
PHYSICS

9702/22

Paper 2 AS Level Structured Questions

May/June 2017

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 will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2017 series for most Cambridge IGCSE[®], Cambridge International A and AS Level and Cambridge Pre–U components, and some Cambridge O Level components.

PUBLISHED

Question	Answer	Marks
1(a)	kelvin, mole, ampere, candela <i>any two</i>	B1
1(b)	use of resistivity = RA/l and $V = IR$ (to give $\rho = VA/Il$)	C1
	units of V : (work done / charge) $\text{kg m}^2 \text{s}^{-2} (\text{A s})^{-1}$	C1
	units of resistivity: $(\text{kg m}^2 \text{s}^{-3} \text{A}^{-1} \text{A}^{-1} \text{m})$ $= \text{kg m}^3 \text{s}^{-3} \text{A}^{-2}$	A1
	or	
	use of $R = \rho L/A$ and $P = I^2 R$ (gives $\rho = PA/I^2 L$)	(C1)
	units of P : $\text{kg m}^2 \text{s}^{-3}$	(C1)
1(c)(i)	units of resistivity: $(\text{kg m}^2 \text{s}^{-3} \times \text{m}^2) / (\text{A}^2 \times \text{m})$ $= \text{kg m}^3 \text{s}^{-3} \text{A}^{-2}$	(A1)
	$\rho = (RA/l)$	C1
	$= (0.03 \times 1.5 \times 10^{-6}) / 2.5$ ($= 1.8 \times 10^{-8}$)	C1
	$= 18 \text{ n}\Omega \text{ m}$	A1
1(c)(ii)	1. precision is determined by the range in the measurements/values/readings/data/results	B1
	2. metre rule measures to $\pm 1 \text{ mm}$ and micrometer to $\pm 0.01 \text{ mm}$ (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)	$s = ut + \frac{1}{2}at^2$	C1
	$t = [(2 \times 1.25) / 9.81]^{1/2} (= 0.5048 \text{ s})$	C1
	or	
	$v^2 = u^2 + 2as$ $v_{\text{vert}} = (2 \times 9.81 \times 1.25)^{1/2} (= 4.95)$	(C1)
	$t = [2s / (u + v)] = 2 \times 1.25 / 4.95 (= 0.5048 \text{ s})$	(C1)
	$v = d / t = 1.5 / 0.50(48)$ $= 3.0 (2.97) \text{ ms}^{-1}$	A1
2(b)(ii)	vertical velocity = at $= 9.81 \times 0.5048 (= 4.95)$ [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 = $\frac{1}{2}mv^2$	C1
	$= \frac{1}{2} \times 0.45 \times (5.8)^2$ $= 7.6 (7.57) \text{ J}$ [using $t = 0.50$ leads to 7.3 J]	A1

PUBLISHED

Question	Answer	Marks
2(b)(iv)	potential energy = mgh	C1
	= $(0.45 \times 9.81 \times 1.25)$	A1
	= 5.5 (5.52) J	
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)	$E = \text{stress} / \text{strain}$ or $(F/A) / (e/l)$	C1
	= $[\text{gradient} \times 3.5] / [\pi \times (0.19 \times 10^{-3})^2]$	C1
	e.g. $E = \{[(40 - 5) / (11.6 - 3.2) \times 10^{-3}] \times 3.5\} / [\pi \times (0.19 \times 10^{-3})^2]$ or $[4170 \times 3.5] / [\pi \times (0.19 \times 10^{-3})^2]$	
	$E (= 1.3 \times 10^{11}) = 0.13 \text{ TPa}$ (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

PUBLISHED

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
	$0.60 \times 100 - 0.80 \times 200 = -0.40 \times 100 + v \times 200$ $v = (-) 0.3(0) \text{ m s}^{-1}$	A1
4(b)(ii)	<u>kinetic</u> energy is not conserved/is lost (but) <u>total</u> energy is conserved/constant or some of the (initial) <u>kinetic</u> 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)	$T = 2(.0) \text{ (ms)}$	C1
	$f = 500 \text{ Hz}$	A1
5(c)(ii)	1. amplitude increases (time) period decreases 2. amplitude decreases (time) period increases <i>any 3 points</i>	B3

Question	Answer	Marks
6(a)(i)	<u>waves</u> at (each) slit/aperture spread	B1
	(into the geometric shadow) <u>wave(s)</u> 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
	$= 4.5 \times 10^{-7} \text{ m}$	A1
6(c)(i)	<u>no</u> 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 = $1.5 - (0.180 \times 0.200)$ or $0.18 \times (2.13 + 6.00)$	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