GCSE MARKING SCHEME

SUMMER 2018

PHYSICS - COMPONENT 1
HIGHER TIER
C420UA0-1

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

COMPONENT 1 – CONCEPTS IN PHYSICS

HIGHER TIER

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.
One tick must equate to one mark (except for the extended response question).
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)			Output power transfer = 900 [W] (1) Use of: $\text{Efficiency} = \frac{\text{output power transfer}}{\text{input power transfer}}$ (1) [or by implication] $= 0.6$ (1) (Accept $\frac{6}{10}$ or 60%)	1	1 1		3	2	
	(b)	(i)		Electrical energy generated = 1 000 × 9 000 = 9.0 million J (1) No of g of CO_2 saved = 9.0 × 120 = 1 080 which agrees with the claim (1) **ALTERNATIVE** $\frac{1000}{120} = 8.33 \text{ million J}$ (1) With either:1 000 W could be generated for 8 333 s Or: 1 153 W could be generated for 9 000 s – to save 1 kg of CO_2 emissions so this agrees with the claim (1)			2	2	2	
		(ii)		CO_2 contributes towards global warming / climate change Or: To slow down global warming / climate change	1			1		
				Question 10 total	**2**	**2**	**2**	**6**	**4**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			1.2 in second column (1) 7.4 in third column (1)		2		2	1	2
	(b)	(i)		Suitable scales using at least half of the graph in each direction and avoiding multiples of 3 (1) All six points plotted to within ± < 1 small square (2) Five points plotted to within ± < 1 small square (1) Four or fewer points plotted to within ± < 1 small square (0) Best fit straight line through the origin drawn with a ruler (1)		4		4	4	4
		(ii)		Reading to be taken from candidate's graph – expect 1.10 ± < 1 square tolerance (i.e. 0.01) [N]		1		1		1
		(iii)		Recall and substitution: e.g. $k = \frac{F}{x} = \frac{1.1\,(\text{ecf})}{4.4}$ (1) Conversion of 4.4 to 0.044 (1) k = 25 [N/m] (1) [accept k = 0.25 for 2 marks] Values should be taken from the graph not the table. Apply values from the graph. Do not accept extensions of 2.5 or 3.1 which do not lie on the line of best fit. Conversion mark is still available.	1	1 1		3	3	3
		(iv)		Straight line from origin above the original line (1) Exactly double the gradient of the original line (1)		2		2	1	2
	(c)	(i)		Recall and substitution: $E = ½kx^2$ = ½ × 25 ecf × (1.6 [× 10^{-2}])^2 (1) = 3.2 × 10^{-3} [J] (1) NB. 3.2 × 10^n ($n \neq -3$) → 1 mark	1	1		2	2	
		(ii)		Recall and substitution: 3.2 × 10^{-3} ecf = $½mv^2$ = ½ × 20 [×10^{-3}] × v^2 (1) v^2 = 3.2 × 10^{-1}, v = 0.57 [m/s] (1)	1	1		2	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		Stored energy would have increased by 4 times / become 1.28 $\times 10^{-2}$ ecf (1) (So v^2 would have become 4 times as big / 1.28) therefore v would be twice as big (1) Alternative qualitative answer: Energy [stored] increases so velocity increases $\rightarrow$ 1 mark.			2	2	1	
				Question 2 total	**3**	**13**	**2**	**18**	**14**	**12**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		Recall moment = $F \times d$ (1) [or by implication] Substitution: 650 × 18 [$\times 10^{-2}$] (1) = 117 [N m] (1) Allow 1 mark for correct conversion → 0.18 m if no other calculation mark given.	1 1	1		3	2	
		(ii)		1 300 [N]		1		1	1	
	(b)	(i)		The range of ratios available on the second gear are all available on either first or third gear on the chain-ring.			1	1		
		(ii)	I	Recall $f = \frac{1}{T}$ (1) [or by implication] $= \frac{1}{0.8} = 1.25$ [Hz] (1)	1	1		2	1	
			II	Gear ratio = 1.58:1 or 38:24 [or equiv or by implication] (1) No of rotations per second = 1.25 ecf × 1.58(1) = 1.975 **ecf** (1)			3	3	3	
			III	Circumference = 2.36 m (1) for conversion Speed = 2.36 × 1.975 ecf = 4.66 [m/s] (1)		2		2	2	
				Question 3 total	**3**	**5**	**4**	**12**	**9**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Very high temperature (1) and high pressure (1) To achieve a high speed / high energy of the nuclei / high collision rate(1) for [positive] nuclei to combine / collide /react / overcome repulsion (1)	4			4		
	(b)	(i)		${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$ [correct symbols required] Award 1 mark for correct left side (1) Award 1 mark for correct right side (1)	2			2		
		(ii)		The helium shown is a nucleus and has no electrons / the atom has 2 electrons (1) ${}^{3}_{2}\mathrm{He}$ is different from ${}^{4}_{2}\mathrm{He}$ in that it has one fewer neutron (1) No evaluation $\rightarrow 1_{max}$	2			2		
				Question 4 total	**8**	**0**	**0**	**8**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			20 million (1) waves / cycles each [or per] second (1)	2			2		
	(b)			**Any 2×(1) from:** • Changes in velocity [accept wavelength] • Change in density [at a boundary] • Absorption • Reflection.	2			2		
	(c)			Scanning a foetus must avoid the heating effect of waves / damage [or harm] the foetus (1) Lower frequency waves have lower energy (1) [Accept increased penetration – for 1 mark]			2	2		
	(d)	(i)		Converting units [cm → m or m/s → cm/s] (1) Doubling the distance (1) Time = 5.19×10^{-5} s **ecf** on distance and conversion(1)	1	1 1		3	2	

