



GCSE MARKING SCHEME

SUMMER 2019

**PHYSICS UNIT 3 FOUNDATION (DOUBLE AWARD)
3430U30-1**

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****Foundation 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)		Mass of bone	32 [g]	(1)						
				Volume of bone	8 [cm ³]	(1)		2		2		2
		(ii)		Density = $\frac{\text{mass}}{\text{volume}} = \frac{32 \text{ (g)}}{8 \text{ (cm}^3\text{)}} \text{ (ecf) (1)}$ $= 4 \text{ [g/cm}^3\text{]} \text{ (1)}$ Answer = 0.47 [g/cm ³] for a volume of 68 cm ³ ecf award 2 marks			1	1		2	2	2
	(b)			Particles in bone [more] tightly packed or particles in bone have a greater mass (1) so there is more mass in the same volume (1)			1	1		2		
				Question 1 total			2	4	0	6	2	4

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Turbine	1			1		
		(ii)		Furnace → bottom (chemical energy to thermal (heat) energy) (1) Generator → top (kinetic energy to electrical energy) (1) Deduct 1 mark for each extra line	2			2		
	(b)			$\% \text{ efficiency} = \frac{4\,500}{15\,000} \times 100 \text{ (1)}$ $= 30 \text{ (1)}$ Answer of 0.3 award 1 mark only		2		2	2	
				Question 2 total	3	2	0	5	2	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Refraction	1			1		1
	(b)			Tick in box 3 i.e. the wave speed is less in shallow water (1) Tick in box 4 i.e. the wavelength decreases as the waves pass from deep to shallow water (1) More than two ticks → -1 per additional tick.	2			2		2
	(c)			Wave speed = 3×5 (1) substitution = 15 [cm/s] (1)	1	1		2	2	
				Question 3 total	4	1	0	5	2	3

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	No or zero CO ₂ Accept no carbon Don't accept less carbon		1		1		
		(ii)	7 000 (1) × 2.5 = 17 500 [g] (1) Answer = 1.75 × 10 ⁿ where n is not equal to 4 award 1 mark only		2		2	2	
	(b)	(i)	4 × 6 × 0.4 (1) = 9.6 [kg] (1) Answer = 24 or 1.6 or 2.4 [kg] award 1 mark only		2		2	2	
		(ii)	The table states no CO ₂ is produced [over 100 km] (1) but CO ₂ produced [at power station] during charging is not counted (1)			2	2		
	(c)		Cost of using petrol = 6 × 7 × 120 = 5 040 [p] (1) Cost of using Voltsa = 4 × 264 = 1 056 [p] (1) so disagree with Ian The conclusion must be present to award 2 marks			2	2	2	
Question 4 total				0	5	4	9	6	0

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
5	(a)	<p>Indicative content:</p> <p>Names: The electromagnetic spectrum includes radio waves, microwaves, infra-red, visible light, ultraviolet, X-rays and gamma rays.</p> <p>Similarities: They are all transverse waves. All regions of the electromagnetic spectrum transfer energy and also transmit information. They all travel at the same speed in space.</p> <p>Differences: Gamma rays have the shortest wavelength and highest frequency/energy. They have different uses (some maybe stated) and different ionising properties.</p> <p>5-6 marks All parts named, similarities and differences correctly identified. <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 Addresses 2 areas well out of parts named, similarities and differences correctly identified OR limited description provided of each area. <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 Addresses 1 area well out of parts named, similarities and differences correctly identified OR limited description provided of up to 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>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)			Ammeter in series (1) With thermistor (1) Voltmeter in parallel with thermistor (1) CORRECT SYMBOLS ONLY	3			3		3
	(b)	(i)		5 points plotted correctly $\pm < 1$ small square (2) 4 points plotted correctly $\pm < 1$ small square (1) 3 or less points plotted correctly $\pm < 1$ small square (0) Smooth curve $\pm < 1$ small square (1) Don't accept wispy, double, disjointed, dot to dot curves		3		3		3
		(ii)		Decrease (1) at decreasing rate (1)		2		2		2
	(c)	(i)		From candidate's graph $\pm < 1$ small square expect 3 600 – 3 900 [Ω]		1		1		1
		(ii)		Selection of: $\text{current} = \frac{\text{voltage}}{\text{resistance}}$ (1) Substitution (1) $\frac{12}{\text{answer from (i)}}$ = correct answer (1) If resistance 3 600 [Ω] then 0.0033 [A] 3 700 [Ω] then 0.0032 [A] 3 800 [Ω] then 0.0032 [A] 3 900 [Ω] then 0.0031 [A] 4 000 [Ω] then 0.0030 [A] Accept answer in mA if correct and unit changed If no workings shown answers of 3.3 [A] etc award 2 marks only	1 1			3	2	
	(d)			Resistance changes by 5 400 – 1 400 (1) = 4 000 [Ω] (1) so it is suitable Award 2 marks only if the conclusion is present			2	2		
				Question 6 total	5	7	2	14	2	9

