GCSE MARKING SCHEME

SUMMER 2019

PHYSICS UNIT 3 HIGHER (DOUBLE AWARD)
3430UC0-1

INTRODUCTION

This marking scheme was used by WJEC for the 2019 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

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)		Ticks in boxes 1, 5 and 6 Television 1 uses less energy per second than television 2 ✓ Television 3 uses 40 units more per year than television 4 ✓ Televisions with the same energy rating, e.g A++, don't always have the same power ✓ –1 mark for each additional box ticked		3		3		
	(b)			**N.B. Only televisions 1 and 2 to be used.** **1st mark – correct substitution of one ratio** **2nd mark – correct calculation of one ratio** **3rd mark – correct calculation of 2nd ratio** **3 marks to be awarded only if correct conclusion present** Screen size to screen size compared with power to power $\frac{139}{69} = 2.01 \quad \frac{78}{32} = 2.44$ **OR** $\frac{69}{139} = 0.50 \quad \frac{32}{78} = 0.41$ Conclusion – [Ratios not the same] so not true **Alternative** Ratio of screen size to power compared $\frac{69}{32} = 2.16 \quad \frac{139}{78} = 1.78$ **OR** $\frac{32}{69} = 0.46 \quad \frac{78}{139} = 0.56$ Conclusion – [Ratios not the same] so not true **Alternative** Ratio of screen size to kWh per year compared $\frac{69}{47} = 1.47 \quad \frac{139}{108} = 1.29$			3	3	3	

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
				OR $\frac{47}{69} = 0.68 \quad \frac{108}{139} = 0.78$ Conclusion – [Ratios not the same] so not true **Alternative:** Screen size to screen size compared with kWh per year to kWh per year $\frac{69}{139} = 0.50 \quad \frac{47}{108} = 0.44$ **OR** $\frac{139}{69} = 2.01 \quad \frac{108}{47} = 2.30$ Conclusion – [Ratios not the same] so not true						
	(c)	(i)		Time = $\frac{108}{\left(\frac{78}{1000}\right)}$ (1) substitution [even for $\frac{108}{78}$] Time = 1 384.6 [hours] (1) correct answer correctly rounded Answer = 1.38×10^{n} where n is not 3 award 1 mark only	1	1		2	2	

<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></td><td></td><td>(ii)</td><td></td><td>Cost = 108 × 16 or 108 × 0.16 (1) substitution
Cost = £17.28 (1) answer
Accept £17 or £17.00</td><td>1</td><td>1</td><td></td><td>2</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Running cost of TV 2 for 10 years = £17.28 (ecf) × 10 = £172.80 (1) Accept £170 or £172 or £173
Running cost of TV 4 for 10 years = 172 × 10 × 0.16 = £275.20 (1) Accept £275
TV 4 costs £102.40 more to run but it is £200 cheaper to buy so Sarah is right (1)

Alternative:
Annual savings from using TV 2 = (172 - 108) × 0.16 = £10.24 (1)
Running cost = £10.24 × 10 = £102.40 (1) OR
Difference in units over 10 years (172 - 108) × 10 = 640 (1)
Difference in running cost = 640 × 0.16 = £102.40 (1)
3rd mark - TV 4 costs £102.40 more to run but it is £200 cheaper to buy so Sarah is right (1)

Alternative:
Total cost of TV 2 = £172.80 ecf (1) + £1 000 = £1 172.80 (1)
Total cost of TV 4 = £1 075.20 so cheaper so Sarah is right (1)
OR
Total cost of TV 4 = £275.20 (1) + £800 = £1 075.20 (1)
Total cost of TV 2 = £1 172.80 so more expensive so Sarah is right (1)

Alternative:
Annual savings from using TV 2 = (172 - 108) × 0.16 = £10.24(1)
Payback time = $\frac{200}{10.24}$ (1) = 19.5 years which is longer than 10 years so Sarah is right (1)</td><td></td><td></td><td>3</td><td>3</td><td>2</td><td></td></tr>
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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		Fewer power stations / less fuel burnt (1) Reducing CO_2 emissions / reducing impact on global warming / reduces carbon footprint (1)	2			2		
				Question 1 total	**4**	**5**	**6**	**15**	**9**	**0**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
2	*(a)*			At least 2 wavefronts with a smaller wavelength (1) At least 1 wavefront joined to those in deep water (1) **N.B. Refracted rays must be going in the correct direction to award any marks i.e. bottom RH corner**		2		2		
	(b)			Selection of: $v = f\lambda$ (1) Wavelength measured to be 1.2 [cm] or 12 [mm] **or** frequency = 0.5 [Hz] (1) v = 0.5 × 0.012 = 0.006 [m/s] (1) cao **Alternative:** Selection of: $\text{speed} = \frac{\text{distance}}{\text{time}}$ (1) Wavelength measured to be 1.2 [cm] or 12 [mm] **or** distance = 6 [cm] or 60 [mm] (1) $\text{speed} = \frac{0.060}{10}$ = 0.006 [m/s] (1) cao	1	1 1		3	2	
	(c)			Frequency same in both regions (1) Wavelength longer in deep / shorter in shallow (1) Wave speed greater in deep / smaller in shallow (1)	3			3		
				Question 2 total	**4**	**4**	**0**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3				**Indicative content:** Determine the mass (g) of the dry pebble using a balance. Place a suitable volume of water into an empty measuring cylinder ensuring that there is space left for the pebble. Record the volume in cm^3. Carefully place the pebble into the measuring cylinder and determine the new volume. Calculate the volume of the pebble by subtracting the volume of the water from the volume of the water + the pebble. Determine the density using the formula: $\text{density} = \dfrac{\text{mass}}{\text{volume}}$ Give the answer with a suitable unit e.g. g / cm^3. **5-6 marks** Fully describes the method in a logical way which could be followed. *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.*	6			6		6

