GCSE MARKING SCHEME

SUMMER 2018

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

INTRODUCTION

This marking scheme was used by WJEC for the 2018 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

SUMMER 2018 MARK SCHEME

UNIT 2: FORCES, SPACE and RADIOACTIVITY

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)			Get other groups or different people [e.g. students] to carry out experiment (1) If the data collected is <u>similar</u> [then it's reproducible] (1) [Independent mark]			2	2		2
	(b)			Drop number 2 or time = 1.10 seconds identified. If two times identified → 0			1	1		1
	(c)			1.48 + 1.52 + 1.54 + 1.46)/4 [**or** 6.00/4] (1) Without anomalous value **ecf** = 1.50 [s] (1) [Accept 1.5] Possible answers applying **ecf** 5.62 s → 1.41 s 5.58 s → 1.40 s 5.56 s → 1.39 s 5.64 s → 1.41 s If anomaly is included - award 1 mark for correct method/calculation [→ 1.42 s] [Accept 1.4]		2		2	2	2
	(d)			Substitution: $(0 + 14.2) \times 1.50$(**ecf**) $\div 2$ (1) = 10.65 [m] (1) NB 1.4 s → 9.9 m, 1.42 s → 10.1 m	1	1		2	2	2
				Question 1 total	**1**	**3**	**3**	**7**	**4**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Boxes 2 and 3 ticked: (1) + (1) **Note –** for each extra tick subtract 1 mark. No negative mark.		2		2		
		(ii)		Kepler 11 has <u>same</u> mass as our Sun (1) Kepler 11 has the [most] <u>similar</u> temperature to our Sun (1) Each additional item of data stated – 1 (minimum 0)			2	2		
	(b)	(i)		The exoplanet blocks / absorbs some light from the star Accept: there is a shadow / eclipse 'The planet doesn't give out light' – not enough	1			1		
		(ii)	I	2 orbits take 150 [days] or 300-150 [days] (1) Single orbit = $\frac{150}{2}$ = 75 [days] (1) [Accept 75 – 78 days] **Alternative** 4 orbits take 300 [days] (1) [accept 310 days] Single orbit = $\frac{300}{4}$ = 75 [days] (1) [Accept 75 – 78 days]			2	2	2	
			II	An extra/different / small<u>er</u> dip in the intensity line is present [accept: reference to an anomaly] **or** there is a dip at ~160 days Not just: there is a slight dip Not: another transit shown			1	1		
			III	[An absorption spectrum arises because] gases absorb some light (1) Different gases [accept: elements] [in the planet's atmosphere] have <u>different</u> black lines / [absorb light at] different wavelength / frequencies. (1)	2			2		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		In both systems the temperature decreases with distance / orbit radius (1) But In the Solar System Venus is the 2nd planet but the hottest /Mercury is the first and not the hottest (1) [i.e the nature of the anomaly must be made clear]			2	2		
		(ii)		0.25 – 0.26		1		1	1	
				Question 2 total	**3**	**3**	**7**	**13**	**3**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			The alpha particle / it has <u>two</u> fewer [accept: less] electrons / no electrons [Not: just less / fewer electrons] [Treat 'it' as the alpha particle] Reference to charge neutral – not credited or penalised	1			1		
	(b)	(i)		<table><tr><th></th><th>Element</th><th>Nucleon number</th></tr><tr><td>X</td><td>Pb / lead (1)</td><td>214 (1)</td></tr><tr><td>Y</td><td>Bi / bismuth (1)</td><td>214 (1)</td></tr></table> NB. Additional numbers in the nucleon number box $\rightarrow$ no mark.		4		4		
		(ii)		Z		1		1		
				Question 3 total	**1**	**5**	**0**	**6**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Substitution: $a = \frac{(25-0)}{20}$ (1) = 1.25 [m/s^2] (1) Substitution into $F = ma$ i.e. 5 000 [N] = $m \times$ 1.25 [m/s^2] (**ecf**) (1) = 4 000 [kg] (1) **Alternative** Substitution for v and t values from the graph: $F = \frac{\Delta p}{t}$ so $F = \frac{m(25-0)}{20}$ (2) [inclusion of *m* (1), substitution of values (1)] 5000 [N] = $m \times$ 1.25 [m/s^2] **ecf** (1) *m* = 4 000 [kg] (1) NB. Ecf on acceleration only if it is calculated [even mysteriously losing a '–' sign] Penalise mistakes in sign by -1.	1 1	1 1		4	4	
