Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **October/November 2021**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Marks
1(a)	10^{12}	B1
	pico (p)	B1
1(b)	ampere and metre both underlined (and no other units underlined)	B1
1(c)(i)	percentage uncertainty = 3.5 + (3.0 × 2) + 2.5 + 2.0	C1
	= 14%	A1
1(c)(ii)	absolute uncertainty = $4.1 \times 10^{-7} \times 14 / 100$ = $6 \times 10^{-8}\ \Omega\,\text{m}$	A1

Question	Answer	Marks
2(a)(i)	$E = (\Delta)V / (\Delta)d$	C1
	= $1340 / 1.4 \times 10^{-2}$ = $9.6 \times 10^{4}\ \text{N C}^{-1}$	A1
2(a)(ii)	$F = Eq$ **or** $q(\Delta)V / (\Delta)d$	C1
	$q = 4.6 \times 10^{-14} / 9.6 \times 10^{4}$ **or** $4.6 \times 10^{-14} \times 1.4 \times 10^{-2} / 1340$ = 4.8×10^{-19} C	A1
	sign of charge: negative	B1
2(b)(i)	(adjacent field) lines have same separation (for both patterns)	B1
	(direction of lines changes from) downwards to upwards	B1

Question	Answer	Marks
2(b)(ii)	resultant force $= 4.6 \times 10^{-14} + (9.6 \times 10^{4} \times 4.8 \times 10^{-19})$ $= 4.6 \times 10^{-14} + 4.6 \times 10^{-14}$ $= 9.2 \times 10^{-14}$ N	**A1**
2(b)(iii)	(a =) F / m **or** $2W / m$ **or** $2g$	**B1**
	$a = 9.2 \times 10^{-14} / (4.6 \times 10^{-14} / 9.81) = 20$ (m s^{-2}) **or** $a = 2 \times 9.81 = 20$ (m s^{-2})	**A1**
2(b)(iv)	$s = ut + ½at^2$ $(1.4 \times 10^{-2} / 2) = ½ \times 20 \times t^2$	**C1**
	$t = 2.6 \times 10^{-2}$ s	**A1**
2(c)	line from $(0, 0.7 \times 10^{-2})$ to a non-zero point on the t-axis	**M1**
	magnitude of gradient of line increases	**A1**

Question	Answer	Marks
3(a)	work (done) / time (taken)	**B1**
3(b)(i)	zero / 0 J	**A1**
3(b)(ii)	work done $= 440 \times 25$ $= 1.1 \times 10^4$ J	**A1**
3(c)(i)	$(\Delta)E_{(P)} = mg(\Delta)h$	**C1**
	$h = 4.8 \times 10^4 / (1700 \times 9.81)$ $= 2.9$ m	**A1**
3(c)(ii)	$\theta = \sin^{-1}(2.9 / 25)$ $= 6.7°$	**A1**
3(d)	work done $= 4.8 \times 10^4 + 1.1 \times 10^4$ $(= 5.9 \times 10^4$ J)	**C1**
	time $= 5.9 \times 10^4 / 1.7 \times 10^4$ $= 3.5$ s	**A1**

Question	Answer	Marks
4(a)(i)	decrease(s)	**B1**
4(a)(ii)	increase(s)	**B1**
4(b)	$f_o = f_s\, v / (v + v_s)$ $= 925 \times 338 / (338 + 12)$	**C1**
	$= 893$ Hz	**A1**
4(c)	distance $= (½ \times 2 \times 12) + (2 \times 12)$ $(= 36$ m$)$	**C1**
	time taken $= 36 / 338$ $= 0.11$ s	**A1**

Question	Answer	Marks
5(a)	a (much) louder sound can be heard	**B1**
5(b)	$v = f\lambda$	**C1**
	$\lambda = 340 / 530$ $(= 0.64$ m$)$	**C1**
	height $= 0.64 / 4$ $= 0.16$ m	**A1**
5(c)	distance $= 0.64 / 2$ **or** 0.16×2 **or** $(¾ \times 0.64 - ¼ \times 0.64)$ $= 0.32$ m	**A1**

Question	Answer	Marks
6(a)	$Q = It$	C1
	$= 0.80 \times 7.5 \times 60$ $= 360$ C	A1
6(b)	$P = EI$ **or** $P = VI$ **or** $P = I^2R$ **or** $P = V^2 / R$	C1
	$0.80^2 \times 0.40$ (= 0.256 W) **or** 0.48×0.80 (= 0.384 W)	C1
	efficiency = $(0.256 / 0.384) \times 100$ = 67%	A1
6(c)(i)	$n = 3.2 \times 10^{22} / (1.3 \times 10^{-7} \times 3.0)$ $= 8.2 \times 10^{28}$ m^{-3}	A1
6(c)(ii)	$I = Anvq$ $v = 0.80 / (1.3 \times 10^{-7} \times 8.2 \times 10^{28} \times 1.60 \times 10^{-19})$	C1
	$= 4.7 \times 10^{-4}$ m s^{-1}	A1
6(d)	(wire Y has) larger resistance / resistance increases	M1
	(wire Y has) smaller current / current decreases	M1
	(average drift) speed is less (in wire Y)	A1

Question	Answer	Marks
7(a)	(total) momentum before (decay) is zero **or** P has zero momentum	**B1**
	(total momentum after decay must be zero so) α-particle and Q have momenta in opposite directions (and therefore velocities are in opposite directions)	**B1**
7(b)	$p = 239\text{ (u)} \times v$ **or** $4\text{ (u)} \times 1.6 \times 10^{7}$	**C1**
	$239\text{ (u)} \times v = 4\text{ (u)} \times 1.6 \times 10^{7}$ $v = 2.7 \times 10^{5}\text{ m s}^{-1}$	**A1**
7(c)	$E_{(K)} = \frac{1}{2}mv^2$	**C1**
	$= \frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times (1.6 \times 10^{7})^2$	**C1**
	$= 8.5 \times 10^{-13}\text{ (J)}$ $= 8.5 \times 10^{-13} / 1.60 \times 10^{-13}\text{ (MeV)}$ $= 5.3\text{ MeV}$	**A1**
7(d)(i)	**1.** R plotted at (95,147)	**B1**
	2. S plotted at (96,146)	**B1**
7(d)(ii)	(electron) antineutrino	**B1**