



Cambridge
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PHYSICS**9702/23**

Paper 2 AS Level Structured Questions

May/June 2019

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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This document consists of **10** printed pages.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)(i)	potential difference / current	B1
1(a)(ii)	$R = 4.0 \times 10^9 (\Omega)$	C1
	$I = 0.60 / 4.0 \times 10^9 = 1.5 \times 10^{-10} (\text{A})$	A1
	$I = 150 \text{ pA}$	
1(b)	units of energy: $\text{kg m}^2 \text{s}^{-2}$	C1
	units of charge: As	C1
	units of potential difference: $(\text{kg m}^2 \text{s}^{-2} / \text{As} =) \text{kg m}^2 \text{A}^{-1} \text{s}^{-3}$	A1

Question	Answer	Marks
2(a)(i)	1. $W = mas$	B1
	2. $s = (v^2 - u^2) / 2a$	B1
2(a)(ii)	W /work equals energy transferred/ <u>gain or change in</u> kinetic energy	B1
	$W (= mas) = ma(v^2 - u^2) / 2a$	B1
	leading to $W = m(v^2 - u^2) / 2$ (so $KE = \frac{1}{2}mv^2$)	
2(b)(i)	1. solid curved line drawn from X to Y along path of ball and labelled D	B1
	2. solid straight line drawn from X to Y and labelled S	B1
2(b)(ii)	$(\Delta)E = mg(\Delta)h$	C1
	$4.5 = (0.040 \times 9.81 \times h) + (\frac{1}{2} \times 0.040 \times 9.5^2)$	C1
	$h = 6.9 \text{ m}$	A1
2(b)(iii)	line with a negative gradient starting from a non-zero value of kinetic energy when the vertical height is zero	M1
	<u>straight</u> line ends at a non-zero value of kinetic energy when the vertical height is h	A1

Question	Answer	Marks
3(a)	$P = Fv$	C1
	$P = 8.9 \cos 30^\circ \times 0.60$ $= 4.6 \text{ W}$	A1
3(b)	$p = F / A$	C1
	$F = 8.9 \sin 30^\circ + (0.24 \times 9.81)$ $(= 6.80 \text{ N})$	C1
	$A = 6.80 / 3500$ $= 1.9 \times 10^{-3} \text{ m}^2$	A1
3(c)(i)	upwards/up	B1
3(c)(ii)	the Earth/planet	B1

Question	Answer	Marks
4(a)	straight (horizontal) lines and from the +0.90 kV plate/to the 0 V plate	B1
	(lines are) equally spaced	B1
4(b)	weight/gravitational force and electric force	B1
4(c)	$s = \frac{1}{2}at^2$ or $s = ut + \frac{1}{2}at^2$ and $u = 0$	C1
	$2.0 = \frac{1}{2} \times 9.81 \times t^2$ so $t = 0.64$ s	A1
4(d)	$0.080 = \frac{1}{2} \times a \times 0.64^2$	C1
	$a = 0.39$ m s ⁻²	A1
4(e)(i)	$E = (\Delta)V / (\Delta)d$	C1
	$E = 0.90 \times 10^3 / 0.12$ $= 7.5 \times 10^3$ N C ⁻¹	A1
4(e)(ii)	$ma = Eq$ or $F = ma$ and $F = Eq$	C1
	$q / m = 0.39 / 7.5 \times 10^3$ $= 5.2 \times 10^{-5}$ C kg ⁻¹	A1
4(f)(i)	no effect	B1
4(f)(ii)	decreases/smaller	B1

Question	Answer	Marks
5(a)	(incident) wave reflects at end/top of tube	B1
	(incident) wave and reflected wave interfere/superpose	B1
5(b)	line has maximum value of amplitude at $h = 0$ and $h = 0.60$ m only	B1
	line has minimum/zero value of amplitude at $h = 0.30$ m only	B1
5(c)(i)	vertical/along length of tube/along axis of tube	B1
5(c)(ii)	phase difference = 0	A1
5(d)	$v = f\lambda$	C1
	$v = 340 / (2 \times 0.60)$ $= 280$ Hz	A1
5(e)	$f = 340 / 0.60$ $= 570$ Hz	A1

Question	Answer	Marks
6(a)	volt / ampere	B1
6(b)(i)	1. $I = 1.8 + 0.60$ $= 2.4 \text{ A}$	A1
	2. $(8.0 \times 0.60) = 1.8 \times (2.0 + R_Z)$	C1
	$R_Z = 0.67 \Omega$	A1
	3. $E - (2.4 \times 1.5) = (0.60 \times 8.0)$ or $E - (2.4 \times 1.5) = 1.8 \times (2.0 + 0.67)$ or $E = 2.4 \times [1.5 + (8.0 \times 2.67) / (8.0 + 2.67)]$	C1
	$E = 8.4 \text{ V}$	A1
6(b)(ii)	1. $R = \rho L / A$ or $R \propto 1 / A$	C1
	ratio $= R_Y / R_X = 2.0 / 8.0$ $= 0.25$	A1
	2. $I \propto Av$ or $I_X / I_Y = A_X v_X / A_Y v_Y$	C1
	ratio $= (0.60 / 1.8) \times (1 / 0.25)$ $= 1.3$	A1

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Question	Answer	Marks
7(a)	beta/ β	B1
7(b)	alpha/ α	B1
7(c)	gamma/ γ	B1
7(d)	beta/ β	B1