



GCSE MARKING SCHEME

SUMMER 2022

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

INTRODUCTION

This marking scheme was used by WJEC for the 2020 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
HIGHER TIER
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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)			Alpha – <u>helium nucleus</u> (1) Treat 2 protons and 2 neutrons as neutral Beta – [fast moving] electron (1) Gamma – em wave (1)	3			3														
	(b)	(i)		$\frac{18}{30} = 0.6$ [counts per second]		1		1	1	1												
		(ii)		Measure for longer (1) Repeat (1)			2	2		2												
		(iii)		[More] radon (1) Due to granite or different types of rock (1) Alternative: [More] cosmic rays (1) Due to high altitude (1)	2			2														
	(c)	(i)		<table border="1"><tr><td></td><td>Alpha</td><td>Beta</td><td>Gamma</td></tr><tr><td>Source 1</td><td>N</td><td>N</td><td>Y</td></tr><tr><td>Source 2</td><td>Y (1)</td><td>Y (1)</td><td>N (1)</td></tr></table> Award 1 mark for source 1 row being correct Accept ticks and crosses for Y and N		Alpha	Beta	Gamma	Source 1	N	N	Y	Source 2	Y (1)	Y (1)	N (1)			4	4		4
	Alpha	Beta	Gamma																			
Source 1	N	N	Y																			
Source 2	Y (1)	Y (1)	N (1)																			

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Lead or concrete [absorber] should be included (1) To confirm that gamma [is emitted] (1) OR reduce distance between source and detector (1) To detect alpha (1) OR Use thick aluminium (1) To confirm no beta is emitted by source 1 (1)			2	2		2
				Question 1 total	5	1	8	14	1	9

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)	(i)		Ticks in boxes 3 and 4 i.e. A year on Earth is about 4 times longer than a year on Mercury. Mercury orbits the Sun with a speed around 10 times greater than Pluto. N.B. Deduct 1 mark for each additional tick		2		2		
		(ii)		Pluto has the <u>smallest</u> mass or Pluto has the <u>smallest</u> diameter or Pluto is smaller than our moon Accept relevant use of data or Pluto is much smaller than the other planets		1		1		
		(iii)		Distance between 1.53 and 5.19 [units]		1		1	1	
	(b)			Earth has largest mass (accept biggest) (1) and shortest day [so agree] (1) OR Mercury has smallest mass (1) and longest day [so agree] (1) OR Mars and Earth have similar day length (1) and Earth has [much] bigger mass [so disagree] (1) OR Venus has larger mass (1) and [much] longer day than Mars [so disagree] (1) OR Venus and Earth have a similar mass (1) But Venus has [much] longer day [so disagree] (1)			2	2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				Accept the following: Earth has largest mass [of the rocky planets] (1) <u>but</u> Jupiter/gas giants have shortest day length [so disagree] (1) OR Jupiter is not a rocky planet / is a gas giant / the gas giants (1) <u>but</u> has (have) the shortest day length [so disagree] (1) N.B. Only award marks for reference to day length on Jupiter if it is clear that there is a comparison to rocky planets. Do not accept Jupiter has the shortest day length alone.						
				Question 2 total	0	4	2	6	1	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)			${}^2_1\text{H} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + {}^1_0\text{n}$ H-2 and H-3 correct (1) Neutron symbol correct (1) He-4 correct (1) If all numbers correct but on the RHS of letters then award 2 marks If symbols are correct but LHS and RHS reversed award 2 marks	1	1 1		3		
	(b)	(i)		Any 2 × (1) from: - Need [very] high temperatures / energy - Need high pressures - Difficult to contain - Atoms need enough energy to combine / atoms need to get close enough	2			2		
		(ii)		Long half-life / dangerous (or radioactive) for long periods of time / takes a long time to decay (1) <u>Highly</u> ionising / penetrating (1)	2			2		
				Question 3 total	5	2	0	7	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	(i)		Suitable scale starting at origin on both axes i.e. plotted points must occupy at least half of the graph paper (1) All points plotted correctly to within <1 small square division (1) Curve of best fit for <u>all</u> points <1 small square division from plotted points (1)	1	1 1		3	3	3
		(ii)		Number of dice remaining = 33 (taken from candidate's graph) (1) So number removed = 4 (1) Award 1 mark for an answer of 17		2		2	1	2
		(iii)		Line evident on graph at 25 (1) Number of throws read from candidate's graph (1) Accept answer rounded to nearest throw		2		2	1	2
		(iv)		Evidence of halving from 1 000 or 3 half-lives (1) $5.1 \text{ (ecf)} \times 3 = 15.3$ (1)		2		2	2	2
	(b)			Any 2 × (1) from: - decay is random / throwing a dice is random - smooths out fluctuations in data - more accurate results / increase confidence in results N.B. Treat reference to anomalies as neutral			2	2		2
				Question 4 total	1	8	2	11	7	11