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Recall and substitution: $v = f\lambda$, 1540 = 2 × 10^7 × wavelength (1) Wavelength, $\lambda = \frac{v}{f} = \frac{1540}{2\times10^7} = 7.7\times10^{-5}$ [m] (1) Number of waves = $\frac{0.04}{7.7\times10^{-5}\text{ecf}}(1)$ = 520 (1) Do not penalise an answer of double this value owing to the presence of reflected waves in this distance Max penalty –1 for conversion, i.e. 5.2 × 10^n → 3 marks.	1	1 1 1		4	3	
				Question 5 total	**6**	**5**	**2**	**13**	**5**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		Currents through X and Y are equal / the same (1) p.d. across X is bigger than the p.d. across Y (1)	1	1		2		2
		(ii)		p.d.'s across X and Y are equal / the same (1) Current through X is smaller than the current through Y (1)	1	1		2		2
	(b)	(i)	I	$\frac{1}{R_P} = \frac{1}{4} + \frac{1}{12}$ [or by implication] (1) $\left[\text{Accept } R_P = \frac{4\times 12}{4+12}\right]$ R_P = 3 (Ω) (1)		2		2	2	2
			II	**Either:** $V_P = IR_P$ = 0.4 × 3(**ecf**) = 1.2 [V] (1) Then $I_4 = \frac{1.2}{4} = 0.3$ [A](1) and $I_4 = \frac{1.2}{12} = 0.1$ [A] (1) **OR**: As above for first two marks then I_{12} = 0.4 – 0.3 = 0.1[A] (1) **Alternative:** Resistors in ratio 3:1, or equiv. (1) Currents of 0.1 A and 0.3 A (1) I_{12} = 0.1 A; I_4 = 0.3 A (1)		3		3	2	3
			III	V_6 = 0.4 × 6 = 2.4 [V] (1) V_P = 1.2 [V] from (II) (**ecf**) or calculated here Then V_{cell} = 2.4 + 1.2(1) = 3.6 [V] (1) **Alternatively:** R_p = 3 Ω from (a)(i) ecf or calculated here Total circuit resistance = 3 (1) (**ecf**) + 6 = 9 Ω (1) V_{cell} = 0.4 × 9 = 3.6 [V] (1)		3		3	2	3

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		In series, the total resistance of the 12 Ω and 4 Ω resistors would be added [or greater than in parallel] or [22 Ω] (1)...... .... so the current would be **smaller [than** 0.4 [A]] **and** the statement is correct. (1)			2	2		2
				Question 6 total	**2**	**10**	**2**	**14**	**6**	**14**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Continuous loop drawn which satisfactorily represents a core of a transformer (1) Labelling of [soft] iron core (1) Stated function is to transfer or link the magnetic field from the primary coil into the secondary coil [more efficiently] / increases field strength (in the coils) (1)	3			3		3
	(b)	(i)		As the number of turns/coils on the primary coil increases, the secondary voltage decreases (1) at a decreasing rate (1) Inversely proportional $\rightarrow$ 2 marks		2		2		2
		(ii)		Selection; $\frac{V_1}{V_2} = \frac{N_1}{N_2}$ (1) Substitution: eg V_1 = 200 turns, N_2 = 6.0 V $\rightarrow \frac{40}{6} = \frac{200}{N_2}$ (1) $\rightarrow N_2 = \frac{200 \times 6}{40}$ = 30 turns (1)	1 1	1		3	2	3
	(c)			Substitution: $40I_1 = 3.6$ (1) $I_1 = \frac{3.6}{40}$ = 0.09 [A] (1) Assumption that the transformer is perfectly efficient or stated/ the equation stated $V_1I_1 = V_2I_2 = P$(1)	1 1	1		3	3	3
				Question 7 total	**7**	**4**	**0**	**11**	**5**	**11**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8				**Indicative content:** **Light absorption** 1. The energy of the in-coming light wave must exactly match the energy difference between an electron in its orbital and its energy at a higher level. 2. The energy is absorbed as the electron is raised to the higher energy level. **Gamma absorption** 3. The absorption of a gamma ray can cause an electron to be knocked out of an atom with energy left over (kinetic). **Light emission** 4. A wave of visible light is emitted when an orbital electron in a high (excited) energy level moves to a lower one. 5. The light energy released is equal to the energy difference between the atom energy levels / same frequency as the one absorbed. **Gamma emission** 6. The emission is caused by a change in the energy levels of an unstable nucleus. In the case of absorption of light, the. . . . This happens after an electron is excited to a higher energy level following which it moves back from the higher (outer) energy level to a lower one and in doing so releases an amount of energy that is equal to the difference. In the case of gamma ray emission, the energy of the wave is much greater and the energy changes in this case are associated with energy level changes in an unstable nucleus and not the orbital electrons. **5 - 6 marks** Expect to see 5 points made from at least three of the different sections of the indicative content. *There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.*	6					

