GCSE MARKING SCHEME

SUMMER 2018

PHYSICS - COMPONENT 2
HIGHER TIER
C420UB0-1

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 2 – Applications 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

SECTION A

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		More space between galaxies / galaxies moved apart Not: the universe has expanded		1		1		
		(ii)		Both moved away from C [or the distances have both increased] (1) A more than D [accept: A faster than D] (1) NB 'A has moved away more / faster than D' $\rightarrow$ both marks		2		2		
		(iii)		B$\rightarrow$E$\rightarrow$A$\rightarrow$D		1		1		
		(iv)		G2 **ecf**		1		1		
	(b)			E6 (1) SBb (1)			2	2		
	(c)	(i)		Scales: y-axis 200 per 2 cm square and x-axis 0.4[or 0.5] per 2 cm square (1) 6 plots correct (2) < 1 square tolerance [ignore (0,0)] 5 plots correct (1) 4 or fewer (0) Suitable straight line through origin (1) [not through extreme points]		4		4	4	
		(ii)		Suitable y and x value chosen (1) Answer in line with graph (1) Expect: 400 – 750 km/s/Mpc.		2		2	2	
		(iii)		May draw a different line of best fit (1) so gradient will be different (1)			2	2		
				Question 1 total	**0**	**11**	**4**	**15**	**6**	**0**

SECTION B

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks available					
2	(a)			Ray inside block bent towards normal (not along normal) (1) Ray outside block bent away from normal (1) Incident ray and ray exiting block parallel by eye (1)	3			3		3
	(b)			{Ray / wavefront} slows down (1) when it enters optically denser medium (1)	2			2		2
				Question 2 total	**5**	**0**	**0**	**5**	**0**	**5**

Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
3	*(a)*			White can cools quick<u>est</u> [or equiv] (1) ..at {4 °C <u>per minute</u> / 8 °C over the <u>two minutes</u>} (1)		2		2	2	2
	(b)			Grey can (1) as its temperature drops the most (1)		2		2		2
	(c)			Black surfaces are the best emitters of infra- red (1) so black should cool the most (1) OR Black can starts at a lower temperature than the other two (1) so it loses the least amount of heat as the temperature gradient is less (1)	2			2		2
	(d)			Start temperature not the same for all cans (1) allow to cool to a selected temperature before starting the experiment (1) Volume [of water] not controlled (1) Measure volume of water with a measuring cylinder (1)		1 1	1 1	4		4
				Question 3 total	**2**	**6**	**2**	**10**	**2**	**10**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			The rod is charged by friction / rubbing (1) Electrons move from the rod onto the cloth (1) Leaving a deficit of {electrons / negative charge} [or excess of {protons /positive charge}] (1)	3			3		3
	(b)			Recall and substitution into: $Q = It$ i.e. $0.5 \times [10^{-9}] = I \times 0.1 \times [10^{-6}]$ (1) Accept $0.\ 0005 = I \times 0.1$ Rearrangement (1) Answer 0.005 [A] (1) 5 A award 2 out of 3 marks	1	1 1		3	3	3
	(c)			There is an electric field around the charged rod (1) where other charges experience a force (1) **Alternative:** The positive rod attracts (negative) electrons in paper (1) This pulls them closer than the positive nuclei so there is a net attraction (1)	2			2		2
				Question 4 total	**6**	**2**	**0**	**8**	**3**	**8**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Surface of ramp (1) …because different surfaces have more or less friction (1) Same type of squash ball (1) …. because different squash balls have more or less rolling resistance [accept: friction] (1) [do not accept same mass] OR Start position on ramp (1) Different start positions will change the height or distance travelled down the ramp (1)	4			4		4
	(b)			**Indicative content (see appendix for alternative)** **Method** 1. Set the height of the ramp to 10 cm above the desk. 2. Measure a distance of e.g 50 cm from the end of the ramp and mark this point. 3. Release the squash ball from the top of the ramp starting the stopwatch as you do. 4. When the squash ball reaches the bottom of the ramp press the lap button on the stopwatch. 5. Stop the stopwatch when the squash ball reaches the 50 cm mark. 6. Record the time taken for the ball to travel down the ramp (lap time) and the total time. 7. Repeat steps 1-6 increasing the height in 5 cm intervals each time up to 25 cm. 8. Repeat the experiment twice more. **Analysis** 1. Calculate the time taken for the ball to travel e.g. 50 cm along the bench; this is the total time – the lap time. 2. Calculate the velocity at the bottom of the ramp using the formula: velocity = 0.5 ÷ mean time taken to travel 50 cm along the bench 3. Calculate the acceleration using the formula: acceleration = velocity at bottom of ramp ÷ mean time to reach bottom of ramp 4. Plot a graph of ramp height against acceleration. *Other equally valid methods such as use of $x = ut + ½ at^2$ can access all the marks.*	6			6	2	6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				5 – 6 marks Describes the method fully with suitable range and values of the independent variable suggested. Details how to measure velocity at the bottom of the ramp **and** how to calculate acceleration. *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.* **3 – 4 marks** Describes the method but leaves out some detail e.g. omits detail on values of variables / how to calculate acceleration or detailed method with no analysis *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** Describes a basic method such as timing duration of travel for different heights of ramp. *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.*						
				Question 5 total	**10**	**0**	**0**	**10**	**2**	**10**

