CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/21**

Paper 2 AS Level Structured Questions **May/June 2025**

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 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **14** printed pages.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	Information missing or insufficient for credit
	Arithmetic error
	Benefit of the doubt given
	Contradiction in response, mark not awarded
	Incorrect point or mark not awarded
	Error carried forward applied
	Ignore the response
	Mandatory mark not awarded
	Power of ten error
	Blank page seen
	Error in number of significant figures

Annotation	Meaning
TE	Transcription error
✓	Correct point or mark awarded
XP	Incorrect physics

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)	rate of change of velocity	**B1**
1(b)(i)	$s = ut + ½at^2$ **and** $u = 0$ or $s = ½at^2$ $t = \sqrt{(2 \times 14 / 9.81)}$	**C1**
	$t = 1.7$ s	**A1**
	OR $v = \sqrt{(0^2 + 2 \times 9.81 \times 14)}$ $v = 17$ (m s^{-1}) $17 = (0 + 9.81) \times t$ **or** $17 = 9.81 \times t$ or $14 = ½ \times (0 + 17) \times t$ **or** $14 = ½ \times 17 \times t$	**(C1)**
	$t = 1.7$ s	**(A1)**
1(b)(ii)	$s = ut + ½at^2$ $u = (3.6 – ½ \times 9.81 \times 1.7^2) / 1.7$	**C1**
	$u = (–) 6.2$ m s^{-1}	**A1**
	OR $v = (3.6 + ½ \times 9.81 \times 1.7^2) / 1.7$ $v = 10$ (m s^{-1}) $10 = u + 9.81 \times 1.7$ or $10^2 = u^2 + (2 \times 9.81 \times 3.6)$ or $3.6 = ½ \times (u + 10) \times 1.7$	**(C1)**
	$u = (−) 6.2$ m s^{-1}	**(A1)**

Question	Answer	Marks
1(c)(i)	Less time (as it reaches a lower height)	**B1**
	(because) the initial vertical (component of the) velocity is smaller (than in part **(b)**)	**B1**
1(c)(ii)	The (total) initial energy is the same (as in part **(b)**)	**B1**
	change in gravitational potential energy is same, so speed is the same	**B1**

Question	Answer	Marks
2(a)	in (rotational) equilibrium	**B1**
	sum / total of clockwise moments about a point = sum / total of anticlockwise moments about the (same) point.	**B1**
2(b)	$80 \times 9.81 \times 3$ **or** $60 \times 9.81 \times 3$ **or** $45 \times 9.81 \times x$	**C1**
	$80 \times 9.81 \times 3 = (60 \times 9.81 \times 3) + (45 \times 9.81 \times x)$	**C1**
	$x = 1.3$ m	**A1**
2(c)(i)	$k = F / x$	**C1**
	$x = 0.80 - 0.59$ $= 0.21$ m	**C1**
	$k = (60 \times 9.81) / 0.21$ $= 2800$ N m^{-1}	**A1**

Question	Answer	Marks
2(c)(ii)	$E = ½\ kx^2$ **or** $E = ½\ Fx$ **or** $E = ½\ F^2/k$ $= ½ \times 2800 \times 0.21^2$ or $= ½ \times 60 \times 9.81 \times 0.21$ or $= ½ \times (60 \times 9.81)^2 / 2800$	**C1**
	$= 62$ J	**A1**

Question	Answer	Marks
3(a)	work done per unit time	**B1**
3(b)(i)	$P = F \times v$ $= 1750 \times 35$	**C1**
	$= 6.1 \times 10^4$ W	**A1**
3(b)(ii)	$W = Fs$ $= 1750 \times 17\,000$	**C1**
	$= 3.0 \times 10^7$ J	**A1**
	or $W = Pt$ $= 6.1 \times 10^4 \times (17\,000 / 35)$	**(C1)**
	$= 3.0 \times 10^7$ J	**(A1)**

Question	Answer	Marks
3(b)(iii)	$P = V \times I$ Power in = $600 \times I$	**C1**
	$\text{Efficiency} = \frac{\text{useful power output}}{\text{(total) power input}}$	**C1**
	$0.85 = 6.1 \times 10^4 / (600 \times I)$ I = 120 A	**A1**
3(c)(i)	Air resistance is the same, as the speed is the same	**B1**
3(c)(ii)	The motor is producing less power (because of gravitational force / conversion of gravitational potential energy to kinetic energy) so the current will be smaller.	**B1**

