Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/23**

Paper 2 AS Level Structured Questions **October/November 2023**

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.

Cambridge International is publishing the mark schemes for the October/November 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

© UCLES 2023

Abbreviations

/	Alternative and acceptable answers for the same marking point.
( )	Bracketed content indicates words which do not need to be explicitly seen to gain credit but which indicate the **context** for an answer. The context does not need to be seen but if a context is given that is incorrect then the mark should not be awarded.
___	Underlined content must be present in answer to award the mark. This means either the exact word or another word that has the same technical meaning.

Mark categories

B marks	These are independent marks, which do not depend on other marks. For a **B** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer.
M marks	These are method marks upon which **A** marks later depend. For an **M** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer. If a candidate is not awarded an **M** mark, then the later **A** mark cannot be awarded either.
C marks	These are compensatory marks which can be awarded 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 them. 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 awarded. If a correct answer is given to a numerical question, all of the preceding **C** marks are awarded automatically. It is only necessary to consider each of the **C** marks in turn when the numerical answer is not correct.
A marks	These are answer marks. They may depend on an **M** mark or allow a **C** mark to be awarded by implication.

© UCLES 2023

Question	Answer	Marks
1(a)	charge **and** power only ticked	**B1**
1(b)(i)	$\%D = 0.4\%$ **and** $\%L = 0.6\%$	**A1**
1(b)(ii)	$\rho = (4 \times 0.247) / [\pi \times (26.2 \times 10^{-3})^2 \times 0.162]$	**C1**
	$\rho = 2.83 \times 10^3$ kg m^{-3}	**A1**
1(b)(iii)	percentage uncertainty $= 0.4 + (2 \times 0.4) + 0.6$	**C1**
	$= 1.8\%$	**A1**

Question	Answer	Marks
2(a)(i)	(time / t =) 9(.0) / 9.5 = 0.95 (s)	**A1**
2(a)(ii)	(u_V) = 9.5 tan 38° **or** 9.5 / tan 52° **or** 9.5 = u cos 38° **and** $u_V = u$ sin 38° **or** 9.5 = u cos 38° **and** $u_V = (u^2 - 9.5^2)^{½}$	**C1**
	$u_V = 7.4$ m s^{-1}	**A1**
2(a)(iii)	$s = ut + ½at^2$ (h =) $7.4 \times 0.95 - ½ \times 9.81 \times 0.95^2$	**C1**
	$h = 2.6$ m	**A1**
2(b)	(collision is) inelastic	**B1**

Question	Answer	Marks
3(a)	resultant force (in any direction) is zero	**B1**
	resultant moment / torque (about any point) is zero	**B1**
3(b)(i)	$F = \rho Vg$ $V = 93\,000 / (1.2 \times 9.81)$ $= 7900\ \text{m}^3$	**A1**
3(b)(ii)	weight $= 93\,000 + 3(.0) \times 10^3$	**C1**
	$m = (93\,000 + 3.0 \times 10^3) / 9.81$ $= 9800\ \text{kg}$	**A1**
3(c)(i)	$(\Delta p) = F(\Delta)t$ **or** $F = \Delta p / (\Delta)t$ **or** F = rate of change of momentum **or** $F = m\,(v - u) / t$	**C1**
	$\Delta p = 2800 \times 0.50$ $= 1400\ \text{kg m s}^{-1}$	**A1**
3(c)(ii)	$(\Delta p =)\ mv$	**C1**
	$v = 1400 / 64$ $= 22\ \text{m s}^{-1}$	**A1**

© UCLES 2023

Question	Answer	Marks
3(c)(iii)	$E_K = ½mv^2$	**C1**
	$= ½ \times 64 \times 22^2$ $= 15\,000$ J	**A1**
	or	
	$E_K = p^2 / 2m$	**(C1)**
	$= 1400^2 / (2 \times 64)$ $= 15\,000$ J	**(A1)**

