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**PHYSICS**

**9702/22**

Paper 2 AS Level Structured Questions

**May/June 2017**

MARK SCHEME

Maximum Mark: 60

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**Published**

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Question	Answer	Marks
1(a)	kelvin, mole, ampere, candela <i>any two</i>	<b>B1</b>
1(b)	use of resistivity = $RA/l$ and $V = IR$ (to give $\rho = VA/Il$ )	<b>C1</b>
	units of $V$ : (work done / charge) $\text{kg m}^2 \text{s}^{-2} (\text{A s})^{-1}$	<b>C1</b>
	units of resistivity: $(\text{kg m}^2 \text{s}^{-3} \text{A}^{-1} \text{A}^{-1} \text{m})$ $= \text{kg m}^3 \text{s}^{-3} \text{A}^{-2}$	<b>A1</b>
	<b>or</b>	
	use of $R = \rho L/A$ and $P = I^2R$ (gives $\rho = PA/I^2L$ )	<b>(C1)</b>
	units of $P$ : $\text{kg m}^2 \text{s}^{-3}$	<b>(C1)</b>
1(c)(i)	units of resistivity: $(\text{kg m}^2 \text{s}^{-3} \times \text{m}^2) / (\text{A}^2 \times \text{m})$ $= \text{kg m}^3 \text{s}^{-3} \text{A}^{-2}$	<b>(A1)</b>
	$\rho = (RA/l)$	<b>C1</b>
	$= (0.03 \times 1.5 \times 10^{-6}) / 2.5$ ( $= 1.8 \times 10^{-8}$ )	<b>C1</b>
	$= 18 \text{ n}\Omega \text{ m}$	<b>A1</b>
1(c)(ii)	<b>1.</b> precision is determined by the range in the measurements/values/readings/data/results	<b>B1</b>
	<b>2.</b> metre rule measures to $\pm 1 \text{ mm}$ and micrometer to $\pm 0.01 \text{ mm}$ (so there is less (percentage) uncertainty/random error)	<b>B1</b>

Question	Answer	Marks
2(a)	rate of change of displacement <b>or</b> change in displacement/time taken	<b>B1</b>
2(b)(i)	$s = ut + \frac{1}{2}at^2$	<b>C1</b>
	$t = [(2 \times 1.25) / 9.81]^{1/2} (= 0.5048 \text{ s})$	<b>C1</b>
	<b>or</b>	
	$v^2 = u^2 + 2as$ $v_{\text{vert}} = (2 \times 9.81 \times 1.25)^{1/2} (= 4.95)$	<b>(C1)</b>
	$t = [2s / (u + v)] = 2 \times 1.25 / 4.95 (= 0.5048 \text{ s})$	<b>(C1)</b>
	$v = d / t = 1.5 / 0.50(48)$ $= 3.0 (2.97) \text{ ms}^{-1}$	<b>A1</b>
2(b)(ii)	vertical velocity = $at$ $= 9.81 \times 0.5048 (= 4.95)$ [using $t = 0.50$ gives 4.9]	<b>C1</b>
	velocity = $[(v_h)^2 + (v_v)^2]^{1/2}$	<b>C1</b>
	$= [(2.97)^2 + (4.95)^2]^{1/2}$ $= 5.8 (5.79)$ [using $t = 0.50$ leads to 5.7]	<b>A1</b>
	direction (= $\tan^{-1} 4.95/2.97$ ) = $59^\circ$	<b>A1</b>
2(b)(iii)	kinetic energy = $\frac{1}{2}mv^2$	<b>C1</b>
	$= \frac{1}{2} \times 0.45 \times (5.8)^2$ $= 7.6 (7.57) \text{ J}$ [using $t = 0.50$ leads to 7.3 J]	<b>A1</b>

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Question	Answer	Marks
2(b)(iv)	potential energy = $mgh$	<b>C1</b>
	= $(0.45 \times 9.81 \times 1.25)$	<b>A1</b>
	= 5.5 (5.52) J	
2(c)	there is KE of the ball at the start/leaving table <b>or</b> the ball has an initial/constant horizontal velocity <b>or</b> the ball has velocity at start/leaving table	<b>B1</b>

Question	Answer	Marks
3(a)	$E = \text{stress} / \text{strain}$ <b>or</b> $(F/A) / (e/l)$	<b>C1</b>
	= $[\text{gradient} \times 3.5] / [\pi \times (0.19 \times 10^{-3})^2]$	<b>C1</b>
	e.g. $E = \{[(40 - 5) / (11.6 - 3.2) \times 10^{-3}] \times 3.5\} / [\pi \times (0.19 \times 10^{-3})^2]$ <b>or</b> $[4170 \times 3.5] / [\pi \times (0.19 \times 10^{-3})^2]$	
	$E (= 1.3 \times 10^{11}) = 0.13 \text{ TPa}$ ( <i>allow answers in range 0.120–0.136 TPa</i> )	<b>A1</b>
3(b)	a larger <u>range</u> of $F$ required <b>or</b> <u>range</u> greater than 35 N	<b>B1</b>

