Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/23**

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

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

[Turn over

Question	Answer	Marks
1(a)	t $= \sqrt{(2s / g)}$ $= \sqrt{[(2 \times 36) / 9.81]}$	**C1**
	$= 2.7$ s	**A1**
1(b)	• reaction time between hearing the splash and stopping the stop-watch • the sound (of the splash) takes time to reach the student **or** the stone hits the water at a different time to the sound being heard **or** the sound (of the splash) has to travel to the student • the student might not let go of the stone from ground level • the student might not let go of the stone and start the stop-watch at the same time • stop-watch may not be properly calibrated / has a zero error • (local value of) g is not (exactly) 9.81 (m s^{-2}) • stone given initial velocity / initial velocity not zero • stone does not fall (exactly) vertically / in a straight line *Any three points, 1 mark each*	**B3**
1(c)	precise: results are close together / have little scatter	**B1**
	not accurate: the values are not close to / 50% different / (very) different from the true value	**B1**

Question	Answer	Marks
2(a)	$F = 1050 \times 9.81 \times 0.21V$ **or** $W = \rho \times 9.81 \times V$	**C1**
	$0.21V \times 1050\ (\times 9.81) = V\ (\times 9.81) \times \rho$ $\rho = 220\ \text{kg m}^{-3}$	**A1**
2(b)(i)	$F = 1050 \times 9.81 \times V$ **or** $W = 220 \times 9.81 \times V$	**C1**
	$(V \times 1050 \times 9.81) - (V \times 220 \times 9.81) = (V \times 220) \times a$	**C1**
	$a = 37\ \text{m s}^{-2}$	**A1**
2(b)(ii)	the (downward) drag / viscous force increases (with speed)	**M1**
	resultant force decreases (as upthrust and weight remain the same)	**M1**
	acceleration decreases (as its velocity increases)	**A1**

Question	Answer	Marks
3(a)	sum / total momentum before = sum / total momentum after **or** sum / total momentum (of a system of objects) is constant	**M1**
	if no (resultant) external force / for an isolated system	**A1**
3(b)(i)	$3m \times 4 = m \times v \sin \theta$ ($v \sin \theta = 12$)	**C1**
	$2m \times 6 = m \times v \cos \theta$ ($v \cos \theta = 12$)	**C1**
	therefore $\sin \theta = \cos \theta$ **or** $\tan \theta = 1$ $\theta = 45°$	**A1**
3(b)(ii)	$mv \times \cos 45° = 12m$ **or** $mv \times \sin 45° = 12m$ **or** $(mv)^2 = (3m \times 4)^2 + (2m \times 6)^2$	**C1**
	$v = 17$ m s^{-1}	**A1**
3(c)(i)	(chemical energy) $= 0.0050 \times 700 = 3.5$ (J) **or** (chemical energy) $= 5.0 \times 0.700 = 3.5$ (J)	**A1**

Question	Answer	Marks
3(c)(ii)	$E = ½mv^2$	C1
	total $E = (0.5 \times 3m \times 4^2) + (0.5 \times 2m \times 6^2) + (0.5 \times m \times 17^2)$	C1
	$3.5 = 204m$ $m = 0.017$ kg	A1

Question	Answer	Marks
4(a)	the number of wavefronts/crests/troughs passing a fixed point per unit time **or** the number of oscillations per unit time (of source / point on wave / particle of medium)	B1
4(b)(i)	$T = 4 \times 0.50 \times 10^{-3}$ $(= 2.0 \times 10^{-3}$ s)	C1
	$f = 1 / 2.0 \times 10^{-3}$ = 500 Hz	A1
4(b)(ii)	amplitude $= 2.8 \times 0.20$ = 0.56 V	A1
4(c)	period same as original trace	B1
	sinusoidal wave of constant amplitude less than 2.8 cm throughout	M1
	amplitude 1.4 cm	A1

Question	Answer	Marks
4(d)(i)	when (two or more) waves meet (at a point)	**B1**
	(resultant) displacement is the sum of the individual displacements	**B1**
4(d)(ii)	node-to-node separation is $\lambda / 2$ **or** microphone moves through 3 node-to-node separations **or** $d = 1.5\lambda$	**C1**
	$\lambda = 1.05 / 1.5$ $= 0.70$ m	**A1**
4(d)(iii)	$v = f \times \lambda$	**C1**
	$= 500 \times 0.70$ $= 350$ m s^{-1}	**A1**

Question	Answer	Marks
5(a)	correct symbol for the heater **or** for the LDR	**M1**
	all correct symbols in series (ignore voltmeter) and no extra symbols	**A1**
	correct symbol for voltmeter and in parallel with the heater	**B1**
5(b)(i)	$R = \rho L / A$	**C1**
	$= (1.1 \times 10^{-6} \times 2.0) / 3.8 \times 10^{-7}$ $= 5.8\,\Omega$	**A1**
5(b)(ii)	$I = 4.8 / 5.8$ $= 0.83$ A	**A1**
5(c)(i)	A larger (for new wire) **or** $A \propto d^2$ (and d larger for new wire) **or** $R \propto 1 / d^2$ (and d larger for new wire)	**M1**
	so R is less (than that of first wire)	**A1**
5(c)(ii)	(heater / total resistance decreases so) current (in circuit) increases (so p.d. across LDR increases) **or** heater resistance decreases so it has a smaller share/proportion/fraction of the (total) voltage / e.m.f.	**M1**
	(so voltmeter) reading is less (than 4.8 V)	**A1**

Question	Answer	Marks
6(a)	(Young modulus =) stress / strain	**B1**
6(b)(i)	unstretched length = 1.9980 m	**A1**
6(b)(ii)	stress = F / A	**C1**
	= $30 / 9.5 \times 10^{-7}$ = 3.2×10^{7} Pa	**A1**
	strain = 0.0050 / 1.9980 = 2.5×10^{-3}	**A1**

Question	Answer	Marks
7(a)	down charge = –1/3(e) **and** charm charge = (+)2/3(e)	**B1**
	all antiquarks have opposite sign and same (non-zero) magnitude of charge as the corresponding quarks	**B1**
7(b)(i)	udd **or** cdd	**B1**
7(b)(ii)	$u\bar{d}$ **or** $c\bar{d}$	**B1**
7(c)(i)	lepton(s)	**B1**
7(c)(ii)	positron / neutrino / antineutrino	**B1**