Question				Marking details	Marks Available AO1	AO2	AO3	Total	Maths	Prac
				3-4 marks Describes most of the method but may be unclear about which measuring instruments are used or how the data is processed. *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.* **1-2 marks** Describes how to make a measurement or how to calculate density. *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**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*	(i)		Suitable scales, e.g. 0, 20, 40, 60 on the x-axis and 0, 2, 4, 6 on the y-axis (1) 5 points correctly plotted ± < 1 small square (2) 4 points correctly plotted ± < 1 small square (1) 3 points or less correctly plotted ± < 1 small square (0) Smooth curve of best fit ± < 1 small square (1)	1	2 1		4	4	4
		(ii)		As temperature increases resistance decreases (1) at a decreasing rate (1)		2		2		2
	(b)	(i)		Resistance correct from their graph (1) e.g. 8 [kΩ] $\frac{1}{R} = \frac{1}{8} + \frac{1}{5}$ (1) substitution R = 3.08 [kΩ] (1) $V = IR$ $12 = I \times 3.08 \times 10^3$ **ecf** on R (1) substitution $I = \frac{12}{3.08 \times 10^3}$ = 0.0039 [A] (1) **ecf** Answer of 3.9×10^n where n is not -3 award 4 marks **Alternative** [for marks 2 – 5] $I = \frac{V}{R} = \frac{12}{5}$ [= 2.4 mA] (1) substitution $I = \frac{V}{R} = \frac{12}{8}$ = [1.5 mA] (1) substitution Total I = 2.4 + 1.5 = 3.9 [mA] (1) **ecf** addition of currents I = 0.0039 [A] (1)	1 1	1 1 1		5	5	5

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Resistance of the thermistor increases (1) So current [through the thermistor] decreases (1) But current through the resistor is unchanged (1) So she is (partially) wrong / correct for one but not the other To award full marks the conclusion must be present			3	3		3
				Question 4 total	**3**	**8**	**3**	**14**	**9**	**14**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			Fuel is <u>burned</u> to heat <u>water</u> [to make steam] (1) [Kinetic energy] of <u>steam</u> turns or drives or rotates a <u>turbine</u> (1) [Turbine turns or drives] <u>generator</u> producing electricity (1) Don't accept moves or pushes.	3			3		
	(b)			Useful power = $\frac{3.2}{40}\times 100 = 8$ [MW] (1) 8 MW = 75 % (1) So total input = $\frac{8}{75}\times 100 = 10.7$ [MW] (1) so she is not correct - to award full marks the conclusion must be present **Alternative:** 40 % of 75 % = 30 % (1) 30 % = 3.2 [MW] (1) so total input = $\frac{3.2}{30}$ x 100 = 10.7 [MW] (1) so she is not correct - to award full marks the conclusion must be present **Alternative:** $\frac{75}{100}$ x 20 = 15 [MWh] (1) $\frac{40}{100}$ x 15 = 6 [MWh] (1) which is not 3.2 [MWh] (1) so she is not correct - to award full marks the conclusion must be present **Alternative:** $\frac{3.2}{20}$ x 100 = 16 [%] (1) 40 % of 75 % = 30 % (1)			3	3	3	

				16 is not equal to 30 % (1) so she is not correct - to award full marks the conclusion must be present						
	(c)			$I = \frac{P}{V}$ (1) manipulation $I = \frac{1200}{400}$ (1) substitution I = 3 000 [A] (1) answer Answer = 3×10^n where n is not 3 award 2 marks	1	1 1		3	3	
				Question 5 total	**4**	**2**	**3**	**9**	**3**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*			**Similarity** – both have the same orbit time [of 24 hrs] (1) **Difference** – an object in geosynchronous orbit returns to the same point in the sky every 24 hours - an object in geostationary orbit always stays in the same position above the Earth - geostationary always orbits above the equator or converse (1)	2			2		
	(b)	(i)		[Satellite] 3		1		1		
		(ii)		$3\times10^{8}=\frac{\text{distance}}{0.48}$ (1) substitution Distance = $0.48 \times 3 \times 10^{8}$ (1) rearrangement Distance = 1.44×10^{8} [m] (1) answer	1	1 1		3	3	
		(iii)		$\frac{1.44\times10^{8}\,\text{ecf}}{36\,000\,000\,\text{ecf}}$ = 4 (1) units must be consistent to award the mark So arrives at base station C (1) workings must be shown to award this mark If satellite 3 is not chosen in part (i) expect the following values – Satellite 1 = 6.71 award only 1 mark Satellite 2 = 6 (1) so arrives at A (1) Satellite 4 = 284 (1) so arrives at B (1) Satellite 5 = 132 (1) so arrives at A (1) Satellite 6 = 7.13 award only 1 mark		1 1		2	1	
				Question 6 total	**3**	**5**	**0**	**8**	**4**	**0**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	5	6	15	9	0
2	4	4	0	8	2	0
3	6	0	0	6	0	6
4	3	8	3	14	9	14
5	4	2	3	9	3	0
6	3	5	0	8	4	0
TOTAL	24	24	12	60	27	20