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Question	Answer	Marks
4(a)	a body/mass/object continues (at rest or) at constant/uniform velocity unless acted on by a resultant force	<b>B1</b>
4(b)(i)	initial momentum = final momentum $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$	<b>C1</b>
	$0.60 \times 100 - 0.80 \times 200 = -0.40 \times 100 + v \times 200$ $v = (-) 0.3(0) \text{ m s}^{-1}$	<b>A1</b>
4(b)(ii)	<u>kinetic</u> energy is not conserved/is lost (but) <u>total</u> energy is conserved/constant <b>or</b> some of the (initial) <u>kinetic</u> energy is transformed into other forms of energy	<b>B1</b>

Question	Answer	Marks
5(a)	frequency is the number of vibrations/oscillations per unit time <b>or</b> the number of wavefronts passing a point per unit time	<b>B1</b>
5(b)	vibrations/oscillation of the air particles are parallel to the direction of it (the direction of travel of the sound wave)	<b>B1</b>
5(c)(i)	$T = 2(.0) \text{ (ms)}$	<b>C1</b>
	$f = 500 \text{ Hz}$	<b>A1</b>
5(c)(ii)	1. amplitude increases (time) period decreases  2. amplitude decreases (time) period increases  <i>any 3 points</i>	<b>B3</b>

Question	Answer	Marks
6(a)(i)	<u>waves</u> at (each) slit/aperture spread	<b>B1</b>
	(into the geometric shadow) <u>wave(s)</u> overlap/superpose/sum/meet/intersect	<b>B1</b>
6(a)(ii)	there is not a constant phase difference/coherence (for two separate light source(s)) <b>or</b> waves/light from the double slit are coherent/have a constant phase difference	<b>B1</b>
6(b)	$x = \lambda D / a$	<b>C1</b>
	$\lambda = (36 \times 10^{-3} \times 0.48 \times 10^{-3}) / (16 \times 2.4)$	<b>C1</b>
	$= 4.5 \times 10^{-7} \text{ m}$	<b>A1</b>
6(c)(i)	<u>no</u> movement of the water/water is flat/no ripples/disturbance	<b>B1</b>
	the path difference is $2.5\lambda$ <b>or</b> the phase difference is $900^\circ$ <b>or</b> $5\pi$ rad	<b>B1</b>
6(c)(ii)	1. surface/water/P vibrates/ripples <b>and</b> as (waves from the two dippers) arrive in phase	<b>B1</b>
	2. surface/water/P vibrates/ripples <b>and</b> as amplitudes/displacements are no longer equal/do not cancel	<b>B1</b>

Question	Answer	Marks
7(a)	energy transformed from <u>chemical to electrical</u> / unit charge (driven around a complete circuit)	<b>B1</b>
7(b)(i)	the current decreases (as resistance of Y increases)	<b>M1</b>
	lost volts go down (as resistance of Y increases)	<b>M1</b>
	p.d. AB increases (as resistance of Y increases)	<b>A1</b>
7(b)(ii)1.	$1.50 = 0.180 \times (6.00 + 0.200 + R_x)$	<b>C1</b>
	$R_x = 2.1(3) \Omega$	<b>A1</b>
7(b)(ii)2.	p.d. AB = $1.5 - (0.180 \times 0.200)$ <b>or</b> $0.18 \times (2.13 + 6.00)$	<b>C1</b>
	= $1.46(4) \text{ V}$	<b>A1</b>
7(b)(ii)3.	efficiency = (useful) power output / (total) power input <b>or</b> $IV / IE$	<b>C1</b>
	(= $1.46 / 1.5$ ) = 0.97 [0.98 if full figures used]	<b>A1</b>

Question	Answer	Marks
8(a)	$\beta^-$ emission: neutron changes to proton (+ beta <sup>-</sup> /electron) <b>and</b> $\beta^+$ emission: proton changes to neutron (+ beta <sup>+</sup> /positron)	<b>B1</b>
	$\beta^-$ emission: (electron) antineutrino also emitted <b>and</b> $\beta^+$ emission: (electron) neutrino also emitted	<b>B1</b>
8(b)	proton: up up down (and zero strange)  neutron: up down down (and zero strange)	<b>B1</b>