GCSE MARKING SCHEME

SUMMER 2024

GCSE
PHYSICS - UNIT 2 (HIGHER TIER)
3420UB0-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCSE PHYSICS

UNIT 2 – FORCES, SPACE AND RADIOACTIVITY

HIGHER TIER

SUMMER 2024 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)		Aberystwyth has less radon than Penzance but more than Chester (1) OWTTE and the pie chart for location A has less radon than location C but more than location B (1) [so Adam is correct]			2	2		
		(ii)	I	$\frac{30}{60}$ = 0.5 [cps]		1		1	1	1
			II	15		1		1	1	1
		(iii)		Man-made sources are only 14.3% or 14.5% (1) this is lower than natural sources (1) ORA so disagree Conclusion must be present to award both marks **OR** Radon [is a natural source and it] is 50% (1) So man-made sources can't be more than 50% (1) so disagree Conclusion must be present to award both marks **OR** Correctly named sources of natural radiation are stated with percentage stated (1) So there is a larger proportion from natural sources (1) so disagree Conclusion must be present to award both marks			2	2		
	(b)	(i)		Attempt at adding her total dose (1) Total dose is 2.7 + 0.18 + 2 × 0.09 + 0.005 + 6.6 = 9.665 [units] [this is less than 20] so it is still safe [for her to work with radiation] (1)			2	2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		{16 hours of flying / 2 flights} (1) gives the same [exposure] as a power station worker [gets in one year] (1) [so disagree] **OR** 3 or more flights **or** more than 24 hours of flying (1) gives more [exposure] than a power station worker [gets in one year] (1) [so disagree] Accept: In 1 year airline pilots receive 32.85 [units] (1) gives more [exposure] than a power station worker [gets in one year] (1) [so disagree]			2	2		
				Question 1 total	**0**	**2**	**8**	**10**	**3**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		[Freya is incorrect,] there is an anomaly (1) and should not be included (1) Award 1 mark for $\frac{7.6+8.0}{2} = 7.8$ [s]			2	2	1	2
		(ii)		Data is not repeatable because repeats are quite far apart (1) **OR** It is repeatable because the repeats are close to each other (1) **OR** It is repeatable apart from 20 cm (1)			1	1		1
	(b)			Timing [moving object] **or** reaction time **or** difficult to {start / stop} the stopwatch on time (1) Accept human error only if qualified Use a slow-motion camera **or** increase the drop height (1) accept record it / video it / light gates. Don't accept use lasers or use your phone Accept reference to keeping the volume of oil constant OWTTE		1	1	2		2
	(c)	(i)		Between 6.8 [s] and 7.2 [s]		1		1	1	1
		(ii)		$\frac{53-30}{12-9}$ (1) = 7.67 **or** 7.7 [cm/s] (1)		2		2	2	2
		(iii)		Decreases (1) To zero (1) **Alternative:** Starts high (1) Then it stops accelerating (1)		2		2		2
				Question 2 total	**0**	**6**	**4**	**10**	**4**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Substitution: $3 \times 10^8 = \frac{\text{distance}}{870 \times 31536000}$ (1) Rearrangement: distance = $3 \times 10^8 \times 870 \times 31\,536\,000$ (1) Distance = 8.23×10^{18} [m] (1) Award 2 marks for answer of 8.23×10^n [m] where n isn't 18 Award 2 marks for answer of 2.61×10^{11} [m] Award 2 marks for answer of 9.46×10^{15} [m] Award 1 mark for answer of 2.61×10^n [m] where n isn't 11 Award 1 mark for answer of 9.46×10^n [m] where n isn't 15 Award 1 mark for answer of 2.74×10^{10} [m]	1	1 1		3	3	
	(b)	(i)		Supergiant (1) Supernova (1) Neutron star **or** black hole (1)	3			3		
		(ii)		Heavy elements {released / returned to space} (1) during supernova (1)	2			2		
		(iii)		Cloud of gas **and** dust (1) collapsed due to gravity OWTTE (1)	2			2		
				Question 3 total	**8**	**2**	**0**	**10**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Substitution: $35 \times 10 \times 0.8$ (1) PE = 280 [J] (1)	1	1		2	2	
		(ii)		280 [J] **ecf**		1		1		
		(iii)		Substitution: 280 **ecf** = $\frac{1}{2} \times 35 \times v^2$ (1) Rearrangement: $v^2 = \frac{2 \times 280}{35}$ (1) v = 4 [m/s] (1) Answer of 16 only award 2 marks **Alternative:** Substitution into: $v^2 = u^2 + 2ax$ i.e. v^2 = 0 (1) + $2 \times 10 \times 0.8$ (1) v = 4 [m/s] (1)	1	1 1		3	3	
	(b)	(i)		Selection of $x = ut + \frac{1}{2} at^2$ (1) x = [0 +] $\frac{1}{2} \times 10 \times 0.5^2$ (1) x = 1.25 [m] (1)	1 1	1		3	3	
		(ii)		Substitution and rearrangement: $\frac{6.4}{3.0}$ (1) F = 2.1 [N] (1)		2		2	2	
