Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **February/March 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 February/March 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 <u>independent</u> 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 <u>method</u> 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 <u>compensatory</u> 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 <u>answer</u> marks. They may depend on an **M** mark or allow a **C** mark to be awarded by implication.

Question	Answer	Marks
1(a)	only ampere and kelvin 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)	$a = 2.75^2 / (2 \times 3.89)$ $= 0.97\ \text{m s}^{-2}$	**A1**
1(c)(ii)	percentage uncertainty = $(2 \times 0.8) + 0.5$	**C1**
	$= 2.1\%$	**A1**
1(c)(iii)	absolute uncertainty = $(2.1 / 100) \times 0.97$ $= 0.02\ \text{m s}^{-2}$	**A1**

Question	Answer	Marks
2(a)(i)	$E = \sigma / \varepsilon$ **or** $E = F / A\varepsilon$	**C1**
	$A = 1.4 \times 10^4 / (2.2 \times 10^{11} \times 0.0012)$ $= 5.3 \times 10^{-5}\ m^2$	**A1**
2(a)(ii)	$(\Delta)h = 0.64 \times 0.49$ (= 0.3136)	**C1**
	$(\Delta)E = mg(\Delta)h$ **or** $W(\Delta)h$	**C1**
	$= 1.4 \times 10^4 \times 0.64 \times 0.49$ $= 4.4 \times 10^3$ J	**A1**
2(b)	$P = Fv$ **or** W / t	**C1**
	$= (1.4 \times 10^4 \times 0.64) / 0.56$ **or** $(4.4 \times 10^3 / 0.49) / 0.56$	**C1**
	$= 1.6 \times 10^4$ W	**A1**
2(c)	$m = 1.4 \times 10^4 / 9.81$ (= 1427 kg)	**C1**
	(resultant) $F = (1.4 \times 10^4 / 9.81) \times 1.3$ (= 1855 N)	**C1**
	$T = 1.4 \times 10^4 - 1855$ **or** $(1.4 \times 10^4 / 9.81) \times (9.81 - 1.3)$ $= 1.2 \times 10^4$ N	**A1**
2(d)	upward sloping straight line from (t_X, 0) to t_Y	**B1**
	from t_Y to t_Z: an upward sloping curve with decreasing magnitude of gradient (that is horizontal at t_Z)	**B1**

Question	Answer	Marks
3(a)	resultant force (in any direction) is zero	**B1**
	resultant moment/torque (about any point) is zero	**B1**
3(b)	(component =) $17\sin 50° = 13$ (N) **or** $17\cos 40° = 13$ (N)	**A1**
3(c)	$(W \times 0.25)$ **or** (12×0.35) **or** (13×0.50)	**C1**
	$(W \times 0.25) + (12 \times 0.35) = (13 \times 0.50)$ $W = 9.2$ N	**A1**
3(d)	$F = 9.2 + 12 - 13$ $= 8$ N	**A1**
3(e)	decrease	**B1**

Question	Answer	Marks
4(a)	$E = ½mv^2$	**C1**
	$p = mv$	**C1**
	$m = 0.37^2 / (2 \times 0.30)$ **or** $0.37 / 1.6$ **or** $(0.30 \times 2) / 1.6^2$ $= 0.23$ kg	**A1**
4(b)	$0.37 – 0.65 = –0.13 – p$ $p = 0.15$ kg m s^{-1}	**A1**
4(c)	$7.7 = (0.13 + 0.37) / (\Delta)t$ **or** $7.7 = (0.65 – 0.15) / (\Delta)t$	**C1**
	time = 0.065 s	**A1**

Question	Answer	Marks
5(a)(i)	period or $T = 1 / 5000$ ($= 2 \times 10^{-4}$ s)	**C1**
	time-base setting = $1.5 \times 2 \times 10^{-4} / 6.0$ **or** $2 \times 10^{-4} / 4.0$ $= 5 \times 10^{-5}$ s cm^{-1}	**A1**
5(a)(ii)	new trace drawn with same period as original trace	**B1**
	new trace drawn with amplitude greater than 1.0 cm	**M1**
	new trace drawn with amplitude of 1.7 cm	**A1**
5(b)(i)	path difference (from slits to P) is zero **or** phase difference (between waves at P) is zero (so constructive interference)	**B1**
5(b)(ii)	$\lambda = ax / D$	**C1**
	$D = (3.6 \times 10^{-4} \times 4.0 \times 10^{-3}) / 630 \times 10^{-9}$	**C1**
	$= 2.3$ m	**A1**
5(c)	upward sloping straight line starting from a non-zero value of x at $\lambda = 400$ nm	**B1**

Question	Answer	Marks
6(a)	energy (transferred from electrical to other forms) per unit charge	**B1**
6(b)(i)	(resistance is) infinite / very high	**B1**
6(b)(ii)	(resistance) decreases (as V increases)	**B1**
6(c)(i)	current = 2.7 – 1.5 = 1.2 A	**A1**
6(c)(ii)	12 = (1.5 × 5.0) + (1.5 × R) **or** R = (12 / 1.5) – 5.0	**C1**
	R = 3.0 Ω	**A1**
6(c)(iii)	$V_{(XZ)}$ = (1.6 / 2.0) × 12 (= 9.6 V)	**C1**
	$V_{(XW)}$ = 1.5 × 5.0 (= 7.5 V)	**C1**
	potential difference = 9.6 – 7.5 = 2.1 V	**A1**
	or	
	$V_{(ZY)}$ = (0.4 / 2.0) × 12 (= 2.4 V)	**(C1)**
	$V_{(WY)}$ = 1.5 × 3.0 (= 4.5 V)	**(C1)**
	potential difference = 4.5 – 2.4 = 2.1 V	**(A1)**

Question	Answer	Marks
6(c)(iv)	current in (fixed / variable) resistor decreases	**B1**
	current in (resistance) wire is unchanged	**B1**
	(so) current in battery decreases, (same e.m.f. so) power decreases	**B1**

Question	Answer	Marks
7(a)(i)	X has same number of protons as Y (and so) charge of X is the same as the charge of Y	**B1**
7(a)(ii)	X has (one) more proton (than Z)	**M1**
	(so) X has greater charge (than Z)	**A1**
7(b)(i)	meson(s)	**B1**
7(b)(ii)	one quark and one antiquark	**B1**