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				3 - 4 marks Expect to see at least 3 points made from at least two of the different sections of the indicative content. *There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.* **1-2 marks** Expect candidates to make one or two points from anywhere in the indicative content. *There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure*. *There may be significant errors or the inclusion of information not relevant to the argument.* **0 marks** *No attempt made or no response worthy of credit.*						
				Question 8 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			5 [s]		1		1	1	
	(b)	(i)		Final velocity , v-=13 [m/s] (1) Subtracting –5 / adding 5 (1) $\rightarrow$ 18 [m/s]		2		2	1	
		(ii)		[In this context] the distance travelled includes both the forward and the reverse direction, but the displacement is the separation [distance] between the start and end points.(1) Either 242.5 m or 212.5 m calculated. (1) Second value calculated and both identified (1)	1	1 1		3	2	
	(c)			Recall and substitution: $a = \frac{(0-13)}{10}$ or $\frac{13}{10}$ (1) = (–)1.3 [m/s^2] (1) Recall and substitution: $F = ma$ = 90 × 1.3 ecf (1) = 117 [N] (1)	1 1	1 1		4	2	
	(d)			B + D – E = A + B + C All operators correct (1) D – E = A + C All operators correct (1) No ecf			2	2	2	
				Question 9 total	**3**	**7**	**2**	**12**	**8**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Measure the time taken for it to drop from top to bottom using light gates / mechanical gates OR slow motion footage (1) to eliminate the effect of reaction time(1) Use the equation $x = ut + ½at^2$ (1)			3	3		3
	(b)			Recall of $E_P = mgh$ (1) or by implication $= 0.4 \times 10 \times 13.5 = 54$ [J] (1) Selection of $\Delta Q = mc\Delta\theta$ (1) Substitution: 54 (**ecf**) = $0.4 \times c \times 1.5$ (1) $c = \frac{54}{0.6}$ = 90 [J/kg °C] (1)	1 1 1	 1 1		5	3	5
	(c)			**Any 2 pairs from:** - If all the [potential / kinetic] energy had not been converted to thermal energy in the putty (1) then the calculated value for the specific heat capacity would be too large.(1) - If the value of "g" had been taken to be 9.8 and not 10 (1) then the calculated value for the specific heat capacity would be too large. (1) - If the height was calculated / or time was measured to be smaller than the value given (1) then the specific heat would be reduced (1) (or converse) - Temperature measured to be too high (1) would give a lower value of c (1) (or converse)			4	4		4
				Question 10 total	**3**	**2**	**7**	**12**	**3**	**12**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			Every object continues in its state of rest or [uniform] motion [in a straight line] (1) unless acted upon by an (external) resultant force (1)	2			2		
	(b)			The perpendicular component / Component B alters the direction of its velocity (1) The tangential component / Component A alters the size of its velocity (1)	2			2		
	(c)			The distance moved in the direction of the force is zero/ the angle between the force and the direction of motion is 90^0	1			1		
	(d)			Circumference = $2\pi r$ = 2 × 3.14 × 5.0 = 31.42 (± 0.01) AU = 31.42 × 149.6 × 10^6 km = 4.70 × 10^9 km (1) $\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{4.70\times10^9\,(\text{e.c.f.})}{13\,(1)}$ [Division by 13] = 3.61 × 10^8 s = 11.44 y (1) Use of r [in km] rather than $2\pi r$ → 1.8 years → 2 marks			3	3	3	
				Question 11 total	**5**	**0**	**3**	**8**	**3**	**0**

COMPONENT 1 - Concepts in Physics

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	2	2	6	4	0
2	3	13	2	18	14	12
3	3	5	4	12	9	0
4	8	0	0	8	0	0
5	6	5	2	13	5	0
6	2	10	2	14	6	14
7	7	4	0	11	5	11
8	6	0	0	6	0	0
9	3	7	2	12	8	0
10	3	2	7	12	3	12
11	5	0	3	8	3	0
TOTAL	**48**	**48**	**24**	**120**	**57**	**49**