				Question 4 total	**4**	**7**	**0**	**11**	**10**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		[Atoms of] the same <u>element</u> with the same number of protons (1) different number of neutrons **or** different mass number **or** different nucleon number (1) Don't accept same number of protons and neutrons or different number of protons and neutrons	2			2		
		(ii)		Due to an imbalance between number of protons and neutrons **or** they have unstable nuclei	1			1		
	(b)			Only alpha blocked by the smoke [so caesium not suitable] (1) ORA It has a much longer half-life [than radium] (1) ORA so it will not need frequent replacing **or** lasts long enough (1)		3		3		
	(c)	(i)		Initial activity = 75 × 16 = 1200 [MBq] (1) Sequence of halving from 1200 shown i.e. 1200 - 600 - 300 -150 - 75 - 37.5 leading to 5 half-lives (1) 5 × 60 = 300 [days] (1) Answer only of ½ award 1 mark		3		3	3	
		(ii)		Gamma is [very] penetrating [so could expose people] (1) and can damage <u>cells</u> **or** is [weakly] ionising (1)		2		2		
				Question 5 total	**3**	**8**	**0**	**11**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Indicative content:** In the fission reaction 1 neutron is absorbed by each uranium nucleus causing fission which gives rise to 3 further neutrons. These can then cause further fissions and even more neutrons so the reaction is uncontrolled. The moderator slows down fast-moving neutrons. This is so that they can be absorbed by the uranium nuclei and allow fission to occur. Control rods absorb neutrons so that on average each fission reaction leads to one further fission. They can be raised and / or lowered to control the rate of the reaction. **5 – 6 marks** Comprehensive description of all 3 areas. *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** Comprehensive description of 2 of the 3 areas **or** limited description of all 3. *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** Limited description of 1 or 2 of the 3 areas. *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.*	6			6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		${}^{2}_{1}\mathrm{H}(1) + {}^{3}_{1}\mathrm{H}(1) \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}(1)$ for the RHS		3		3		
		(ii)		Waste products not radioactive **or** more energy produced [per reaction] **or** fuel readily available **or** no chance of an uncontrolled reaction		1		1		
				Question 6 total	**6**	**4**	**0**	**10**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		CMBR (1) Red shift (1)	2			2		
		(ii)		**Any 2 × (1) from:** – The galaxy is moving away from us – Light is stretched – It has travelled through expanding space **or** universe is expanding	2			2		
	(b)			It contains hydrogen **or** it doesn't contain carbon (1) All the lines match up for hydrogen **or** not all of the lines match up for carbon (1) so disagree / partially agree If only one element discussed conclusion must be present to award both marks			2	2		
				Question 7 total	**4**	**0**	**2**	**6**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		Mass	1			1		
		(ii)		Body at rest remains at rest, body in motion remains at {constant velocity / constant speed in a straight line} (1) unless {resultant / external / unbalanced} force acts (1) OWTTE	2			2		
	(b)	(i)		[Applied] force - accept {mass / weight} of the hanger	1			1		1
		(ii)		Acceleration	1			1		1
		(iii)		Total mass **or** surface **or** the distance travelled	1			1		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		When force doubles [from 0.5 to 1.0] (1) acceleration [roughly] doubles from 0.310 to 0.619 (1) so agree Conclusion must be present to award both marks **Or** When force triples [from 0.5 to 1.5] (1) acceleration [roughly] triples from 0.310 to 0.931 (1) so agree Conclusion must be present to award both marks **Or** using ratios: 1 mark for 1 ratio correctly calculated 2 marks for 2 ratios correctly calculated with so agree i.e. $\frac{0.310}{0.5} = 0.62$; $\frac{0.619}{1.0} = 0.62$; $\frac{0.931}{1.5} = 0.62$ or reciprocals Conclusion must be present to award both marks **Or** An increase of 0.5 [N] (1) Produces an increased acceleration of approximately 0.310 [m/s^2] each time (1) Conclusion must be present to award both marks			2	2	2	2
		(v)	I	0.5 = $m \times 0.310$ (1) $m = \frac{0.5}{0.310}$ (1) m = 1.61 or 1.6 [kg] (1)	1	1 1		3	3	3
			II	Use a balance to determine the mass of the trolley and the slotted masses		1		1		1
				Question 8 total	**7**	**3**	**2**	**12**	**5**	**9**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	0	2	8	10	3	0
2	0	6	4	10	4	10
3	8	2	0	10	3	0
4	4	7	0	11	10	0
5	3	8	0	11	3	0
6	6	4	0	10	0	0
7	4	0	2	6	0	0
8	7	3	2	12	5	9
Total	**32**	**32**	**16**	**80**	**28**	**19**