GCSE MARKING SCHEME

SUMMER 2023

GCSE
PHYSICS – UNIT 2 (FOUNDATION TIER)
3420U20-1

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.

WJEC GCSE PHYSICS

UNIT 2 – FORCES, SPACE AND RADIOACTIVITY

FOUNDATION TIER

SUMMER 2023 MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

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)			<table><tr><th>N1</th><th>N2</th><th>N3</th></tr><tr><td>✓</td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td>✓</td><td></td><td></td></tr><tr><td></td><td></td><td>✓</td></tr></table> **Award 1 mark for each correct row** Ignore any ticks in row 1 More than 1 tick in a row no marks can be awarded	3			3		
	(b)	(i)		Substitution: v = [0 +] 10 × 1.2 (1) = 12 [m/s] (1)	1	1		2	2	
		(ii)		Substitution: $x = \frac{[0+]12\ (\mathbf{ecf})}{2} \times 1.2$ (1) = 7.2 [m] (1)	1	1		2	2	
				Question 1 total	**5**	**2**	**0**	**7**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Box 2 i.e. $^{133}_{55}Cs$		1		1		
	(b)	(i)		Box 3 i.e. the number of neutrons and protons is unbalanced	1			1		
		(ii)		Box 2 i.e. $^{0}_{-1}\beta$	1			1		
		(iii)		Box 3 i.e. It is a high energy electron	1			1		
	(c)	(i)		80		1		1	1	
		(ii)		Activity will be a quarter / 40 (1) **ecf** because 2 half-lives / halves again / it is another 30 years (1) so disagree Conclusion must be present to award 2 marks Award 2 marks for: 160 to 80 to 40 so disagree			2	2		
				Question 2 total	**3**	**2**	**2**	**7**	**1**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Extraction of any correct pair of readings from the graph e.g. $\frac{8}{0.20}$(1) $= 40$ [N/m] (1)		2		2	2	2
	(b)	(i)	I	C			1	1	1	1
			II	E			1	1	1	1
			III	E			1	1	1	1
			IV	D			1	1	1	1
		(ii)		Straight line through the origin (1) That passes through the point (4,8) (1)		2		2	2	2
				Question 3 total	**0**	**4**	**4**	**8**	**8**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			As distance increases, the speed decreases (1) At a decreasing rate / by decreasing amounts / in a non-uniform way (1)		2		2		
	(b)			35 [km/s] 30 [AU] accept 29.8 or 29.9 [AU]		2		2	2	
	(c)			Uranus		1		1	1	
	(d)			Distance from Earth to the Sun		1		1		
	(e)			18 km/s is between 24.1 and 13 (1) 10 AU is {not between 1.5 and 5.2 / between Saturn and Uranus} (1) Accept should be a number quoted between 1.5 and 5.2 Agree with Paula **and** disagree with Owain (1)			3	3	2	
				Question 4 total	**0**	**6**	**3**	**9**	**5**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Ticks in boxes alongside statements 2, 4 and 5 i.e. The proton numbers of barium and krypton add to give the proton number of urainium-235. During the second round of fission, another 9 neutrons are released. During the second round of fission, another 6 product nuclei are created. Lose 1 mark for each additional tick		3		3	1	
	(b)	(i)		Moderator (1) absorb (1)	2			2		
		(ii)		Control (1) one (1)	2			2		
		(iii)		Control (1) reactor (1)	2			2		
				Question 5 total	**6**	**3**	**0**	**9**	**1**	**0**

<table>
<tr><th colspan="3" 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>6</td><td>(a)</td><td>(i)</td><td>35 [m]</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>60 [km/h]</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>80 [km/h]</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td>[Alert driver – thinking distance =] 25 [m] (1)
[Tired driver – doubles to] 50 [m] (1)
[Braking distance of 20 m stays the same giving stopping distance of] 70 [m] (1) so disagree
To award 3 marks the conclusion must be present</td><td></td><td></td><td>3</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(v)</td><td>25 seen anywhere (1)
17 seen anywhere (1)

Time = 1.47 [s] (1)</td><td></td><td>3</td><td></td><td>3</td><td>3</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><td>Thinking distance</td><td>Braking distance</td><td>Stopping distance</td><td>Impact speed</td></tr><tr><td>Stays the same (1)</td><td>Increases (1)</td><td>Increases</td><td>Increases (1)</td></tr></table></td><td>2</td><td></td><td>1</td><td>3</td><td></td><td></td></tr>
</table>

