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.

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)	$F = \rho V g$ $V = 93\,000 / (1.2 \times 9.81)$ $= 7900\ \text{m}^3$	**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**

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**

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**

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**