	(b)			Acceleration would be less [as mass increased] (1) [Not: slower] So the gradient would be less steep [Not: the line AB would be longer] (1)	1	1		2	1	
	(c)	(i)		If the [external] forces on an object are balanced/zero <u>resultant</u> force [accept: equal and opposite] (1) the object moves at constant velocity [or speed in a straight line] or is stationary / acceleration zero / uniform motion in a straight line (1)	2			2		
		(ii)		The velocity [accept: speed] is constant / is 25 m/s [accept: it has reached its terminal velocity / it is travelling at terminal velocity] (1) <u>Resultant</u> force [on bus] = zero / forces [on bus] are balanced (1)	1	1		2	1	
	(d)			Times at 12.5 m/s : 10 ± 2 s and 170 ± 2 s (1) [or by implication] 170 – 10 = 160 [s] (1) [accept 156 to 164 s]	1	1		2	1	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			Total area under graph = total distance travelled by bus (1) [Award on attempt to calculate total area under graph, not 25 × 190 ! : use of trapezium rule, or multiple areas] Substitution: (0.5 × 20 × 25) + (25 × 130) + (0.5 × 40 × 25) Or 0.5 × (130 + 190) × 25 (1) = 4 000 [m] (1) Other distances between 3900 m and 4 100 m → 2 marks up to this point] $v = \frac{4\,000(\textbf{ ecf})}{190}$ = 21.1 [m/s] (1) [20.5 – 21.6 m/s from above] Horizontal line at 21 m/s **ecf** (1) Tolerance ± ½ square. Ignore any parts of the line with *t* > 190 s & don't penalise slightly shorter lines **Alternative:** Use of equations of motion: $x = \frac{(v+u)t}{2}$ + (vt) + $\frac{(v+u)t}{2}$ (1) Substitution: $x = \frac{(25+0)}{2}$ x 20 +(25 ×130) + $\frac{(0+25)}{2}$ x 40 (1) = 4 000 [m] (1) Other distances between 3900 m and 4 100 m → 2 marks up to this point] $v = \frac{4\,000(\textbf{ ecf})}{190}$ = 21.1 [m/s] (1) Horizontal line at 21 m/s **ecf** (1) Tolerance ± ½ square. Ignore any parts of the line with *t* > 190 s & don't penalise slightly shorter lines	1 1	1 1 1		5	4	
				Question 4 total	**9**	**8**	**0**	**17**	**11**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Radioactive decay/dice throwing is a random process (1) A larger number reduces the effect of random variations [accept anomalous results] / gives more accurate value of half-life / reduces effects of random errors / large sample improves confidence in trend / improves confidence in results (1)	2			2		2
		(ii)		Ticks in 2nd 3rd and 5th boxes i.e. 3 × (1) **Note -** For each extra tick subtract 1 mark. No negative mark.			3	3		3
		(iii)	I	Represents a non-radioactive material present [accept background [count].			1	1		1
			II	Would always be 20 higher / would never go below 20			1	1		1
	(b)	(i)		$\frac{56}{8}$ = 7 half-lives (1) 68→34→17→8.5→4.25→2.13→1.07→0.54 (1 for halving the mass 7 times **ecf**) **or** $\frac{68}{2^7}$ **ecf** on number of half lives 0.5 [mg] to 1sig fig (1) [Do not accept 1 mg]		3		3	3	
		(ii)		Lead absorbs / blocks [all] the beta [radiation] [emitted from the strontium] (1) Lead reduces the gamma radiation (1) This reduces the exposure / received dose / amount of radiation / harm [to the scientist] (1)	3			3		