Question	Answer	Marks
4(a)(i)	spring constant	**B1**
4(a)(ii)	area represents the work done (to extend the wire)	**B1**
	work done (to extend the wire) is equal to elastic potential energy	**B1**
4(b)(i)	x_G = 0.39 mm **and** x_H = 0.29 mm	**A1**
4(b)(ii)	$E = \frac{1}{2}Fx$ **or** $E = \frac{1}{2}kx^2$ **and** $F = kx$ **or** E = area under graph	**C1**
	for G: $E = \frac{1}{2} \times 2.0 \times (0.39 \times 10^{-3})$ **or** $\frac{1}{2} \times 5.1 \times 10^3 \times (0.39 \times 10^{-3})^2$ for H: $E = \frac{1}{2} \times 2.0 \times (0.29 \times 10^{-3})$ **or** $\frac{1}{2} \times 6.9 \times 10^3 \times (0.29 \times 10^{-3})^2$ $E_P = 3.9 \times 10^{-4} + 2.9 \times 10^{-4}$ $= 6.8 \times 10^{-4}$ J	**A1**
4(b)(iii)	$E = FL / Ax$ **or** stress / strain = FL / Ax	**C1**
	$A_G / A_H = 1 \times (0.29 \times 10^{-3}) / [1.5 \times (0.39 \times 10^{-3})]$	**C1**
	ratio = 0.50	**A1**

© UCLES 2023

Question	Answer	Marks
5(a)(i)	cross labelled Y drawn: at any position where wavefronts cross **or** centrally in a 'diamond' shape formed between any adjacent wavefronts from A and B	**B1**
5(a)(ii)	cross labelled Z drawn on a wavefront from one source at a point midway between adjacent wavefronts from the other source	**B1**
5(b)(i)	$\lambda = ax / D$	**C1**
	$a = (2.9 \times 10^{-5} \times 140) / (1.2 \times 10^{-2})$	**C1**
	$= 0.34$ m	**A1**
5(b)(ii)	infrared	**A1**

Question	Answer	Marks
6(a)	$291 = 251 \times 340 / (340 - v_{(s)})$	**C1**
	$v_s = 47$ m s^{-1}	**A1**
6(b)(i)	$I \propto A^2$	**B1**
6(b)(ii)	sketch: line starts at (1.0, 1.0)	**B1**
	approximately straight line drawn with negative gradient and line ends at (4.0, 0.25)	**B1**

Question	Answer	Marks
7(a)	current (through a conductor is directly) proportional to potential difference (across the conductor) or vice versa	**M1**
	(provided that) temperature (of conductor remains) constant	**A1**
7(b)(i)	$R = \rho L / A$	**C1**
	$\rho = (18 \times 7.2 \times 10^{-8}) / 0.94$ $= 1.4 \times 10^{-6}\,\Omega\,\text{m}$	**A1**
7(b)(ii)	voltmeter reading = 3.1 V	**A1**
7(b)(iii)	current in the battery: increase	**B1**
	voltmeter reading: decrease	**B1**
7(b)(iv)	cross marked on the resistance wire to right of the arrowhead of S, but not touching the right-hand end of the resistance wire	**B1**
7(c)(i)	$I = Anvq$ $q = 0.93 / [(7.2 \times 10^{-8}) \times (9.0 \times 10^{28}) \times (1.3 \times 10^{-3})]$	**C1**
	$q = 1.1 \times 10^{-19}$ C	**A1**
7(c)(ii)	charge / q (value) is below 1.6×10^{-19} (C) **or** charge cannot be below 1.6×10^{-19} (C) **or** (the charge carriers / q) should have a charge of 1.6×10^{-19} (C)	**B1**

© UCLES 2023

Question	Answer	Marks
8(a)(i)	23: nucleon number **or** number of neutrons and protons	**B1**
	12: proton number **or** number of protons	**B1**
8(a)(ii)	both numbers correct for X: $^{23}_{11}X$	**B1**
	both numbers correct for beta-plus: $^{0}_{1}\beta^{+}$	**B1**
8(a)(iii)	lepton(s)	**A1**
8(b)	(the emitted particles) have a single (kinetic) energy **or** beta particles / decay have a (continuous) range of (kinetic) energies	**B1**

© UCLES 2023