Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **May/June 2023**

MARK SCHEME

Maximum Mark: 60

Published

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[Turn over

Question	Answer	Marks
1(a)(i)	force / area (normal to the force)	**B1**
1(a)(ii)	($p = F / A$ so units are) kg m s^{-2} / m^2 = kg m^{-1} s^{-2}	**A1**
1(b)	unit of R: m **and** unit of t: s **and** unit of L: m	**C1**
	unit of ρ: kg m^{-3} **or** $\rho = m / V$	**C1**
	base units of k: (kg m^{-1} s^{-2} × m^4 × kg m^{-3} × s) / (kg × m) = kg m^{-1} s^{-1}	**A1**
1(c)	R contributes 4 × 2% **or** 8% (and L contributes 2%) so R contributes more (to the percentage uncertainty in k)	**B1**

Question	Answer	Marks
2(a)	the point where (all) the weight (of the object) is taken to act	**B1**
2(b)(i)	(54 × 0.45) **or** (2.4 × 0.95) **or** (T sin 30° × 1.3)	**C1**
	(54 × 0.45) = (2.4 × 0.95) + (T sin 30° × 1.3)	**C1**
	T = 34 N	**A1**
2(b)(ii)	resultant moment = (54 × 0.45) – (2.4 × 0.95) **or** (34 sin 30° × 1.3) = 22 N m	**A1**
2(c)(i)	(Δ)E = mg(Δ)h **or** W(Δ)h	**C1**
	= 2.4 × 1.8 = 4.3 J	**A1**

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Question	Answer	Marks
2(c)(ii)	$E = \frac{1}{2}mv^2$	C1
	$= \frac{1}{2} \times (2.4 / 9.81) \times 3.4^2$ $= 1.4$ J (at X)	C1
	kinetic energy at Y $= 4.3 + 1.4$ $= 5.7$ J	A1
	or	
	$\frac{1}{2}mv^2 = \frac{1}{2}mu^2 + mg(\Delta)h$	(C1)
	$v^2 = 3.4^2 + 2 \times 9.81 \times 1.8$ $v^2 = 46.9$ so $v = 6.85$ ($m\,s^{-1}$) KE $= \frac{1}{2} \times (2.4 / 9.81) \times 6.85^2$	(C1)
	$= 5.7$ J	(A1)
2(c)(iii)	no variation **or** acceleration is (always) vertically downwards	B1
2(c)(iv)	horizontal straight line at a non-zero value of velocity	B1

Question	Answer	Marks
3(a)(i)	rate of change of momentum	**B1**
3(a)(ii)	change in momentum = $(1.4 - 0.80) \times 3.0$	**C1**
	$= 1.8$ kg m s^{-1}	**A1**
3(b)(i)	resultant force (on block) is zero	**B1**
	(so) velocity is constant	**B1**
3(b)(ii)	$P = Fv$ **or** $P = Fs / t$	**C1**
	$v = 2.0 / 0.80$ ($= 2.5$ m s^{-1})	**C1**
	distance $= 2.5 \times 3.0$ $= 7.5$ m	**A1**
	or	
	$P = W / t$ **or** $P = Fs / t$	**(C1)**
	$W = 2.0 \times 3.0$ ($= 6.0$ J)	**(C1)**
	distance $= 6.0 / 0.80$ $= 7.5$ m	**(A1)**
3(c)	0 to 3.0 s: upward sloping straight line from the origin.	**B1**
	3.0 to 6.0 s: horizontal line at non-zero value of momentum with no 'step change' in momentum at 3.0 s	**B1**

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Question	Answer	Marks
4(a)	Hooke's (law)	**B1**
4(b)	$k = F / x$ **or** k = gradient	**C1**
	= e.g. 12.0 / (0.240 – 0.08) = 75 N m^{-1}	**A1**
4(c)	$E = \frac{1}{2}Fx$ **or** $E = \frac{1}{2}kx^2$ **or** E = area under graph	**C1**
	$E = \frac{1}{2} \times 6.0 \times 0.080$ **or** $\frac{1}{2} \times 75 \times 0.08^2$ = 0.24 J	**A1**

Question	Answer	Marks
5(a)(i)	(they are) perpendicular	**B1**
5(a)(ii)	(they are) parallel	**B1**
5(b)(i)	$\lambda = v / f$	**C1**
	$= 340 / 1700$ $= 0.20$ m	**A1**
5(b)(ii)	$L = \frac{3}{4} \times \lambda = \frac{3}{4} \times 0.20$ $= 0.15$ m	**A1**
5(b)(iii)	$\lambda = 4 \times 0.15$ **or** 0.20×3 $= 0.60$ m	**A1**
5(c)(i)	$(I =) 8.5 \times \cos^2 35° = 5.7$ (W m^{-2})	**A1**
5(c)(ii)	$5.2 = 5.7 \cos^2 \theta$ $(\theta = 17°)$	**C1**
	$\alpha = 35° + 17°$ $= 52°$	**A1**

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Question	Answer	Marks
6(a)	temperature decreases (so) resistance decreases	**B1**
6(b)(i)	current = V / R	**A1**
6(b)(ii)	$I = Anvq$ $n = N / V$ **or** $n = N / AL$	**C1**
	$v = (V / R) / [(V / L) (N / V) e]$ **or** $(V / R) / [A (N / AL) e]$ $= VL / RNe$	**A1**
	or	
	$v = L / t$ $= L / (Q / I)$	**(C1)**
	$= LI / Q$ $= L(V / R) / Ne$ $= VL / RNe$	**(A1)**
6(b)(iii)	time = distance / speed **or** Q / I $= L / (VL / RNe)$ **or** $Ne / (V / R)$ time = RNe / V	**A1**

Question	Answer	Marks
7(a)	V / 9.0 = 1800 / (1800 + 1200)	C1
	V = 5.4 V	A1
	or	
	I = 9.0 / (1800 + 1200) = 3.0×10^{-3} (A) V = $3.0 \times 10^{-3} \times 1800$	(C1)
	= 5.4 V	(A1)
7(b)(i)	L / 1.2 = 5.4 / 9.0 **or** XZ / 1.2 = 5.4 / 9.0	C1
	L = 0.72 m	A1
	or	
	L / 1.2 = 1800 / (1800 + 1200) **or** XZ / 1.2 = 1.8 / (1.8 + 1.2)	(C1)
	L = 0.72 m	(A1)
7(b)(ii)	• (intensity) increase	B1
	• (power) increase	B1
	• (length XZ) decrease	B1

Question	Answer	Marks
8(a)(i)	number of protons: equal/same	**B1**
	number of neutrons: unequal/different	**B1**
8(a)(ii)	down (quark) changes to up (quark) **or** up down down (quarks) change to up up down (quarks)	**B1**
8(a)(iii)	(electron) antineutrino	**B1**
8(b)	charm (quark charge) is (+)2/3(e) **or** 2 charm (quark charges) is (+)4/3(e) **or** bottom (quark charge) is –1/3(e)	**C1**
	charge = +2/3(e) + 2/3(e) –1/3(e) = (+)1(e)	**A1**

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