



GCSE MARKING SCHEME

SUMMER 2022

**GCSE
SCIENCE (DOUBLE AWARD) – UNIT 6
HIGHER TIER
3430UF0-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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 SCIENCE (DOUBLE AWARD) – UNIT 6 – PHYSICS 2**HIGHER TIER****SUMMER 2022 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
owtte = or words to that effect

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)	Substitution: work done = 450×0.8 (1) $\times 2$ (1) $= 720$ (1) [J] Answer 360 [J] award 2 marks Alternative: $2 \times 0.8 = 1.6$ [m] (1) 450×1.6 (1) $= 720$ (1) [J]	1 1	1		3	3	
		(ii)	Answer from (i) ecf expect 720 [J] or 720 [J]	1			1		
		(iii)	[Work done in overcoming] friction / lifting the forks or [energy transferred as] sound / heat		1		1		
	(b)		$450 - (12 \times 10) = 330$ [N] (1) $\frac{330}{10} = 33$ (1) [kg] Alternative: $\frac{450}{10} = 45$ (1) [kg] $45 - 12 = 33$ (1) [kg]		2		2	2	
			Question 1 total	3	4	0	7	5	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)	(i)		Callisto		1		1		
		(ii)		Moons of Jupiter get their heat from the Sun / Jupiter doesn't give out much heat / Jupiter isn't a star / Jupiter is a planet (1) They are [about] the same distance from the Sun / don't orbit the Sun (1)			2	2		
		(iii)		Callisto doesn't have the largest mean <u>diameter</u> [so claim not true] Alternative: Callisto has a smaller mean <u>diameter</u> than Ganymede [so claim not true]. Accept the converse. Accept correct reference to data.			1	1		
		(iv)		$671\,000 \times 2 = 1\,342\,000$ [km] [so not true] Alternative: $\frac{1\,070\,400}{2} = 535\,200$ km [so not true] Alternative: $\frac{1\,070\,400}{671\,000} = 1.6$ [so not true] Alternative: $1\,070\,400 - 671\,000 = 399\,400$ [so not true]			1	1	1	

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)	Box 3. A light minute is the distance travelled by light in 60 seconds. Extra tick award 0 marks	1			1		
		(ii)	Mean distance = $\frac{588\,000\,000}{3.92}$ (1) = 150 000 000 (1) [km] accept 1.5×10^8 [km] or 150×10^6 [km]	1	1		2	2	
			Question 2 total	2	2	4	8	3	0

Question		Marking details		Marks available															
				AO1	AO2	AO3	Total	Maths	Prac										
3.	(a)			Carbon-12, 6 neutrons and 6 protons or same number of p and n (1) Carbon-14, has 8 neutrons and 6 protons or more neutrons than protons (1) [So] C-14 is unbalanced or C-12 is balanced (1) Don't accept stable or unstable. N.B. treat as neutral any reference to electrons	3			3											
	(b)			<table border="1"> <tr> <td>gamma</td> <td>γ (1)</td> <td></td> </tr> <tr> <td>alpha</td> <td></td> <td><u>helium nucleus</u> (1) Neutral: 2 protons and 2 neutrons</td> </tr> <tr> <td>beta</td> <td>${}^0_{-1}\beta$ or ${}^0_{-1}e$ (1)</td> <td>[high energy / fast moving] <u>electron</u> (1)</td> </tr> </table>	gamma	γ (1)		alpha		<u>helium nucleus</u> (1) Neutral: 2 protons and 2 neutrons	beta	${}^0_{-1}\beta$ or ${}^0_{-1}e$ (1)	[high energy / fast moving] <u>electron</u> (1)	4			4		
gamma	γ (1)																		
alpha		<u>helium nucleus</u> (1) Neutral: 2 protons and 2 neutrons																	
beta	${}^0_{-1}\beta$ or ${}^0_{-1}e$ (1)	[high energy / fast moving] <u>electron</u> (1)																	
				Question 3 total	7	0	0	7	0	0									

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	<p>Indicative content:</p> <p>AB and CD have a gradient of 0 which means the acceleration is 0. The train moves at constant velocity between AB and is stopped from CD. BC has a [constant] gradient which is double the value of DE so has a [constant] acceleration that is double. However, BC has a negative gradient and DE a positive gradient. BC is a deceleration or negative acceleration, whereas DE shows a positive acceleration.</p> <p>The area under AB is 4 squares, BC 2 squares, CD 0 squares and DE 4 squares. AB and DE have identical areas so the train travels equal distances in both. In comparison BC is $\frac{1}{2}$ the area of AB or DE so $\frac{1}{2}$ the distance is travelled.</p> <p>5–6 marks Detailed comparison of distances travelled and accelerations. <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 Limited comparison of distances travelled and accelerations or detailed comparison of either distances travelled or acceleration. <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 A brief comparison of either distances travelled or accelerations. <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></p>	3	3		6	2	