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	Ticks in boxes 1, 5 and 6 (3) 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)		<p>N.B. Only televisions 1 and 2 to be used.</p> <p>1st mark – correct substitution of one ratio</p> <p>2nd mark – correct calculation of one ratio</p> <p>3rd mark – correct calculation of 2nd ratio</p> <p>3 marks to be awarded only if correct conclusion present</p> <p>Screen size to screen size compared with power to power</p> $\frac{139}{69} = 2.01 \quad \frac{78}{32} = 2.44$ <p>OR</p> $\frac{69}{139} = 0.50 \quad \frac{32}{78} = 0.41$ <p>Conclusion – [Ratios not the same] so not true</p> <p>Alternative</p> <p>Ratio of screen size to power compared</p> $\frac{69}{32} = 2.16 \quad \frac{139}{78} = 1.78$ <p>OR</p> $\frac{32}{69} = 0.46 \quad \frac{78}{139} = 0.56$ <p>Conclusion – [Ratios not the same] so not true</p> <p>Alternative</p> <p>Ratio of screen size to kWh per year compared</p> $\frac{69}{47} = 1.47 \quad \frac{139}{108} = 1.29$ <p>OR</p>			3	3	3	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
			$\frac{47}{69} = 0.68$ $\frac{108}{139} = 0.78$ Conclusion – [Ratios not the same] so not true Alternative: Screen size to screen size compared with kWh per year to kWh per year $\frac{69}{139} = 0.50$ $\frac{47}{108} = 0.44$ OR $\frac{139}{69} = 2.01$ $\frac{108}{47} = 2.30$ 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	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	Cost = 108×16 or 108×0.16 (1) substitution Cost = £17.28 (1) answer Accept £17 or £17.00	1	1		2	2	
		(iii)	Running cost of TV 2 for 10 years = $£17.28$ (ecf) $\times 10 = £172.80$ (1) Accept £170 or £172 or £173 Running cost of TV 4 for 10 years = $172 \times 10 \times 0.16 = £275.20$ (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 = $(172 - 108) \times 0.16 = £10.24$ (1) Running cost = $£10.24 \times 10 = £102.40$ (1) OR Difference in units over 10 years $(172 - 108) \times 10 = 640$ (1) Difference in running cost = $640 \times 0.16 = £102.40$ (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 = $(172 - 108) \times 0.16 = £10.24$ (1) Payback time = $\frac{200}{10.24}$ (1) = 19.5 years which is longer than 10 years so Sarah is right (1)			3	3	2	

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 7 total	4	5	6	15	9	0

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	4	0	6	2	4
2	3	2	0	5	2	0
3	4	1	0	5	2	3
4	0	5	4	9	6	0
5	6	0	0	6	0	0
6	5	7	2	14	2	9
7	4	5	6	15	9	0
TOTAL	24	24	12	60	23	16