GCSE MARKING SCHEME

SUMMER 2019

PHYSICS UNIT 6 HIGHER (DOUBLE AWARD)
3430UF0-1

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 SCIENCE (DOUBLE AWARD)

UNIT 6: PHYSICS 2

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)		174, 180, 194, 196 – all correct		1		1	1	1
		(ii)		50		1		1	1	1
		(iii)		3 [throws]		1		1	1	1
	(b)			14 (1) 7 (1)		2		2	2	
	(c)	(i)		800 in every cell in the second column (1) 130, 70, 40, 20, 10 in last column (1)		2		2	2	
		(ii)		Plots at (15,130), (20,70), (25,40), (30,20), (35,10) **ecf** - within a tolerance of ± <1 small square 2 marks for all 5 plots correct 1 mark for 4 plots correct 0 marks for 3 or fewer plots correct Smooth curve must extend back to 800 judge quality of curve in the region 10 – 35 thousand years it must pass within ± <1 small square of these points (1) Don't accept double lines, whispy, disjointed curves		3		3	2	
	(d)	(i)		It is the time taken to halve (1) the {number of radioactive particles or atoms or nuclei / activity / mass / amount of the substance} (1)	2			2		
		(ii)		6 ± 0.5 [thousand years]		1		1	1	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			[The 60 (6) million fall [out of 800 (80) million] in carbon nuclei or rise in nitrogen nuclei] occurs at about 700 years (1) Which is less than 2 000 years so the claim is incorrect (1) **Alternative:** After 2 000 years approx. 160 / 170 (16 / 17) million [out of 800 (80) million] nuclei of carbon will have decayed / nitrogen nuclei produced (1) So 60 (6) million nuclei will have decayed in much less time (1)			2	2	2	
				Question 1 total	**2**	**11**	**2**	**15**	**12**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*			If object A exerts a force on object B, then B exerts an equal and opposite force on A (1) Accept action and reaction are equal and opposite The wall applies a force on the car in the collision (1) Therefore the car applies an equal <u>and opposite</u> force on the wall (1)	1	1 1		3		
	(b)	(i)		Use of $a = \frac{v-u}{t}$ and $F = ma$ (1) $a = \frac{(0-15)}{0.028}$ = (–)535.7 [m s^{-2}] (1) [ignore sign] Accept 536 [m s^{-2}] F = 85 × 535.7 **ecf** = 46 000 [N] (1)	1	1 1		3	2	
		(ii)		Gradient / slope of the graph isn't constant / acceleration is changing or increasing (1) Don't accept acceleration is decreasing Which shows that the <u>force increases</u> through the stopping process (1) Don't accept that the force changes		2		2	2	
	(c)			The crumple zone increases the distance or time to stop (1) So the <u>force</u> is smaller [on the driver] (1) N.B. Award only 1 mark if a fully correct answer is accompanied with an incorrect statement about work done changing	1 1			2	2	
				Question 2 total	**4**	**6**	**0**	**10**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*			**Indicative content:** **Forces** In its main sequence, the forces of gravity and radiation pressure are balanced. Eventually a large mass star expands into a [red] supergiant when the outward radiation pressure is bigger than the inwards force of gravity. Eventually the gravitational force exceeds the force of radiation pressure and the star shrinks to form either a neutron star or a black hole. **Fusion** When the hydrogen reduces, the star will begin to fuse helium and then increasingly heavier elements to maintain fusion, the elements will continue fusing into heavier and heavier elements. Finally, the [red] supergiant explodes in a supernova, sending the outer layers back into space and creating heavy elements (heavier than iron) in the process. **5-6 marks** Comprehensively describes in terms of both forces **and** fusion. *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.*	6			6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				3-4 marks Comprehensively describes in terms of either forces **or** fusion **or** provides a basic description in terms of both forces **and** fusion. *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.* **1-2 marks** Provides a basic description in terms of either forces **or** fusion **or** stages in the life cycle identified. *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.*						
