away from appliance when a fault occurs (1)	3			3		
	(b)			mcb trip if a current is too large (1) rccb trips when imbalance in current between the live and neutral wires (1) mcb protect the circuit <b>or</b> rccb protects people (1) Accept mcb prevents overheating or protects the appliance. rccb prevents electric shocks	3			3		
				<b>Question 3 total</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>	<b>0</b>

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	<p><b>Any 3 × (1) from:</b>            Particles vibrate (1)            More <b>or</b> faster (1)            collide with neighbours <b>or</b> pass on energy to neighbours (1)            Free electrons (1)            [free] <u>electrons</u> increase in kinetic energy <b>or</b> move faster (1)  <u>Electrons</u> pass on the energy as they move through the lattice <b>or</b>  <u>electrons</u> collide with the lattice owtte (1)</p>	3			3		
	(b)	<p><b>Any 2 × (1) from:</b>            Convection [currents] (1)            Heated liquid rises [from solar panel] (1)            Hot liquids are less dense (1)            Accept cold liquids fall (1) and cold liquids are more dense (1)</p>		2		2		
	(c)	<p><math>960 \times 2 = 1920</math> (1)  <math>1920</math> (<b>ecf</b>) <math>\times \frac{1}{3} = 640</math> [J] (1)</p> <p><b>Alternative:</b>  <math>\frac{960}{3} = 320</math> (1)  <math>320</math> <b>ecf</b> <math>\times 2 = 640</math> [J] (1)</p> <p>Award 1 mark for answer of 576 [J]</p>		2		2	2	
		<b>Question 4 total</b>	<b>3</b>	<b>4</b>	<b>0</b>	<b>7</b>	<b>2</b>	<b>0</b>

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5.			<p><b>Indicative content:</b></p> <p><b>Generation</b> Gas is burned to heat water. Steam turns a turbine which is connected to a generator which produces electricity as it rotates.</p> <p><b>Efficiency</b> The output from a power station is connected to a step-up transformer. This increases the voltage and decreases the current. Lower current through cables means less energy loss as heat.</p> <p><b>Safety</b> A step-down transformer reduces voltage before it is supplied to consumers. Lower voltages are safer.</p> <p><b>5–6 marks</b> Comprehensive description of generation, efficiency and safety. <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><b>3–4 marks</b> Comprehensive description of two of the three areas: generation, efficiency and safety OR limited description of all 3 areas. <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><b>1–2 marks</b> Comprehensive description of one of the three areas: generation, efficiency and safety OR limited description of 1 or 2 areas. <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 5 total</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>	<b>0</b>	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6.	(a)	(i)	Reduction in units = $15\,000 - 3\,000 = 12\,000$ [kWh] (1) Reduction in cost = $12\,000 \text{ ecf} \times 20 = 240\,000$ [p] (1) Conversion to £ = [£]2 400 (1)  <b>Alternative:</b> $15\,000 \times 20 = 300\,000$ [p] (1) $3\,000 \times 20 = 60\,000$ [p] (1) Saving = $3\,000 \text{ ecf} - 600 \text{ ecf} = [£]2\,400$ (1)  Award 2 marks for answers of $2.4 \times 10^n$ where $n$ is not 3		3		3	3	
		(ii)	Payback time = $\frac{152\,400}{2\,400 \text{ ecf}} = 63.5$ [months] accept 64 [months]		1		1	1	
	(b)	(i)	Selection and substitution into efficiency equation: $\frac{1.9}{5.3} (1) [x 100]$ (1) % efficiency = 35.849 <b>or</b> 35.8 <b>or</b> 35.85 <b>or</b> 36 <b>or</b> 40 (1) Award 1 mark for 0.36 or 0.4		2		2	2	
		(ii)	Weekly mass of dung = $150 \times 60 = 9\,000$ [kg/week] (1) Weekly volume of gas = $9\,000 \text{ (ecf)} \times 0.05 = 450$ [m <sup>3</sup> ] (1) Weekly number of kWh = $450 \text{ (ecf)} \times 1.9 = 855$ [kWh] (1) Annual number of kWh = $855 \text{ (ecf)} \times 52$ (1) = 44 460 <b>(ecf)</b> [kWh] [so farmer is incorrect] (1)			5	5	5	

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
	<p><b>Alternative 1</b>  Weekly mass of cow dung = 9 000 [kg] (1)  Yearly mass of cow dung = 468 000 (ecf) (1)  Gas/year = 468 000 (ecf) <math>\times</math> 0.05 = 23 400 (1)  Units/year 23 400 (ecf) <math>\times</math> 1.9 (1)  = 44 460 (ecf) [kWh] (1) [so incorrect]</p> <p><b>Alternative 2</b>  Weekly gas/cow = 60 <math>\times</math> 0.05 = 3 (1)  Weekly units/cow = 3 (ecf) <math>\times</math> 1.9 = 5.7 (1)  Weekly units for herd of cows = 5.7(ecf) <math>\times</math> 150 = 855 (1)  Units/year = 855 (ecf) <math>\times</math> 52 (1)  = 44 460 (ecf) [kWh] (1) [so incorrect]</p> <p><b>Alternative 3</b>  Weekly units required = <math>\frac{144\,000}{52} = 2\,769.23</math> (1)  Weekly volume of gas required = <math>\frac{2\,769.23\text{ ecf}}{1.9} = 1\,457.5</math> (1)  Weekly mass of dung required = <math>\frac{1\,457.5\text{ ecf}}{0.05} = 29\,149.8</math> (1)  Number of cows required = <math>\frac{29\,149.8\text{ ecf}}{60}</math> (1)  = 486 (ecf) (1) [so incorrect]</p> <p>Accept for 4 marks a final answer of 148 200 [kWh]  Common answer 235 638 award 4 marks or 296.4 award 4 marks  also or 124 020</p>						



Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			<p><b>Any 2 × (1) from:</b>            It reduces the amount of <u>methane</u> added to the atmosphere (1)  <u>Methane</u> [into the atmosphere] is replaced with carbon dioxide or less harmful gas (1)  <u>Methane</u> has a bigger impact on the greenhouse effect (1)            so <u>better</u> to use <u>methane</u> as a fuel <b>or</b> <u>better</u> to burn <u>methane</u> (1)            using the methane (or biogas) reduces demand for other fossil fuels (1)</p>	2			2		
<b>Question 6 total</b>					<b>2</b>	<b>6</b>	<b>5</b>	<b>13</b>	<b>11</b>	<b>0</b>

## HIGHER TIER

## SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	5	6	15	6	15
2	3	9	1	13	7	0
3	6	0	0	6	0	0
4	3	4	0	7	2	0
5	6	0	0	6	0	0
6	2	6	5	13	11	0
<b>TOTAL</b>	<b>24</b>	<b>24</b>	<b>12</b>	<b>60</b>	<b>26</b>	<b>15</b>