



GCSE MARKING SCHEME

SUMMER 2019

**PHYSICS UNIT 2 HIGHER (SEPARATE AWARD)
3420UB0-1**

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 PHYSICS

UNIT 2: FORCES, SPACE and RADIOACTIVITY

HIGHER 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)	Straight line through origin shows a proportional relationship (1) so true for thinking distance but not braking distance (1) OR Braking distance is a curve so it isn't true (1) Thinking distance is a straight line through the origin so true (1) Accept answers based on data							2	2																							
		(ii)	40 mph converted to 18 m/s (1) Distance of 12[m] seen anywhere (1) Answer = 0.67 [s] (1) Award 2 marks for an answer of 0.3 [s]					1	1		3	3																						
		(iii)	<table border="1"> <tr> <td>Speed (mph)</td> <td>0</td> <td>20</td> <td>30</td> <td>40</td> <td>60</td> <td>70</td> </tr> <tr> <td>Total stopping distance (m)</td> <td>0</td> <td>12</td> <td>22 or 22.5 or 23</td> <td>36</td> <td>72 or 72.5 or 73</td> <td>95 or 95.5 or 96</td> </tr> <tr> <td colspan="7">5 or 6 correct (2) 3 or 4 correct (1) 1 or 2 correct (0)</td> </tr> </table>					Speed (mph)	0	20	30	40	60	70	Total stopping distance (m)	0	12	22 or 22.5 or 23	36	72 or 72.5 or 73	95 or 95.5 or 96	5 or 6 correct (2) 3 or 4 correct (1) 1 or 2 correct (0)								2		2	2	
Speed (mph)	0	20	30	40	60	70																												
Total stopping distance (m)	0	12	22 or 22.5 or 23	36	72 or 72.5 or 73	95 or 95.5 or 96																												
5 or 6 correct (2) 3 or 4 correct (1) 1 or 2 correct (0)																																		
		(iv)	5 points plotted correctly (ignore (0,0) $\pm < 1$ small square (2) ecf on table 4 points plotted correctly $\pm < 1$ small square (1) 3 or less points plotted correctly $\pm < 1$ small square (0) Best fit curve through (0,0) $\pm < 1$ small square (1) Don't accept double, thick, disjointed, wispy curves						3		3	3																						
	(b)		At 30 mph stopping distance = 22 or 22.5 m or 23 m (ecf) (1) At 20 mph the stopping distance = 12 m (ecf) (1) 12 m is less than 15 m or 12 m is less than the distance after the bend or there is a 3 m gap so less chance of a collision (1)							3	3																							
			Question 1 total					1	7	5	13	8	0																					

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		Half-life is <u>too</u> short / <u>only</u> 13 hours (1) Don't accept very short or shorter So will decay [too] quickly [to treat cancer] / will need replacing frequently / doesn't last long enough [to treat the cancer] (1)		2		2		
	(b)		Half-life is longer / decays more slowly (1) [Combination of beta and] gamma will be more penetrating (1)		2		2		
	(c)		80 days = 10 half-lives (1) Series of halving starting from 1 or 100% or 1 000 e.g. $1 \rightarrow \frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8}$ etc (1) Answer = $\frac{1}{1024}$ so 80 days is long enough or it will not trigger the monitors (1)			3	3	3	
			Question 2 total	0	4	3	7	3	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3			<p>Indicative content: Origin of the Universe Both provide evidence to support the Big Bang when the Universe originated from a point. CMBR At the time of the Big Bang high energy short wavelength em waves were produced (gamma rays). Over time as space expanded, these em waves also stretched / became longer forming microwaves. The CMBR fills all of space with (nearly) uniform intensity in all directions. Cosmological red shift Evidence for the expansion of the Universe since the radiation was emitted. As the space between galaxies stretches any light moving through space will also be stretched and its wavelength will increase i.e. be red shifted. This is revealed in the study of spectra since absorption lines have increased wavelengths.</p> <p>5-6 marks Detailed description/explanation of cosmological red shift, CMBR and how they support the origin of the Universe. <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 Detailed description/explanation of cosmological red shift or CMBR OR limited description/explanation of cosmological red shift and CMBR. <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> <p>1-2 marks Limited description/explanation of cosmological red shift or CMBR or reference to how they support the origin of the Universe. <i>There is a basic line of reasoning which is not coherent, largely irrelevant,</i></p>	6			6		

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
				<i>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>							
				Question 3 total	6	0	0	6	0	0	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Both distances / 20 cm and 1.5 m / <u>drop</u> height	1			1		1
		(ii)		Reduces effect of anomalies or random errors / identify anomalies (1) Accept outliers. Don't accept no anomalies So the <u>mean</u> is more <u>accurate</u> (1)	2			2		2
		(iii)		There are variations in the mass of each case (1) So weighing gives a more accurate value or results (1) OR Variations in the mass of each case is very small (1) Using the mean will not affect the results (1)		2		2		2
	(b)	(i)		As case <u>accelerates</u> the air resistance increases (1) until air resistance balances the weight of the case[s] / until the resultant force is zero / forces become balanced (1) Don't accept forces are equal or gravity	2			2		2
		(ii)		Measure split times e.g. over each 50 cm or 75 cm (1) All [split] times should be equal (1) OR Drop from >20 cm above pointer / drop from higher point (1) Check whether it affects the times / check the results are the same (1) OR Use multi-flash photographs / strobe (1) Check whether [successive] distances are equal (1)			2	2		2