Question	Answer	Marks
4(a)	(when two or more) waves meet / overlap (at a point)	**B1**
	(resultant) displacement is sum of the individual displacements	**B1**
4(b)(i)	Fringe width, $x = 3.2 \times 10^{-2} / 8$ $= 4.0 \times 10^{-3}$ (m)	**C1**
	$D = ax / \lambda$ $= (4.0 \times 10^{-3} \times 0.16 \times 10^{-3}) / 7.2 \times 10^{-7}$	**C1**
	= 0.89 m	**A1**

Question	Answer	Marks
4(b)(ii)	Curved line with a negative gradient of decreasing magnitude throughout, from slit separation 0.04 mm to 0.16 mm	**B1**
	Line of negative gradient ending at (0.16, 0.4), from slit separation 0.04 mm	**B1**
	Line of negative gradient passing through (0.08, 0.8) and (0.04, 1.6)	**B1**

Question	Answer	Marks
5(a)	wavelength: • wavelength = distance between successive / adjacent in phase points / wavefronts / crests / troughs • $\lambda = d$ / (number of) oscillations frequency: • frequency = (number of) oscillations / cycles crests / troughs / wavefronts (passing a point) per unit time • f = (number of) oscillations / t One correct point from **either** list	**B1**
	One correct point from **both** lists **and** speed = distance / time **and** one of: • wavelength $\times$ frequency (= distance per unit time) = speed • [(number of) oscillations / t] $\times$ [d / (number of) oscillations] = $f\lambda$ • v (= d / t) = λ / (1/f) = $f\lambda$ or v (= d / t) = λ / T = $f\lambda$	**B1**
5(b)(i)	$T = 4 \times 10^{-3}$ $f = 1 / T = 1 / 0.004$	**C1**
	f = 250 Hz	**A1**

Question	Answer	Marks
5(b)(ii)	$f_o = f_s\, v / (v - v_s)$ $250 = 236 \times v / (v - 20)$ $v = (250 \times 20) / (250 - 236)$	**C1**
	$= 360\ \text{m s}^{-1}$	**A1**

Question	Answer	Marks
6(a)(i)	$I = 1.3 / 1.1$ $= 1.2\ \text{A}$	**A1**
6(a)(ii)	$v = I / nqA$ $= 1.2 / (8.5 \times 10^{28} \times 1.60 \times 10^{-19} \times 4.7 \times 10^{-7})$	**C1**
	$= 1.9 \times 10^{-4}\ \text{m s}^{-1}$	**A1**
6(a)(iii)	$\rho = RA / L$	**C1**
	$= (1.1 \times 4.7 \times 10^{-7}) / 0.45$	**C1**
	$= 1.1 \times 10^{-6}\ \Omega\,\text{m}$	**A1**
6(b)(i)	(Total) resistance decreases (and the potential difference stays the same)	**M1**
	(so the reading on the ammeter) increases	**A1**
6(b)(ii)	(The average drift speed will be) the same because the current is the same (in X).	**B1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="3">7(a)</td><td>$^{12}_{7}\text{N} \rightarrow {}^{12}_{6}\text{C} + {}^{0}_{1}\beta^{+} + {}^{(0)}_{(0)}\text{n}$

beta-plus shown</td><td>B1</td></tr>
<tr><td>neutrino shown</td><td>B1</td></tr>
<tr><td>symbols, nucleon numbers and proton numbers all correct</td><td>B1</td></tr>
<tr><td>7(b)(i)</td><td>+1</td><td>B1</td></tr>
<tr><td>7(b)(ii)</td><td>Lepton(s)</td><td>B1</td></tr>
<tr><td rowspan="4">7(b)(iii)</td><td><table><tr><th>flavour</th><th>charge / e</th></tr><tr><td>up / u</td><td>$-\frac{2}{3}$</td></tr><tr><td>up / u</td><td>$-\frac{2}{3}$</td></tr><tr><td>down / d</td><td>$(+)\frac{1}{3}$</td></tr></table></td><td></td></tr>
<tr><td>3 correct quark flavours</td><td>B1</td></tr>
<tr><td>Charge on anti-up quark –⅔(e)</td><td>B1</td></tr>
<tr><td>Charge on anti-down quark (+)⅓(e)</td><td>B1</td></tr>
</table>