OCR
Oxford Cambridge and RSA

…day June 20XX–Morning/Afternoon

AS Level Physics A

H156/02 Depth in physics

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

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This document consists of 16 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

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5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space

   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')

   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

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10. For answers marked by levels of response:

- Read through the whole answer from start to finish.
- Decide the level that **best fits** the answer – match the quality of the answer to the closest level descriptor.
- To select a mark within the level, consider the following:

  Higher mark: A good match to main point, including communication statement (in italics), award the higher mark in the level
  Lower mark: Some aspects of level matches but key omissions in main point or communication statement (in italics), award lower mark in the level.

  Level of response questions on this paper are **5(b)** and **7(a)**.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

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12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

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CATEGORISATION OF MARKS

The marking schemes categorise marks on the MACB scheme.

B marks: These are awarded as independent marks, which do not depend on other marks. For a **B**-mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

M marks: These are method marks upon which **A**-marks (accuracy marks) later depend. For an **M**-mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular **M**-mark, then none of the dependent **A**-marks can be scored.

C marks: These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a **C**-mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C**-mark is given.

A marks: These are accuracy or answer marks, which either depend on an **M**-mark, or allow a **C**-mark to be scored.

Note about significant figures:

If the data given in a question is to 2 sf, then allow to 2 or more significant figures.
If an answer is given to fewer than 2 sf, then penalise once only in the entire paper.
Any exception to this rule will be mentioned in the Additional Guidance.

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Question			Answer	Marks	Guidance
1	(a)		Take moments about contact point of rod and wall (because this removes the unknown forces in the calculation). *W* x *l*/2 = *F* x *l* **or** the vertical force is at a distance twice that for the weight.	**B1** **B1**	
	(b)		*T* = 60/sin 30 **or** 60/cos 60 *T* = 120 (N)	**C1** **A1**	
	(c)	(i)	arrow from rod wall junction through point where T and line of W cross.	**B1**	
		(ii)	require triangle of forces for equilibrium **or** the forces must pass through a point for equilibrium.	**B1**	
			Total	**6**	

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Question			Answer	Marks	Guidance
2	(a)		horizontal component = 17 sin 30 or 17 cos 60 = 8.5(m s^{-1}) at highest point vertical component of velocity is zero.	B1 B1	
	(b)	(i)	u = 17 cos 30 = 14.7 (m s^{-1}) h = ut - ½gt^2; = 14.7 x 1.5 - ½ x 9.81 x 1.5^2 h = 11 (m)	C1 C1 A1	**or** use $v^2 = u^2 – 2gs$ **or** s = (u + v)t/2 **note**: if g = 10 is used, then maximum score is 2/3
		(ii)	s = 2 x 8.5 x 1.5 s = 26 (m)	C1 A1	**ecf 2a** allow 25.5 m
	(c)		0 = 17 sin 30 t - ½ x 9.81 x t^2 so t = 0 or 17/9.81 = 1.73 s = 14.7 x 1.73 = 25.4 (m)	C1 C1 A1	 allow s = 15 x 1.7 = 25.5 (accept 25 or 26 to 2 sf)
	(d)		the ball has the <u>same</u> speed (of 17 m s^{-1}) but is at <u>different</u> (either at 60° or 30°) angle to the horizontal. larger horizontal velocity (second trajectory) so travels further or higher bounce (first trajectory) so less drag from grass so travels further.	B1 B1	 accept any sensible answer, e.g. steeper bounce loses more energy in impact so slows more.
			Total	**12**	

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Question			Answer	Marks	Guidance
3	(a)	(i)	48 (N);0.25 (s)	A1	both values correct; no tolerance
		(ii)	estimate area under graph by counting squares **or** method of estimating mean F multiplied by time of contact (0.25 s)	B1 B1	second mark awarded for some detail about how to estimate area. e.g. areas above and below mean under curve are equal.
	(b)	(i)	(F = ma) a = 48/0.6 a = 80 (m s^{-2})	C1 A1	**ecf a(i)**
		(ii)	(Ft = mv) v = 6.5/0.6 v = 11 (m s^{-1})	C1 A1	**ecf a(i)** allow 10.8
	(c)		Ft = mv + mu Ft = 0.6 (6 + 11) = 10(.2) F = 10/0.18 = 57 (N)	C1 C1 A1	award 1 mark out of 3 for mv - mu; = 0.6 (11 - 6) = 3 giving 17 (N).
			Total	10	

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Question			Answer	Marks	Guidance
4	(a)		electron; ion	B1	both required for 1 mark.
	(b)	(i)	$I = Q/t = 650/5 = 130$ A	A1	
		(ii)	$n = I/e = 130/1.6 \times 10^{-19} = 8.13 \times 10^{20}$	A1	**ecf(b)(i)**.
		(iii)	$I = 10^{29}Aev$ giving $8.13 \times 10^{20} = 10^{29}Av$ $v = 8.13 \times 10^{20} / 10^{29} \times 3.0 \times 10^{-4} = 2.7 \times 10^{-5}$ (m s^{-1}).	C1 A1	**ecf(b)(ii)**.
	(c)	(i)	because of Kirchhoff's first law **or** statement of this law.	B1	
		(ii)	Using $I = nAev$ so v is proportional to 1/A giving 5.4×10^{-5} (m s^{-1}).	B1	**ecf(b)(iii)**.
			Total	**7**	