<table>
<tr><th colspan="3" 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>(c)</td><td></td><td>
<table>
<tr><th>Action</th><th>Seat belt</th><th>Crumple zone</th></tr>
<tr><td>Increases the time of the collision</td><td></td><td>✓</td></tr>
<tr><td>Reduces force on the car</td><td></td><td>✓ (1)</td></tr>
<tr><td>Prevents driver continuing through the windscreen</td><td>✓ (1)</td><td></td></tr>
</table>
Ignore any ticks in row 1
More than 1 tick in a row no marks can be awarded</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>Question 6 total</td><td>4</td><td>6</td><td>4</td><td>14</td><td>6</td><td>0</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7				**Indicative content:** **Set-up** Use the optical pin and cork to suspend the ruler from its mid-point. Add plasticine to one end of the metre ruler so that it is balanced. Use cotton loops to attach the weights to the ruler. **Taking measurements** Hang a 100 g mass / 1 N at one end of the ruler. Hang a 200 g mass / 2 N on the other side. Move it until balance is achieved. Record the distances of the masses from the pivot. Repeat for additional masses and distances. **Analysis** Calculate the clockwise and anticlockwise moment for each mass using the following equation (100 g = 1 N): moment = $F\,d$ Determine if the Principle of Moments is satisfied for each. **5–6 marks** Description of the apparatus set-up, method and analysis. *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** Description of 2 out of 3 of the apparatus set-up, the method or the analysis **or** a 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.*	6			6		6

Question	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
	1–2 marks Description of 1 out of 3 of the apparatus set-up, the method or the analysis **or** a limited description of 1 or 2 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.*						
	Question 7 total	**6**	**0**	**0**	**6**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			Risk – {damage cells / cause mutations / ionises cells} when handling (1) Don't accept causes cancer Control measure – limit exposure <u>time</u> / use tongs / shielding when not in use / source directed away from teacher [and student] (1) Don't accept wear gloves **or** goggles **or** use tweezers	2			2		2
	(b)	(i)		Paper has no effect on count rate Don't accept alpha is low penetrating **or** alpha is stopped by paper			1	1		1
		(ii)		<u>Count rate</u> drops at aluminium so beta present (1) <u>Count rate</u> drops [again] at lead so gamma present (1) Award 1 mark only for <u>count rate</u> drops at aluminium and lead Don't accept aluminium absorbs beta or lead absorbs gamma without reference to count rate			2	2		2
		(iii)	I	Radon / cosmic rays / rocks / food and drink / buildings / nuclear power stations / medical uses Accept Sun **or** stars Don't accept X-rays **or** Big Bang **or** CMBR	1			1		1
			II	[Measure the background radiation and] subtract background from all readings Accept a numerical value taken away	1			1		1
				Question 8 total	**4**	**0**	**3**	**7**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			Substitution: $m = \frac{10\,000}{10}$ (1) = 1 000 [kg] (1)	1	1		2	2	
	(b)	(i)		5 000 – 2 000 (1) = 3 000 [N] (1)		2		2	1	
		(ii)		Substitution: $\frac{3\,000 \text{ ecf}}{1000 \text{ ecf}}$ (1) = 3 (1) m/s^2 (1)	1 1	1		3	2	
		(iii)	I	Resultant force decreases (1) because {air resistance / drag / friction / resistive forces} increases (1)		2		2		
			II	Decreases		1		1		
	(c)	(i)		{Energy losses / energy transfers / work done / heat losses} due to {air resistance / drag / friction / resistive forces} Accept no energy had been lost due to friction [at the top of the hill]		1		1		
		(ii)		Substitution: $\frac{72\,000}{15}$ (1) = 4 800 [N] (1)	1	1		2	2	
				Question 9 total	**4**	**9**	**0**	**13**	**8**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL	MATHS	PRAC
1	5	2	0	7	4	0
2	3	2	2	7	1	0
3	0	4	4	8	8	8
4	0	6	3	9	5	0
5	6	3	0	9	1	0
6	4	6	4	14	6	0
7	6	0	0	6	0	6
8	4	0	3	7	0	6
9	4	9	0	13	8	0
TOTAL	**32**	**32**	**16**	**80**	**33**	**20**