CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

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.

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)	acceleration and displacement identified as vectors (and no others)	**B1**
	speed, temperature and gravitational potential energy identified as scalars (and no others)	**B1**
1(b)(i)	$W = Fs$ **or** $W = mas$	**B1**
	$s = v^2 / 2a$ **or** $a = v^2 / 2s$ **or** $as = v^2 / 2$	**B1**
	$W = ma(v^2 / 2a)$ **or** $W = m(v^2 / 2s)s$ **or** $W = m(v^2 / 2)$ **and** (so E_K)= $½mv^2$	**B1**
	OR $W = Fs$ or $W = mas$	**(B1)**
	$F = mv / t$ **and** $s = ½vt$	**(B1)**
	$W = mv / t \times ½vt$ **and** (so E_K)= $½mv^2$	**(B1)**
	OR $W = Fs$ or $W = mas$	**(B1)**
	$a = v / t$ **and** $s = ½vt$	**(B1)**
	$W = m(v / t)(½vt)$ **and** (so E_K)= $½mv^2$	**(B1)**
	OR $W = Fs$ **or** $W = mas$	**(B1)**
	$a = v / t$ **and** $s = ½at^2$	**(B1)**
	$W = m(v / t)(½ \times (v / t) \times t^2)$ **and** (so E_K)= $½mv^2$	**(B1)**

Question	Answer	Marks
1(b)(ii)	kinetic energy $= \frac{1}{2} mv^2$ $= \frac{1}{2} \times 920 \times 17^2$ $= 1.3 \times 10^5$ J	**A1**
1(b)(iii)	$P = W/t$	**C1**
	$= (4.7 \times 10^4 + 1.3 \times 10^5) / 5.8$	**C1**
	$= 3.1 \times 10^4$ W	**A1**
1(b)(iv)	(at/after t = 5.8 s) the kinetic energy (of the car) does not change / work is done only against resistive forces / no work is done to accelerate (the car) so (power output is) less	**B1**

Question	Answer	Marks
2(a)	force × <u>perpendicular</u> distance (of line of action of force to / from the point)	**B1**
2(b)(i)	(moment due to weight =) $1.2 \times 270 \times 9.81$	**B1**
	(moment due to post =) $1800 \times (1.6 / \cos\theta)$	**B1**
	$1.2 \times 270 \times 9.81 = 1800 \times (1.6 / \cos\theta)$ so $\theta = 25(°)$ or $1.2 \times 270 \times 9.81 - 1800 \times (1.6 / \cos\theta) = 0$ so $\theta = 25(°)$	**B1**
2(b)(ii)	A closed tip-to-tail vector triangle	**M1**
	vector labelled *F* at an angle of 25° ± 3° anticlockwise from vertical **and** vector labelled *R* at an angle of 37° ± 3° clockwise from vertical	**A1**

Question	Answer	Marks
2(b)(iii)	$A = F / p$ $= 1800 / (150 \times 10^3)$	**C1**
	$= 0.012\ m^2$	**A1**

Question	Answer	Marks
3(a)	10.0 cm	**A1**
3(b)(i)	$v = f\lambda$ $= 16 \times 0.40$	**C1**
	$= 6.4\ m\ s^{-1}$	**A1**
3(b)(ii)	(X and Y have a) constant phase difference (of 180°) so (they are) coherent	**B1**
3(c)	A single wave of amplitude 10.0 cm	**B1**
	A single negative sine wave of wavelength 0.40 m	**B1**
3(d)	$I \propto A^2$ $\frac{I_X}{I_Y} = 10^2 / 20^2$	**C1**
	ratio = 0.25	**A1**

Question	Answer	Marks
4(a)	The (total) kinetic energy changes / decreases so (the collision is) inelastic	**B1**
	OR (relative) speed of approach not equal to / greater than (relative) speed of separation so (collision is) inelastic	**(B1)**
4(b)(i)	$p = mv$ **or** 0.25×3.6 **or** 0.25×5.2 $\Delta p = 0.25 \times (3.6 + 5.2)$	**C1**
	$= 2.2$ kg m s^{-1}	**A1**
4(b)(ii)	$F = \Delta p / (\Delta) t$ $= 2.2 / 0.18$	**C1**
	$= 12$ N	**A1**
	OR $F = ma$ **and** $a = (v–u) / t$ $= m\Delta v / t$ $= 0.25 \times (3.6 + 5.2) / 0.18$	**(C1)**
	$= 12$ N	**(A1)**