Question			Marking details	Marks available						
				AO1	AO2	AO3	Total	Maths	Prac	
			0 marks <i>No attempt made or no response worthy of credit.</i>							
	(b)	(i)	$F = ma$ or accept in words	1			1			
		(ii)	I Total mass of train = $2.3 \times 10^5 \times 2$ (1) = $[4.6 \times 10^5]$ [kg] = $4.6 \times 10^5 \times 0.7$ = 3.22×10^5 (1) [N] accept 322×10^3 [N] Award maximum of 1 mark for $2.3 \times 10^5 \times 0.7 = 1.61 \times 10^5$ [N] accept 161×10^3 [N] Award 1 mark for answer of 3.22 or 1.61		2		2	2		
			II Substitution: $0.7 = \frac{55.8}{t}$ (1) Rearrangement: time = 79.7 (1) [s] accept 80 [s]	1	1		2	2		
		(iii)	$2.3 \times 10^5 \times 2 = 4.6 \times 10^5$ (1) which is approximately 4.4×10^5 so this part of claim correct (1) Both trains have same emergency deceleration / 1.2 m/s^2 and so will take the same time to stop / this part of the claim is incorrect (1) Alternative: $\frac{4.4 \times 10^5}{2.3 \times 10^5} = 1.9$ (1) which is approximately 2 so this part of claim correct (1) Both trains have same emergency deceleration / 1.2 m/s^2 and so will take the same time to stop / this part of the claim is incorrect (1)			3	3	1		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>Alternative: $\frac{4.4 \times 10^5}{2} = 2.2 \times 10^5$ (1) which is approximately 2.3×10^5 so this part of claim correct (1)</p> <p>Both trains have same emergency deceleration / 1.2 m/s^2 and so will take the same time to stop / this part of the claim is incorrect (1)</p>						
				Question 4 total	5	6	3	14	7	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)	(i)		$\frac{0.036 + 0.032 + 0.033 + 0.034 + 0.030}{5} = \frac{0.165}{5} = 0.033 \text{ [N]}$ Don't accept 0.03 N		1		1	1	1
		(ii)		$\frac{0.036 - 0.030}{2} = 0.003 \text{ [N]}$		1		1	1	1
		(iii)		$\frac{0.003 \text{ ecf}}{0.033 \text{ ecf}} (1)$ $\times 100 \% = 9 \text{ [%]} \text{ [this is less than 10 \%] so the data is repeatable (1)}$ Accept 9.09 [%] or 9.1 [%]			2	2	1	2
	(b)	(i)		Light gates are more accurate measurement or no human reaction time when using light gates Accept no human error Don't accept to make it more repeatable	1			1		1
		(ii)		Selection of 0.55 and 1.1 (1) $0.5 \times 3.3 \times 10^{-3} \times 0.55^2 = 4.99125 \times 10^{-4} \text{ [J]}$ OR $0.5 \times 3.3 \times 10^{-3} \times 1.1^2 = 1.9965 \times 10^{-3} (1) \text{ [J]}$ accept $5 \times 10^{-4} \text{ [J]}$ or $2 \times 10^{-3} \text{ [J]}$ $\frac{1.9965 \times 10^{-3}}{4.99125 \times 10^{-4}} = 4 \text{ or } 4.99125 \times 10^{-4} \times 4 = 1.9965 \times 10^{-3} \text{ so the student is correct (1)}$ N.B. No penalty if $\times 10^{-3}$ is omitted throughout Alternative: $\frac{1.1^2(1)}{0.55^2(1)} = 4 \text{ so the student is correct (1)}$ or $0.3025 (1) \times 4 (1) = 1.21 \text{ so the student is correct (1)}$			3	3	3	3

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)	[As the drop height increases] the mean speed increases (1) at a decreasing rate (1) Don't accept speed accelerates or speed increase slows down		2		2		2
		(ii)	1.1 [m/s]		1		1		1
		(iii)	I Weight / <u>force of gravity</u> and air resistance / drag	1			1		1
			II Forces are balanced / equal	1			1		1
			Question 5 total	3	5	5	13	6	13

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6.	(a)		<u>Radiation</u> may come from different directions or to monitor <u>radiation</u> levels across Wales or background <u>radiation</u> may vary across Wales		1		1		
	(b)		Measure count for a lengthy period of time e.g. 5 minutes (1) Divide the count value by the time to get cpm (1) Alternative: Measure count for 1 minute (1) Repeat this numerous times and calculate a mean to get cpm (1)	2			2		2
	(c)	(i)	It is the time taken to halve (1) number of radioactive particles or nuclei or atoms / activity / mass / amount of substance / count rate (1)	2			2		
		(ii)	8 [days]		1		1	1	
	(d)		$[1 \rightarrow] \frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8} \rightarrow \frac{1}{16} \rightarrow \frac{1}{32} \rightarrow \frac{1}{64} \rightarrow \frac{1}{128} \rightarrow \frac{1}{256} \rightarrow \frac{1}{512}$ (1) 9 [half-lives] (1) The first mark can be implied if 9 half-lives shown so two marks can be awarded. $9 \times 30.2 = 271.8$ (1) [years] Alternative: $2^n = 512$ (1) $n = 9$ (1) $9 \times 30.2 = 271.8$ (1) [years]		3		3	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			I-131 has a shorter half-life [than Cs-137] (1) accept converse and nearly all of it will have decayed [in 35 years] (1) Alternative: Cs-137 will not be safe for 271.8 years or the activity of Cs-137 will still nearly be a half [after 35 years] (1) I-131 will be safe after 72 days (1)		2		2		
				Question 6 total	4	7	0	11	3	2

HIGHER TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	Total	Maths	Prac
1	3	4	0	7	5	0
2	2	2	4	8	3	0
3	7	0	0	7	0	0
4	5	6	3	14	7	0
5	3	5	5	13	6	13
6	4	7	0	11	3	2
Total	24	24	12	60	24	15