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Question			Answer	Marks	Guidance
5	(a)		V across 750 Ω = 45 - 0.03 x 1000 = 15 (V) current in 750 Ω = 15/750 = 0.02 (A) current in **R** = 0.01 (A) R = 15/0.01 = 1500 (Ω)	**C1** **C1** **C1** **A1**	several methods available, e.g. find the total resistance = 45/0.03 = 1500 (Ω) resistance of parallel pair = 500 (Ω) $R=(500^{-1} – 750^{-1})^{-1}$ = 1500 (Ω) or use potential divider argument.
	(b)*		**Level 3 (5–6 marks)** Circuit including meter is correctly drawn. Explanation of action of circuit is correct. Concept of sensitivity understood and 750 Ω justified (6 marks) LDR wrong symbol or value of resistor not fully justified (5 marks). *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Circuit has correct symbol for LDR Action of circuit explanation limited 750 Ω stated but not justified Concept of sensitivity (4 marks) Any point omitted or incorrect (3 marks). *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.*	**B1** **x6**	**circuit diagram** 1. resistor and LDR in series 2. ammeter in series or voltmeter in parallel with resistor 3. correct symbols for LDR, ammeter, voltmeter, etc. **action of circuit** 1. when light intensity increases R of LDR falls 2. so I in circuit increases or V across resistor increases or *V* across LDR decreases (meter reading increases). **meter and sensitivity** 1. need the largest change in current or voltage for a given change in light intensity 2. choose resistor of 750 Ω to give the largest change on the meter **or** need a meter which can display small changes in value of current or voltage.

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Question			Answer	Marks	Guidance
			Level 1 (1–2 marks) Correct symbol for LDR (1 mark) Action of circuit only addresses point (1 mark) Sensitivity poorly addressed (1 mark) (Maximum 2 marks) *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.		
			Total	**10**	

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Question			Answer	Marks	Guidance
6	(a)		tube pushed into water by λ/2	B1	allow any statement about antinode needed at open end and node at water level.
			therefore λ/2= 0.506 – 0.170 giving λ = 0.672 (m)	B1	
			using v = fλ	C1	
			v = 500 x 0.672 = 336 (m s^{-1})	A1	A solution worked to 2 SF will score a maximum of 3 marks.
	(b)		smaller λ means smaller l to measure, so less accurate measurement.	B1	
			added detail or expansion of argument.	B1	
	(c)		the wave reflected at the end of the pipe interferes/superposes with the incident wave .	B1	
			to produce a resultant wave with nodes and antinodes.	B1	
			both ends must be antinodes **or** the pipe must be nλ/2 in length for this to happen.	B1	
			at **Q** air molecules <u>oscillate</u>	B1	**allow** vibrate.
			with motion along the axis of the tube **or** with maximum amplitude.	B1	
			at **P** no motion/nodal point.	B1	
			Total	12	

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Question			Answer	Marks	Guidance
7	(a)*		**Level 3 (5–6 marks)** at least E3,4 and 2 or 5 at least P1,2 and 5 *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** expect 3 points from E and 2 points from P or 2 points from E and 3 points from P *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** at least 2 points from E and 1 point from P or vice versa. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.	**B1 x 6**	**Experiment (E)** 1. Adjust the potential divider to low or zero voltage 2. connect flying lead to one LED 3. increase voltage until LED just lights or strikes 4. repeat several times and average to find V_{min} 5. repeat for each LED 6. shield LED inside opaque tube to judge strike more accurately. **Processing (P)** 1. a graph of V_{min} against $1/\lambda$ will be a straight line 2. through the origin 3. so need to calculate values of $1/\lambda$ 4. then draw line of best fit through origin 5. gradient $G = V_{min}\ \lambda = hc/e$ 6. hence $h = eG/c$
	(b)	(i)	The wave-model cannot explain the cut-off frequency/threshold frequency Nor why the KE of the electrons is dependent on frequency	**B1** **B1**	Allow reverse argument in terms of photons, e.g. the photon-model can explain the threshold frequency and why the KE of the electrons is dependent on frequency.

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Question			Answer	Marks	Guidance
		(ii)	h = 32 x 10^{-20}/5 x 10^{-14} = 6.4 x 10^{-34} (J s)	C1 A1	sensible attempt at gradient gains 1 mark
		(iii)	8.75 ± 0.25 x 10^{14} (Hz)	B1	tolerance is to within grid square
		(iv)	φ = 6.4 x 10^{-34} x 8.75 x 10^{14} = 5.6 x 10^{-19} (J)	C1 A1	**ecf (b)(i)(ii)**
			Total	**13**	

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Summary of updates

Date	Version	Change
January 2019	2.0	Minor accessibility changes to the paper: i) Additional answer lines linked to Level of Response questions ii) One addition to the rubric clarifying the general rule that working should be shown for any calculation questions

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