GCSE MARKING SCHEME

SUMMER 2023

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

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.

GCSE PHYSICS

UNIT 2 – FORCES, SPACE AND RADIOACTIVITY

HIGHER 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.

<u>Marking abbreviations</u>

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)			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 1 total	**4**	**0**	**3**	**7**	**0**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Substitution: $m = \dfrac{10\,000}{10}$ (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: $\dfrac{3\,000 \text{ ecf}}{1000 \text{ ecf}}$ (1) = 3 (1) m/s² (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: $\dfrac{72\,000}{15}$ (1) = 4 800 [N] (1)	1	1		2	2	
				Question 2 total	**4**	**9**	**0**	**13**	**8**	**0**

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Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
3	(a)			4.37 <u>years</u> Don't accept 4.37 light years Accept 137 812 320 <u>s</u> or 1595 <u>days</u>	1			1		
	(b)	(i)		Gravitational force and {gas / radiation} pressure (1) Don't accept gravity are {balanced / equal and opposite / outward and inward are equal} (1)	2			2		
		(ii)		{Gas / radiation} pressure increases (1) Star becomes a red giant (1) Treat intermediate stages as neutral	2			2		
	(c)			Involved in <u>fusion</u> (1) {to produce heat or light / into helium or heavier elements} (1)	2			2		
				Question 3 total	**7**	**0**	**0**	**7**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4				**Indicative content:**	4	2		6	2	
				Dark lines:						
				Certain wavelengths of light are absorbed						
				by gas atoms in the atmosphere of the star						
				and are re-emitted in all directions so appear dimmer.						
				Each element has its own specific dark line(s).						
				Elements:						
				Helium is present because there are dark lines at 447 and 502 nm.						
				Hydrogen is present because there are dark lines at 410, 434, 486 and 656 nm.						
				Sodium is present because there is a dark line at 590 nm.						
				Iron is not present because there are no dark lines at 431, 467, 496 and 527 nm.						
				[Another element may be present because of the line at 422 nm.]						
				N.B. References to red shift and Big Bang are neutral.						
				5–6 marks						
				Detailed description of both 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						
				Detailed description of one area **or** limited descriptions of both.						
				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.						

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				1–2 marks A limited description of one area **or** very limited description of both. *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 4 total	**4**	**2**	**0**	**6**	**2**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	200 [g]		1		1	1	1
		(ii)	$\dfrac{9.3 - 8.9}{2}$ (1) = 0.2 [cm] (1) **ecf** for incorrect mass selected in (i) except for 500 [g]		2		2	2	2
	(b)		<u>Reduce</u> the distance between the ruler and the spring / use a pointer			1	1		1
	(c)		Calculate mean <u>extension</u> for each {force / mass} (1) Plot a graph of force against [mean] extension (1) Determine the gradient – this is the spring constant (1) **Alternative:** Calculate mean <u>extension</u> for each {force / mass} (1) Determine k for each force from $F = kx$ (1) Add up the <u>5 values</u> for k and use them to calculate the mean (1) Don't accept reference to 6 values **Alternative:** Determine k from $F = kx$ (1) Do this for all extensions (1) Add up the <u>10 values</u> for k and use them to calculate the mean (1)		3		3		3
	(d)		Data are accurate (1) because the spring constant is close to the true value (1) Accept the converse argument i.e. Data are <u>slightly</u> inaccurate (1) because the spring constant is not exactly the true value (1)			2	2		2
			Question 5 total		6	3	9	3	9

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			LHS: $^{235}_{92}U$ (1) RHS: $^{140}_{55}Cs + {}^{92}_{37}Rb + 4\,^{1}_{0}n$ Cs data correct (1) Rb data correct (1) FOUR neutrons (1)		4		4	2	
	(b)	(i)		To slow <u>neutrons</u> down (1) so {cause fission of / are absorbed by / are captured by / react with} <u>uranium</u> (1)	2			2		
		(ii)		By control rods (1) being raised (1) accept removed so fewer neutrons are absorbed [by control rods] **or** more neutrons available to be absorbed by <u>uranium</u> (1)	1	1 1		3		
	(c)	(i)		65 536 [g] (1) No rounding accepted		1		1	1	
		(ii)	I	16		1		1	1	
			II	8 half-lives remaining (1) Sequence of halving starting at 512 [g] (1) Award the 1st and 2nd marks for: $\frac{1}{2^8}$ = 2 [g] (1) Award 2 marks for an answer of 4 [g]		3		3	3	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		Rubidium decays faster / rubidium has a shorter half-life / less rubidium than caesium remaining as time passes (1) Accept the converse argument So ratio increases / after 64 seconds the ratio becomes 32 768:1 (1) Accept attempt of numerical calculation that shows an increase in the ratio			2	2	1	
				Question 6 total	**3**	**11**	**2**	**16**	**8**	**0**

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i) (ii) (iii)	The same (1) Increases (1) Increases (1)	1 1 		 1	3		
	(b)	(i)	Initial speed (km/h) / Initial speed (m/s) / Thinking distance (m) / Braking distance (m) / Stopping distance (m) 60 / 16.8 (1) Accept 17 / 25 (1) / 20 (1) / 45 (1)			4	4	4	
		(ii)	Substitution into: $s = \dfrac{d}{t}$ **ecf** (1) Manipulation i.e. $t = \dfrac{25}{16.8}$ (1) Time = 1.488 [s] or 1.49 [s] or 1.5 [s] (1) N.B. Use of 17 m/s $\rightarrow$ 1.47 [s]	1	1 1		3	2	
		(iii)	$v = 0$ (1) Substitution: = 16.8² **ecf** + (2 × a × 20 **ecf**) (1) a = [-]7.056 [m/s²] (1) N.B. Use of u = 17 m/s $\rightarrow$ [−] 7.225 [m/s²] accept correctly rounded answers	1	1 1		3	3	
	(c)	(i)	Seat belts produce an <u>unbalanced force</u> on the occupants (1) which prevents them continuing moving forward [at a constant speed] / so the occupant remains in their seat (1) Award 1 mark for N1L correctly stated if no other creditworthy response provided	2			2		

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Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	Car produces a force on the obstacle (1) producing an <u>equal and opposite</u> force on the car (1) Award 1 mark for N3L correctly stated if no other creditworthy response provided	2			2		
		(iii)	Crumple zone increases {time / distance} of the collision **OR** increases the time for the change in momentum (1) Reducing the {deceleration / force} on the occupant / car (1) Award 1 mark for N2L correctly stated if no other creditworthy response provided	2			2		
	(d)		{Braking / stopping} distance would be reduced [to less than 35 m] (1) Decrease in collisions / accidents (1) Reduced severity of collisions (1) so agree To award full marks a conclusion must be present			3	3		
			Question 7 total	**10**	**4**	**8**	**22**	**9**	**0**

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HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL	MATHS	PRAC
1	4	0	3	7	0	6
2	4	9	0	13	8	0
3	7	0	0	7	0	0
4	4	2	0	6	2	0
5	0	6	3	9	3	9
6	3	11	2	16	8	0
7	10	4	8	22	9	0
TOTAL	32	32	16	80	30	15

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