Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **February/March 2024**

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 February/March 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

Question	Answer	Marks
1(a)	current and mass only ticked	**A1**
1(b)	(power =) work (done) / time	**C1**
	units of power = $J\ s^{-1}$ = $kg\ m^2\ s^{-2} / s$ = $kg\ m^2\ s^{-3}$	**A1**
1(c)	power = intensity × area	**C1**
	= $950 \times 2.2 \times 10^{-4}$	**C1**
	= 0.21 W	**A1**

Question	Answer	Marks
2(a)	rate of change of velocity	**B1**
2(b)	$\frac{1}{2}\, m(\Delta)v^2 = mg(\Delta)h$	**C1**
	$v^2 = 5.9^2 + 2 \times 9.81 \times 7.8$ $v^2 = 188$	**C1**
	$v = 14\ \text{m s}^{-1}$	**A1**
	or by resolving components Vertically: $v^2 = u^2 + 2as$ $v^2 = (5.9\sin 60)^2 + 2 \times -9.81 \times (1.2 - 9.0)$ $v_v = 13.4$	**(C1)**
	horizontally: $v_h = 5.9\cos 60$ $v_h = 2.95$	**(C1)**
	resultant velocity $= \sqrt{(13.4^2 + 2.95^2)}$ $= 14\ \text{m s}^{-1}$	**(A1)**
2(c)(i)	(As the diver moves down their) speed decreases	**B1**
	(So) viscous force / drag (force) decreases	**B1**
2(c)(ii)	$(F =)\ \rho gV$ $= 1000 \times 9.81 \times 7.5 \times 10^{-2} = 740$ (N)	**A1**

Question	Answer	Marks
2c(iii)	resultant force = 740 + 950 – (78 × 9.81) = 925	C1
	acceleration = F / m	C1
	= 925 / 78 = 12 m s^{-2}	A1
	(vertically) upwards	B1

Question	Answer	Marks
3(a)(i)	$\sigma = 0.72 \times 10^9$	C1
	force = $\sigma \times A$ = $0.72 \times 10^9 \times \pi \times (1.2 \times 10^{-3} / 2)^2$	C1
	= 810 N	A1
	or Young modulus = gradient of graph e.g. = $0.80 \times 10^9 / 6.0 \times 10^{-3}$ = 1.33×10^{11}	(C1)
	force = Young modulus × strain × A = $1.33 \times 10^{11} \times 5.4 \times 10^{-3} \times \pi \times (1.2 \times 10^{-3} / 2)^2$	(C1)
	= 810 N	(A1)

Question	Answer	Marks
3(a)(ii)	$E_{(P)} = ½ Fx$ or $E_{(P)} = ½ kx^2$ **and** $F = kx$	**C1**
	$x = 2E_P / F$ $x = 2 \times 0.31 / 810$ $x = 7.7 \times 10^{-4}$	**C1**
	$L = x / \varepsilon$ $L = 7.7 \times 10^{-4} / 5.4 \times 10^{-3}$ $L = 0.14$ m	**A1**
	or $E_{(P)} = ½ Fx+$ or $E_{(P)} = ½ kx^2$ **and** $k = EA/L$	**(C1)**
	$x = 2E_P / EA\ \varepsilon$ $x = 2 \times 0.31 / (1.33 \times 10^{11} \times \pi \times (1.2 \times 10^{-3} / 2)^2 \times 5.4 \times 10^{-3})$ $x = 7.6 \times 10^{-4}$	**(C1)**
	$L = x / \varepsilon$ $L = 7.6 \times 10^{-4} / 5.4 \times 10^{-3}$ $L = 0.14$ m	**(A1)**
3(b)	A straight line, passing through the origin with a larger gradient than wire X.	**M1**
	Gradient of the line is twice the gradient of wire X.	**A1**

Question	Answer	Marks
4(a)	$^{4}_{2}\alpha$	B1
	$^{211}_{82}Q$	B1
4(b)(i)	**sum / total** momentum (of a system of bodies) is constant **or** **sum / total** momentum before = **sum / total** momentum after	M1
	for an isolated system / no (resultant) **external** force	A1
4(b)(ii)	$p_{\alpha} = p_{P} - p_{Q}$ $4(u)v = 215(u) \times 3.2 \times 10^{5} (- 0)$ $v = 215(u) \times 3.2 \times 10^{5} / 4(u)$	C1
	$v = 1.7 \times 10^{7}$ m s^{-1}	A1

Question	Answer	Marks
5(a)	vibrations / oscillations (of the particles / wave) are perpendicular to the direction (of the propagation of energy)	B1
5(b)	infrared	B1
5(c)	$T = 6 \times 5.0 \times 10^{-15}$ $T = 3.0 \times 10^{-14}$	C1
	$\lambda = c\,T$ **or** $\lambda = c / f$ **and** $f = 1 / T$	C1
	$\lambda = 3.0 \times 10^{8} \times 3.0 \times 10^{-14}$ **or** $\lambda = 3.0 \times 10^{8} / 3.33 \times 10^{13}$ $= 9.0 \times 10^{-6}$ m	A1

Question	Answer	Marks
6(a)(i)	Any three from: • Light diffracts at the (two) slits. • Light (from each slit) meets / superposes (at the screen). • When the phase difference is 0 (degrees) a bright fringe / (intensity) maximum is formed. • When the phase difference is 180 (degrees) a dark fringe / (intensity) minimum is formed.	**B3**
6(a)(ii)	$\lambda = ax / D$	**C1**
	$\lambda = 1.2 \times 10^{-3} \times (10.2 \times 10^{-3} / 6) / 3.1$	**C1**
	$\lambda = 6.6 \times 10^{-7}$ m	**A1**
6(a)(iii)	(new fringe separation will be) smaller	**B1**
6(b)(i)	A cross at the intersection of the string and the mean position line.	**B1**
6(b)(ii)	0	**A1**
6(b)(iii)	180°	**A1**

Question	Answer	Marks
7(a)	energy (transferred) per (unit) charge	**B1**
7(b)	V = 0.25 × 6 =1.5	**C1**
	Ir = *E* – *IR* *Ir* = 1.8 – 1.5 = 0.3	**C1**
	r = 0.3 / 0.25 = 1.2 Ω	**A1**
	or (Total) *R* = 1.8 / 0.25 = 7.2 *E* / *I* = (*R* + *r*)	**(C1)**
	1.8/0.25 = 6 + *r*	**(C1)**
	r = 7.2 – 6 = 1.2 Ω	**(A1)**
7(c)(i)	The same	**B1**
7(c)(ii)	Any 3 from: • before t_1 / when current constant, the (total) resistance is constant • at t_1 / when current increases, the (total) resistance decreases (due to decrease of external resistance) • (after t_1) temperature (of lamp) increases (so the resistance of the lamp increases) • (after t_1) resistance **of lamp** increases (so total resistance increases so the current in the ammeter decreases)	**B3**

Question	Answer	Marks
8(a)	lepton(s)	**B1**
8(b)(i)	up or top or charm	**B1**
8(b)(ii)	meson(s)	**B1**
8(c)(i)	β^- (particle) **or** electron	**B1**
8(c)(ii)	equal	**B1**
8(c)(iii)	(the charge of) R is greater (than Q)	**B1**