Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **October/November 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 October/November 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

Abbreviations

/	Alternative and acceptable answers for the same marking point.
( )	Bracketed content indicates words which do not need to be explicitly seen to gain credit but which indicate the **context** for an answer. The context does not need to be seen but if a context is given that is incorrect then the mark should not be awarded.
___	Underlined content must be present in answer to award the mark. This means either the exact word or another word that has the same technical meaning.

Mark categories

B marks	These are independent marks, which do not depend on other marks. For a **B** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer.
M marks	These are method marks upon which **A** marks later depend. For an **M** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer. If a candidate is not awarded an **M** mark, then the later **A** mark cannot be awarded either.
C marks	These are compensatory marks which can be awarded even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known them. For example, if an equation carries a **C** mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C** mark is awarded. If a correct answer is given to a numerical question, all of the preceding **C** marks are awarded automatically. It is only necessary to consider each of the **C** marks in turn when the numerical answer is not correct.
A marks	These are answer marks. They may depend on an **M** mark or allow a **C** mark to be awarded by implication.

Question	Answer	Marks
1(a)	only electric current **and** time underlined	**B1**
1(b)	initial speed / velocity is zero	**B1**
	(non-zero magnitude of) acceleration is constant / uniform (and in a straight line)	**B1**
1(c)(i)	• magnitude of acceleration at t = 8.0 s is less than that at t = 14.0 s	**B1**
	• direction of acceleration at t = 8.0 s is opposite to that at t = 14.0 s	**B1**
1(c)(ii)	a = gradient **or** $a = (v - u) / t$ **or** $a = \Delta v / (\Delta)t$	**C1**
	a = e.g. (20 + 10) / 12 **or** (0 + 10) / 4 **or** (20 – 0) / (12 – 4) $a = 2.5\ \text{m s}^{-2}$	**A1**
1(c)(iii)	displacement = [½ × (12 – 4) × 20] – [½ × 4 × 10] **or** displacement = (–10 × 12) + (½ × 2.5 × 12^2) **or** displacement = (20 × 12) – (½ × 2.5 × 12^2) **or** displacement = ½ × (20 – 10) × 12	**C1**
	displacement = 60 m	**A1**

Question	Answer	Marks
2(a)	$65 = \rho gV$ **or** $65 = mg$ **and** $m = \rho V$	**C1**
	$\rho = 65 / (9.81 \times 7.5)$ $= 0.88\ \text{kg m}^{-3}$	**A1**
2(b)(i)	acceleration $= 9.8\ \text{m s}^{-2}$	**A1**
2(b)(ii)	air resistance (acting on sphere) increases	**B1**
	resultant force (on sphere) decreases	**B1**
	(magnitude of) acceleration decreases	**B1**
2(c)	$F = ma$ $= 4.0 \times 1.9$ (= 7.6 N)	**C1**
	resistive force $= (4.0 \times 9.81) - (4.0 \times 1.9)$ $= 32\ \text{N}$	**A1**

Question	Answer	Marks
3(a)	$E_{(P)} = ½kx^2$ **or** $E_{(P)} = ½Fx$ **and** $F = kx$	**C1**
	$0.048 = ½ \times k \times (2.1 \times 10^{-2})^2$ $k = 220\ \text{N m}^{-1}$	**A1**
3(b)	$E_{(K)} = ½mv^2$	**C1**
	$0.048 = ½ \times 7.5 \times 10^{-3} \times v^2$ $v = 3.6\ \text{m s}^{-1}$	**A1**
3(c)(i)	$(\Delta)E = mg(\Delta)h$	**C1**
	$0.039 = 7.5 \times 10^{-3} \times 9.81 \times (\Delta)h$ $\Delta h = 0.53\ \text{m}$	**A1**
3(c)(ii)	$F \times 0.53 = 0.048 - 0.039$	**C1**
	$F = 0.02\ \text{N}$	**A1**
3(d)	sketch: curved line from the origin	**M1**
	curved line has increasing gradient	**A1**

Question	Answer	Marks
4(a)(i)	component of momentum $= 0.25 \times 3.7 \times \sin 27°$	**C1**
	$= 0.42$ N s	**A1**
4(a)(ii)	$m_{(Z)} \times 5.5 \times \sin 44° = 0.42$ **or** $m_{(Z)} \times 5.5 \times \sin 44° = 0.25 \times 3.7 \times \sin 27°$ $m_Z = 0.11$ kg	**A1**
4(a)(iii)	magnitudes: equal	**B1**
	directions: opposite	**B1**
4(b)	$4 + 6 = 2 + v$ $v = 8$ m s^{-1}	**A1**

Question	Answer	Marks
5(a)(i)	light intensity has maximum value at 0°, 180°, 360° and zero intensity at 90°, 270°	**M1**
	'sinusoidally-shaped' curve	**A1**
5(a)(ii)	$4.2 = 7.6 \cos^2\theta$	**C1**
	$\theta = 42°$	**A1**
5(b)	wave passes (through) an aperture **or** wave passes (by / through / around) an edge	**B1**
	wave spreads (into geometrical shadow)	**B1**
5(c)(i)	$n\lambda = d \sin\theta$	**C1**
	$d = (3 \times 4.3 \times 10^{-7}) / \sin 68°$ $= 1.4 \times 10^{-6}$ m	**A1**
5(c)(ii)	$1.4 \times 10^{-6} \times \sin 68° = 2 \times \lambda$ **or** $3 \times 4.3 \times 10^{-7} = 2 \times \lambda$	**C1**
	$\lambda = 6.5 \times 10^{-7}$ m	**A1**

Question	Answer	Marks
6(a)	$R = \rho L / A$	**C1**
	$\rho = 0.92 \times 5.3 \times 10^{-7}$ $= 4.9 \times 10^{-7}\ \Omega\,\text{m}$	**A1**
6(b)(i)	(current =) $6.4 / 1600 = 4.0 \times 10^{-3}$ (A)	**A1**
6(b)(ii)	charge $= 4.0 \times 10^{-3} \times 3.2 \times 60$ $(= 0.768\ \text{C})$	**C1**
	number $= 0.768 / 1.6 \times 10^{-19}$ $= 4.8 \times 10^{18}$	**A1**
6(b)(iii)	$6.4 / E = 1600 / (1400 + 1600)$ **or** $E = 6.4 + (4.0 \times 10^{-3} \times 1400)$ **or** $E = 4.0 \times 10^{-3}\ (1600 + 1400)$	**C1**
	$E = 12\ \text{V}$	**A1**
6(b)(iv)	$P = I^2R$ **or** $P = VI$ **or** $P = V^2 / R$	**C1**
	ratio $= (6.4^2 / 1600) / [(4.0 \times 10^{-3})^2 \times 1400]$ $= 1.1$	**A1**
6(c)(i)	increase	**B1**
6(c)(ii)	increase	**B1**
6(c)(iii)	decrease	**B1**

Question	Answer	Marks
7(a)	only baryon **and** nucleon underlined	**B1**
7(b)	number of α-particles = 6	**B1**
	number of β^- particles = 4	**B1**
7(c)	charm antiquark (charge) = $-\frac{2}{3}(e)$ **or** $-\frac{2}{3}(e) + q = -1(e)$	**B1**
	(other quark $q = -\frac{1}{3}(e)$ so) down / strange / bottom	**B1**