Appendix to Q5 *(b)*

Indicative content using $x = ut + \frac{1}{2}at^2$

Method

1. Set the height of the ramp to 10 cm above the desk.
2. Measure the distance from the top to the bottom of the ramp, x.
3. Release the squash ball from the top of the ramp starting the stopwatch as you do.
4. When the squash ball reaches the bottom of the ramp press the stop button on the stopwatch. Record the time.
5. Repeat steps 3 – 4 twice and calculate the mean time, t.
5. Repeat steps 3 – 5 increasing in the height in 5 cm intervals each time up to 25 cm.

Analysis

1. For each height calculate the acceleration using $x = ut + \frac{1}{2}at^2$ with u = 0. [Or, calculate the final velocity from $x = \frac{u+v}{2}t$ and then use $a = \frac{v-u}{t}$]
2. Plot a graph of acceleration against height

Or alternative method using light gates to measure velocities at different positions when rolling down the ramp.

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
6	(a)			2.50 (do not accept 2.5)	1			1	1	1
	(b)	(i)		Smooth curve through the origin		1		1		1
		(ii)		As depth increases speed increases (1) at a decreasing rate (1)		2		2		2
	(c)			When depth doubles from 0.5 cm to 1.0 cm speed increases from 22.5 m/s to 32.2 m/s a factor of 1.43 (1) This is close to 1.41 so supports theory [accept: which is different from 1.41 so not true] (1) **OR** $22.5 \times \sqrt{2}$ = 31.8 m/s (1) This is close to 32.2 m/s so supports theory (1) **OR** When depth doubles from 1.0 cm to 2.0 cm speed increases from 32.2 m/s to 45.8 m/s a factor of 1.42 (1) This is close to 1.41 so supports theory (1) **OR** $32.2 \times \sqrt{2}$ = 45.5 m/s (1) This is close to 44.0 m/s so supports theory (1)			2	2	1	2
	(d)	(i)		Because at this depth the times are smaller (1) So random errors in timing have a greater effect (1)			2	2	1	2
		(ii)		Yes because {its degree of scatter / range of times} is the same as other depths but the times are smaller.			1	1		1
	(e)	(i)		Substitution: $v = \sqrt{10 \times 0.025}$ (1) [accept 2.5] v = 0.5 [m/s] c.a.o.(1)		2		2	2	2
		(ii)		This is 48 cm/s so close to 50 cm/s so data are accurate			1	1		1
				Question 6 total	**1**	**5**	**6**	**12**	**5**	**12**

COMPONENT 2 – Applications in Physics

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

	Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Section A	1	0	11	4	15	6	0
Section B	2	5	0	0	5	0	5
	3	2	6	2	10	2	10
	4	6	2	0	8	3	8
	5	10	0	0	10	2	10
	6	1	5	6	12	5	12
	TOTAL	**24**	**24**	**12**	**60**	**18**	**45**