				Question 5 total	**5**	**3**	**5**	**13**	**3**	**7**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Indicative content:** **Description of fission** 1. A heavy nucleus, such as U-235, captures a slow neutron, splits into lighter nuclei (fission fragments), releases energy and excess neutrons 2. The fission reaction can be controlled safely with boron control rods, which absorb excess neutrons 3. A moderator is needed to slow down the neutrons so they can cause further fission events in a chain reaction **Description of fusion** 4. Two light nuclei, such as heavy hydrogen, collide and fuse producing helium and releasing energy 5. The process requires very high temperature and pressure, making it very difficult to contain. **Comparison** 6. Nuclear fission is splitting of nuclei; fusion is joining of nuclei. 7. Currently fission is used for energy generation but fusion reactors have not yet been built. 8. Badly-controlled fission reactors can overheat and cause meltdown / breach their containment; fusion reactors will be much safer and shut down automatically. 9. Fission products are long half-life radioactive materials and require safe storage; Fusion does not produce long half-life radioactive waste 10. Per kilogram, fusion releases more energy than fission **5 – 6 marks** Detailed description of both fission and fusion reactions and significant comparisons. *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	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				3 – 4 marks Outline description of both fission and fusion reactions with some comparison. *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** Some points made from any parts of the indicative content. *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)			Substitution: $\frac{6.2\times10^{x}}{2.82\times10^{-12}} = 2.2\times10^{n}$ with n = 18 (2) [$n \neq 18 \rightarrow$ (1)]	1	1		2	2	
				Question 6 total	**7**	**1**	**0**	**8**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		Scales on y-axis multiples of 2, scale on x-axis multiples of 5 (1) [NB. Points must occupy at least half of each axis] 5 points plotted correctly to within <1 small square division (2) 4 correct (1) 3 or less (0) Best fit line drawn to within <1 small square division - line need not extend to the x-axis.(1)	1	1 1 1		4	4	4
		(ii)		5 (or accept reading from candidate's graph)		1		1	1	1
	(b)	(i)		Use of area under the graph or $W = ½ Fx$ (1) Substitution: $0.5 \times 15 \times 10^{-2} \times 12$ (1) $= 0.9$ (1) Only 90 (without working) on the answer line → 1 mark Joules / J (1) or N m [but not kJ etc.] **Alternative:** Use of W = <u>mean</u> force × distance (1) $= \frac{(0+12)}{2} \text{ x } 15 \text{ x } 10^{-2}$ (1) $= 0.9$ (1) Only 90 (without working) on the answer line → 1 mark Joules / J (1) or N m [but not kJ etc.]	1 1 1	1		4	3	3
		(ii)		[Work done =] KE = 0.9 [J] (1) (**ecf** from (i)) Manipulation and substitution: $v^2 = \frac{0.9 \text{ ecf}}{0.5 \times 55 \times 10^{-3}}$ [or euqiv] (1) v = 5.7 m/s too fast / doesn't meet guidelines (1) (**ecf**)		1 1	1	3	3	3
		(iii)		Plane has <u>less</u> KE (1)… … because some energy [from spring system] 'wasted'/not transferred to plane [not: air resistance] (1)	2			2		1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iv)		Momentum also takes account of mass / momentum = mv (1) Heavier object with same velocity [accept: speed] / 4 m/s has more momentum / even a lower velocity [accept: speed] could have more momentum = more dangerous (1)		2		2		
				Question 7 total	**6**	**9**	**1**	**16**	**11**	**12**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	Total	Maths	Prac
1	1	3	3	7	4	7
2	3	3	7	13	3	0
3	1	5	0	6	0	0
4	9	8	0	17	11	0
5	5	3	5	13	3	7
6	7	1	0	8	2	0
7	6	9	1	16	11	12
Total	**32**	**32**	**16**	**80**	**34**	**26**