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)			[Dark lines are formed when] atoms / gases in the star's atmosphere (1) absorb light (1) accept absorb colour at particular wavelengths (accept different frequencies) (1) [identifying the element]	3			3		
	(b)			Cosmic microwave background radiation, accept CMBR (1) is detected throughout the Universe / <u>gamma rays</u> have been stretched [to longer wavelength] (1) [Cosmological] red shift (1) shows that light (wavelengths) is stretched / galaxies are moving away from us (1) Accept shows that the Universe starts from a single point or the Universe is expanding for either but award each point only once	4			4		
				Question 5 total	7	0	0	7	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)	(i)		Substitution into: $v^2 = u^2 + 2ax$ i.e. $v^2 = 225 - 2 \times 3.5 \times 20$ (1) $v^2 = 85$ (1) $v = 9.22$ [m/s] (1) Award 2 marks for an answer of 19.1 [m/s] Award 1 mark for an answer of 365 [m/s]	1	1 1		3	3	
		(ii)		$5\,625 - 2\,125 = 3\,500$ (1) Substitution: $3\,500 \text{ ecf} = F \times 20$ (1) N.B. the ecf only applies to an incorrect subtraction $F = \frac{3\,500}{20} = 175$ [N] (1) Award 2 marks: $F = 281.25$ [N] or $F = 106.25$ [N] or $F = 193.75$ [N]	1	1 1		3	3	
	(b)			Increase the distance (1) over which the energy is transferred / [same] work is done / work done = force $\times$ distance (1) so the force decreases (1) Or Increase the time (1) so there is decreased deceleration / to reduce the momentum / force = $\frac{\text{change in momentum}}{\text{time}}$ (1) so the force decreases (1) Don't accept impact	3			3		
				Question 6 total	5	4	0	9	6	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)			Indicative content: Initially, only weight acts, there is a resultant force downwards and the skydiver accelerates described by Newton's second law, $F = ma$. As the skydiver speeds up air resistance increases until the forces balance. Newton's first law states that if the forces acting on a body are balanced then it will remain in a constant state of motion, so the skydiver travels at terminal speed. Newton's third law states that if a body A exerts a force on body B, then body B exerts an equal and opposite force on body A. As the skydiver exerts a force on the air, the air exerts an equal and opposite force on the skydiver which is air resistance. 5–6 marks Correctly states all 3 laws and correctly applies them to the motion. <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> 3–4 marks Correctly states and applies 2 laws or does 3 partially. <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> 1–2 marks Correctly states and applies 1 law or a partial treatment of 1 or 2. <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> 0 marks <i>No attempt made or no response worthy of credit.</i>	3	3		6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		Gradient = $\frac{(54 - 13)(1)}{(9.5 - 0.5)(1)}$ Gradient = $\frac{41}{9} = 4.6 \text{ [m/s}^2\text{]} (1)$ Accept range $4.6 \pm 0.3 \text{ [m/s}^2\text{]}$		3		3	3	
		(ii)		[Acceleration] decreases (1) to zero [at 15 s] (1)		2		2	1	
		(iii)		Distance travelled = area under line stated or implied or $x = \frac{1}{2}(u + v)t \text{ (1)}$ $(\frac{1}{2} \times 5 \times 33) (1)$ $= 82.5 \text{ [m]} (1)$ Accept answers in the range 80-85 [m]	1	1 1		3	3	
				Question 7 total	4	0	0	14	7	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	(a)			[Total] momentum before [a collision] = [total] momentum after [a collision] (1) provided no external forces act (1)	2			2		
	(b)			$35 \times 2 = 70$ (1) $0.45 \times [-]10 = [-]4.5$ (1) $70 - 4.5 = 65.5$ (1) kg m/s (1) Award 2 marks for an answer of 74.5	1 1	1 1		4	2	
	(c)			Substitution: 65.5 (ecf) = $35.45 \times v$ (1) $v = 1.85$ [m/s] or 1.8477 [m/s] (1) Accept 1.8 [m/s] ecf on 74.5 gives $v = 2.1$ [m/s] so award 2 marks	1	1		2	2	
	(d)			$\frac{1}{2} \times 35 \times 2^2 = 70$ [J] OR $\frac{1}{2} \times 0.45 \times 10^2 = 22.5$ [J] (1) KE before = 92.5 [J] ecf (1) KE after = $\frac{1}{2} \times 35.45 \times 1.85^2$ (ecf) (1) = 60.66 [J] (1) Conclusion must be given to award full marks i.e. so KE not the same so disagree ecf on 2.1 [m/s] gives 78.17 [J]			4	4	4	
				Question 8 total	5	3	4	12	8	0

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	5	1	8	14	1	9
2	0	4	2	6	1	0
3	5	2	0	7	0	0
4	1	8	2	11	7	11
5	7	0	0	7	0	0
6	5	4	0	9	6	0
7	4	10	0	14	7	0
8	5	3	4	12	8	0
Total	32	32	16	80	30	20