Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

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.

® IGCSE is a registered trademark.

© UCLES 2017

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: $(kg\ m^2\ s^{-3} \times m^2) / (A^2 \times m)$ $= kg\ m^3\ s^{-3}\ A^{-2}$	**(A1)**
1(c)(i)	$\rho = (RA / l)$	**C1**
	$= (0.03 \times 1.5 \times 10^{-6}) / 2.5$ $(= 1.8 \times 10^{-8})$	**C1**
	$= 18\ n\Omega\ m$	**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**

© UCLES 2017

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 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)**
	$v = d / t = 1.5 / 0.50(48)$ $= 3.0\ (2.97)\ \text{m s}^{-1}$	**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) J [using $t = 0.50$ leads to 7.3 J]	**A1**

© UCLES 2017

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] / [π × (0.19 × 10^{-3})^2] e.g. E = [{(40 – 5) / ([11.6 – 3.2] × 10^{-3})} × 3.5] / [π × (0.19 × 10^{-3})^2] **or** [4170 × 3.5] / [π × (0.19 × 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 range of F required **or** range greater than 35 N	**B1**

© UCLES 2017

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)	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**

© UCLES 2017

Question	Answer	Marks
7(a)	energy transformed from chemical to electrical / 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**

© UCLES 2017