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PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **May/June 2017**

MARK SCHEME

Maximum Mark: 60

Published

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This document consists of **7** printed pages.

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

Question	Answer	Marks
2(a)	rate of change of displacement **or** change in displacement/time taken	**B1**
2(b)(i)	$s = ut + ½at^2$	**C1**
	$t = [(2 \times 1.25) / 9.81]^{1/2}$ (= 0.5048 s)	**C1**
	or	
	$v^2 = u^2 + 2as$ $v_{vert} = (2 \times 9.81 \times 1.25)^{1/2}$ (= 4.95)	**(C1)**
	$t = [2s / (u + v)] = 2 \times 1.25 / 4.95$ (= 0.5048 s)	**(C1)**
	$v = d / t = 1.5 / 0.50(48)$ = 3.0 (2.97) m s^{-1}	**A1**
2(b)(ii)	vertical velocity = at = 9.81 × 0.5048 (= 4.95) [using t = 0.50 gives 4.9]	**C1**
	velocity = $[(v_h)^2 + (v_v)^2]^{1/2}$	**C1**
	= $[(2.97)^2 + (4.95)^2]^{1/2}$ = 5.8 (5.79) [using t = 0.50 leads to 5.7]	**A1**
	direction (= $\tan^{-1}$ 4.95/2.97) = 59°	**A1**
2(b)(iii)	kinetic energy = $½mv^2$	**C1**
	= ½ × 0.45 × $(5.8)^2$ = 7.6 (7.57) J [using t = 0.50 leads to 7.3 J]	**A1**

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

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

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

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

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

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

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