	(b)			The inner planets are rocky (1) The outer planets are gaseous (1) During formation rocks tended to gather close to the Sun and formed the rocky planets **or** gaseous substances gathered together at distances further away and formed the gas planets (1)	3			3		
				Question 3 total	**9**	**0**	**0**	**9**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			Alpha presents no danger or it can't pass through the skin (1) Beta **and** gamma can get into the body (1) Beta is more ionising [than gamma so more dangerous] (1) Treat statements about cancer as being neutral	3			3		
	(b)	(i)		Finding the ratio of LLW to reactors in UK = $\frac{30\,100}{15}$ = 2007 (1) For France, ratio = $\frac{87\,000}{58}$ = 1 500 so not valid (1) [Conclusion must be present to award 2 marks] **Alternative:** Ratio of reactors France to UK is $\frac{58}{15}$ = 3.87 (1) Ratio of LLW France to UK = $\frac{87\,000}{30\,100}$ = 2.89 so not valid (1) [Conclusion must be present to award 2 marks] **Alternative:** Ratio of reactors France to UK is $\frac{58}{15}$ = 3.87 (1) Expected LLW in France: 30 100 × 3.87 = 116 487 so not valid (1) [Conclusion must be present to award 2 marks]			2	2	2	
		(ii)	I	The presence of volcanoes (1) Creates a danger of leakage from the containers (1)			2	2		
			II	Large population in a small area / population density (1) means there is less likelihood of remote areas being available as storage sites **or** being stored far away from people (1)			2	2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		Low fuel <u>cost</u> [over time] (1) It now needs to include the cost of long term storage of the waste (which is very high) (accept reference to cost of decommissioning) (1)			2	2		
		(iv)		**Either:** **Sent on a rocket into space** (1) – adv-gone from Earth, disadv-costly/danger of take-off failure (1) **Or:** **Very deep sea storage** (Accept underwater) (1) – adv – well away from human activity, disadv – possible leakage in the long term (1) **Or:** **Polar ice cap storage or remote island** (1) – adv – well away from human activity – disadv – long term leakage etc (1) **Or:** **Vitrification** (1) – adv – easily stored, disadv – high cost (1)	2			2		
				Question 4 total	**5**	**0**	**8**	**13**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*	(i)		D		1		1		1
		(ii)		[k = 0.17 × 1 000 =] 170 [N/m]		1		1	1	1
	(b)	(i)		$F = kx$ = 120 × (10.7 × 10^{-3}) = 1.284 [N] (1) Substitution into: E = ½ Fx i.e. E = 0.5 × 1.284 **ecf** × (10.7 × 10^{-3}) **ecf** (1) = 0.0068694 [J] (1) Answer of 6.9 × 10^{n} where n is not -3 award a maximum of 2 marks	1	1 1		3	3	3
		(ii)		Substitution into $\mathrm{PE} = mgh$ i.e. 0.0068694 **ecf** = 0.015 × 10 × h (1) $h = \frac{0.0068694}{0.015 \times 10}$ (1-rearrangement) h = 0.045796 [m] (1) Accept 0.0458 or 0.046 or 0.05 Answer of 4.6 × 10^{n} where n is not -2 award a maximum of 2 marks Award 3 marks for an answer of 8.56 with **ecf** applied for E = 1.284 [J] Answer of 8.56 × 10^{n} where n is not 0 award a maximum of 2 marks	1	1 1		3	3	3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)	I	Dist = area under graph = $0.5 \times 0.9 \times 0.09$ (1) = 0.0405 [m] which is different (1) Accept 0.041 [m]			2	2	2	2
			II	Some of the stored energy in the spring is lost to heat **or** work done (1) As the spring retracts **or** friction **or** air resistance (1)	2			2		2
			III	Choose a spring that has a bigger stiffness constant **or** stiffer spring / bigger [maximum] extension **or** longer spring / smaller mass **or** weight ball / use spring D or F		1		1		1
				Question 5 total	**4**	**7**	**2**	**13**	**9**	**13**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	11	2	15	12	3
2	4	6	0	10	6	0
3	9	0	0	9	0	0
4	5	0	8	13	2	0
5	4	7	2	13	9	13
TOTAL	**24**	**24**	**12**	**60**	**29**	**16**