Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **October/November 2022**

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 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

[Turn over

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)	force × displacement in the direction of the force	**B1**
1(b)	$P = Fs / t$ $= (\text{kg m s}^{-2} \times \text{m}) / \text{s}$	**C1**
	$= \text{kg m}^2 \text{ s}^{-3}$	**A1**
1(c)(i)	$84 \times 10^3 = v^3 \times 0.56$	**C1**
	$v = 53 \text{ m s}^{-1}$	**A1**
1(c)(ii)	percentage uncertainty = (5% + 7%) / 3 (= 4%) **or** fractional uncertainty = (0.05 + 0.07) / 3 (= 0.04)	**C1**
	absolute uncertainty $= 0.04 \times 53$ $= (\pm) 2 \text{ m s}^{-1}$	**A1**

Question	Answer	Marks
2(a)	$F = \rho g V$ $0.071 = 1.2 \times 9.81 \times V$	**C1**
	$(V = 6.03 \times 10^{-3}\ m^3)$ $4/3 \times \pi \times r^3 = 6.03 \times 10^{-3}$ $r = 0.11$ m	**A1**
2(b)	$m = 0.053 / 9.81$ $(= 5.4 \times 10^{-3}$ kg)	**C1**
	$F = 0.071 - 0.053$ $(= 0.018$ N)	**C1**
	$a = (0.071 - 0.053) / (0.053 / 9.81)$ $= 3.3\ m\ s^{-2}$	**A1**
2(c)(i)	$v^2 = u^2 + 2as$ $3.6^2 = (-1.4)^2 + 2 \times 9.81 \times s$ **or** $3.6^2 = 1.4^2 + 2 \times 9.81 \times s$	**C1**
	$s = 0.56$ m	**A1**
2(c)(ii)	single straight line from any positive non-zero value of v at $t = 0$ to any negative non-zero value of v at $t = T$	**B1**
	line starting at (0, 1.4) and ending at (T, –3.6)	**B1**

Question	Answer	Marks
3(a)	point where (all) the weight (of an object) is taken to act	**B1**
3(b)(i)	vertical component = 45 sin 37° = 27 N	**A1**
3(b)(ii)	the magnitudes of the three moments about A are (23×0.48), (27×0.56) and $(W \times 0.76)$ correct magnitude of any one moment about A	**C1**
	correct magnitudes of any two moments about A	**C1**
	$(23 \times 0.48) + (W \times 0.76) = 27 \times 0.56$ $W = 5.4$ N	**A1**
3(b)(iii)	horizontal component = 45 cos 37° = 36 N	**A1**
3(b)(iv)	decrease	**B1**
3(b)(v)	$\sigma = F / A$	**C1**
	$\sigma = F / \pi r^2$ or $4F / \pi d^2$ so $\sigma = 5.3 \times 10^7 \times \pi r^2 / \pi(3r)^2$ $= 5.3 \times 10^7 / 9$ $= 5.9 \times 10^6$ Pa	**A1**

Question	Answer	Marks
4(a)	$E = ½mv^2$	**C1**
	$= ½ \times 0.25 \times 2.3^2$ $= 0.66$ J	**A1**
4(b)	$E = ½kx^2$ **or** $E = ½Fx$ **and** $F = kx$	**C1**
	$x = [(2 \times 0.66) / 420]^{0.5}$ $= 0.056$ m	**A1**
	or	
	$E = ½kx^2$	**(C1)**
	$½mv^2 = ½kx^2$ $x = (0.25 \times 2.3^2 / 420)^{0.5}$ $= 0.056$ m	**(A1)**
4(c)(i)	(p =) 0.25×2.3 **or** 0.25×1.5	**C1**
	change in momentum = $0.25 (2.3 + 1.5)$ $= 0.95$ N s	**A1**
4(c)(ii)	resultant force = $0.95 / 0.086$ or $0.25 \times (2.3 + 1.5) / 0.086$ $= 11$ N	**A1**
4(d)	curved line from the origin with an increasing gradient	**B1**

Question	Answer	Marks
5(a)	(they travel in) opposite directions	**B1**
5(b)(i)	straight line from A to B, labelled P	**B1**
	line that is 'mirror image' of given line, labelled Q	**B1**
5(b)(ii)	$\lambda = 0.80 / 2$ $(= 0.40$ m)	**C1**
	$v = \lambda / T$ **or** $v = f\lambda$ **and** $f = 1 / T$	**C1**
	$v = 0.40 / 0.016$ **or** 62.5×0.40 $= 25$ m s^{-1}	**A1**
5(c)(i)	$I_1 / I_0 = \cos^2 30°$	**C1**
	$= 0.75$	**A1**
5(c)(ii)	$I_2 / I_1 = \cos^2 60°$ $I_2 / I_0 = \cos^2 30° \times \cos^2 60°$ **or** $0.75 \times \cos^2 60°$	**C1**
	$= 0.19$	**A1**

Question	Answer	Marks
6(a)	energy transferred per (unit) charge (from electrical to other forms)	**B1**
6(b)	same/equal current (in X and Y)	**B1**
	$P = I^2R$ (and $R_X > R_Y$) **or** $P = VI$ **and** $V_X > V_Y$	**M1**
	(so) X (dissipates more power)	**A1**
6(c)(i)	$I = Q / t$	**C1**
	$= 650 / 540$ $= 1.2$ A	**A1**
6(c)(ii)	$V = W / Q$ **or** W / It	**C1**
	$= 4800 / 650$ **or** $4800 / (1.2 \times 540)$ $= 7.4$ V	**A1**
	or	
	$V = P / I$ **and** $P = W / t$	**(C1)**
	$= 8.9 / 1.2$ $= 7.4$ V	**(A1)**
6(c)(iii)	$I = 4.5 + 1.2$ (= 5.7 A)	**C1**
	$9.0 = 7.4 + 5.7r$ **or** $9.0 = 5.7 (1.3 + r)$ $r = 0.28\ \Omega$	**A1**

Question	Answer	Marks
7(a)	92 protons and 146 neutrons (in nucleus)	**B1**
	92 (orbital) electrons	**B1**
7(b)	charge = 2*e* (= $2 \times 1.60 \times 10^{-19}$ C)	**C1**
	mass = 4u (= $4 \times 1.66 \times 10^{-27}$ kg)	**C1**
	ratio = $(2 \times 1.60 \times 10^{-19}) / (4 \times 1.66 \times 10^{-27})$ = 4.8×10^{7} C kg^{-1}	**A1**
7(c)(i)	up down down / udd	**B1**
7(c)(ii)	up up up / uuu	**B1**