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
(c)	(i)		Substitution: $2.54 = \frac{1.5}{t}$ (1) Manipulation so $t = \frac{1.5}{2.54} = 0.59$ [s] (1) Accept 0.6 [s] Don't award marks for incorrect substitution	1			2	2	2
	(ii)		Mass of 250 cases = 100 g (1) Mass of 1 case = 0.4 g (1) Substitution and conversion: $\left(\frac{4 \times 0.4 \mathbf{ecf}}{1000}\right) \times 10$ (1) Air resistance = 0.016 [N] (1) Answer of 16 N or 0.004 [N] award 3 marks Answer of 4 N award 2 marks Alternative: Mass of 4 cases = 1.6 g (2) = 1.6×10^{-3} kg ecf (1) Air resistance = 0.016 [N] (1)		4		4	3	4
Question 4 total				6	7	2	15	5	15

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Ticks in boxes 2, 3, 4 (-1 for each additional box ticked) (3) The largest supergiant is Betelgeuse (✓) The radius of a white dwarf is approximately 100 times smaller than the radius of the Sun (✓) The hottest star is β Centauri (✓)		3		3		
	(b)	(i)		Currently the temperature is: stated between 5500 \rightarrow 6 000 K (1) When it becomes a [red] giant its temperature will decrease to: stated between 3000 \rightarrow 5000 K (1) When it becomes a white dwarf its temperature will increase to: stated between 6 100 \rightarrow 30000 K, so disagree (1) Award for 1 mark for stating when it becomes a red giant, temperature decreases and when it becomes a white dwarf, temperature increases			3	3	3	
		(ii)		Radiation / pressure becomes greater than the gravitational [force] (1) So it will <u>expand</u> into a <u>red</u> giant (1) In the final stage the radiation / pressure becomes smaller [than the gravitational force] so it contracts into a white dwarf (1)	3			3		
	(c)			During the <u>supernova</u> stage in the life cycle of a <u>large</u> star (1) material [including heavy elements] is returned into space (1) The solar system originated from the <u>collapse</u> of a cloud of gas and dust from such an event (1)	3			3		
				Question 5 total	6	3	3	12	3	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Graphite / moderator slows the neutrons down (1) so they can be absorbed [by uranium atoms] (1) Boron / control rods absorb fission neutrons (1) so only 1 causes further fission / keeps the reaction at constant rate or converse (1)	4			4		
	(b)	(i)		2 (1) ${}_0^1\text{n}$ (1) Award 2 marks for ${}_0^1\text{n} + {}_0^1\text{n}$		2		2		
		(ii)		[The absorption of a neutron] makes the nucleus unstable (1) due to an imbalance between the numbers of neutrons and protons (1) Accept U-236 produced or increases the mass number	2			2		
	(c)	(i)		${}_{38}^{94}\text{Sr} \rightarrow {}_{39}^{94}\text{Y}$ (1) + ${}_{-1}^0\beta$ (1) [accept ${}_{-1}^0\text{e}$] Treat as neutral the next decay if shown	1	1		2		
		(ii)		It takes <u>75s</u> to halve the (1) {number of particles or atoms or nuclei / activity / mass / amount of the substance} (1) Treat as neutral reference to radioactivity	2			2		
		(iii)		[No] because half-lives for strontium and yttrium are short (1) so will decay into stable <u>zirconium</u> or a stable product [quickly] (1)	1	1		2		
				Question 6 total	10	4	0	14	0	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	Momentum before = momentum after (1) provided no external forces act (1)	2			2		
		(ii)	No because of gravity Don't accept air resistance			1	1		
	(b)		Some is converted to heat or sound during collision / it's not an elastic collision / it's an inelastic collision / the block becomes deformed (1) and then into PE as the block swings up (1)			2	2		
	(c)	(i)	PE = KE or $\frac{1}{2}mv^2 = mgh$ or implied (1) $v^2 = 2gh$ (1) $= 2 \times 10 \times 0.119 = 2.38$ [m ² /s ²] (1) Velocity = 1.54 [m/s] (1) Alternative: $v^2 = u^2 + 2ax$ or implied (1) $0 = u^2 - 2 \times 10 \times 0.119$ (1) $u^2 = 2.38$ [m ² /s ²] (1) Velocity = 1.54 [m/s] (1) Award 3 marks for answer of 15.4 [m/s]		4		4	3	
		(ii)	Attempt at: momentum of bullet = momentum of block and bullet (1) Conversion of 16 g into 0.016 kg (1) $0.016u = 2.516 \times 1.54$ (ecf) (1) $u = 242.2$ [m/s] Accept 242.6 [m/s] (1) Award 3 marks for answer of 0.242 or 1.782 [m/s]	1	1 1 1		4	3	
			Question 7 total	3	7	3	13	6	0

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	A01	A02	A03	TOTAL MARK	MATHS	PRAC
1	1	7	5	13	8	0
2	0	4	3	7	3	0
3	6	0	0	6	0	0
4	6	7	2	15	5	15
5	6	3	3	12	3	0
6	10	4	0	14	0	0
7	3	7	3	13	6	0
TOTAL	32	32	16	80	25	15