Question	Answer	Marks
4(c)	½ $mv^2 = mg(\Delta)h$ ½ × 0.25 × 5.2^2 = 0.25 × g × h_1 $h_1 = 5.2^2 / 2g$ h_1 = 1.38	**C1**
	½ × 0.25 × 3.6^2 = 0.25 × g × h_2 $h_2 = 3.6^2/2g$ h_2 = 0.66 h_2 / h_1 = 0.66 / 1.38	**C1**
	ratio = 0.48	**A1**

Question	Answer	Marks
5(a)	the ratio of stress to strain	**B1**
5(b)(i)	$A = FL / Ex$	**C1**
	A = e.g. (500 × 0.81) / (95 × 10^9 × 4.0 × 10^{-3})	**C1**
	A = 1.1 × 10^{-6} m^2	**A1**
	OR $A = kL / E$ **or** A = gradient × L / E k = e.g. 500 / 4.0 × 10^{-3} k = 1.25 × 10^5	**(C1)**
	A = 1.25 × 10^5 × 0.81 / 95 × 10^9	**(C1)**
	A = 1.1 × 10^{-6} m^2	**(A1)**

Question	Answer	Marks
5(b)(ii)	$E = ½\ kx^2$ **or** $E = ½\ Fx$ **or** E = area (under graph)	**C1**
	$(\Delta)E = ½ \times 1.25 \times 10^5 \times ((3.0 \times 10^{-3})^2 – (2.0 \times 10^{-3})^2)$ **or** $(\Delta)E = (½ \times 375 \times 3.0 \times 10^{-3}) – (½ \times 250 \times 2.0 \times 10^{-3})$ **or** $(\Delta)E = ½ \times (375 + 250) \times 1.0 \times 10^{-3}$	**C1**
	work done = 0.31 J	**A1**

Question	Answer	Marks
6(a)	energy transferred (to the component) per (unit) charge	**B1**
6(b)(i)	$Q = It$ $= 0.030 \times 4.0 \times 60$	**C1**
	= 7.2 C	**A1**
6(b)(ii)	$I = V / R$ $I_1 = 8.0 / (430+240)$	**C1**
	= 0.012 A	**A1**
6(b)(iii)	$I_2 = 0.030 – I_1$ $= 0.030 – 0.012$ = 0.018 A	**A1**

Question	Answer	Marks
6(b)(iv)	R = V / I_2 = (8.0 – (0.018 × 210)) / 0.018	**C1**
	= 230 Ω	**A1**
	OR resistance of top branch = 8.0 / 0.018 R = 8.0 / 0.018 – 210	**(C1)**
	= 230 Ω	**(A1)**
	OR total circuit resistance = 8.0 / 0.030 = 267 1 / 267 = 1 / (210 + R) + 1 / (430 + 240) 1 / 267 – 1 / 670 = 1 / (210 + R) 210 + R = 443	**(C1)**
	R = 230 Ω	**(A1)**
6(c)	(When) the galvanometer reads 0 (A)	**M1**
	The ratio of the resistances in the top branch will equal the ratio of the resistances in the bottom branch (so the resistance of X can be determined)	**A1**
	OR The ratio of the left pair of resistances will equal the ratio of the right pair of resistances	**(A1)**

Question	Answer	Marks
7(a)	(a particle that) cannot be divided/subdivided (into smaller particles)	**B1**
7(b)(i)	$(p \times e) / (14\text{u}) = 4.1 \times 10^{7}$	**C1**
	$p = (4.1 \times 10^{7} \times 14 \times 1.66 \times 10^{-27}) / (1.60 \times 10^{-19})$	**C1**
	$p = 6$ (answer should be an integer)	**A1**
7(b)(ii)	${}^{14}_{6}\text{X} \rightarrow {}^{14}_{7}\text{Z}$	**B1**
	${}^{0}_{-1}\text{e}^{(-)}$ or ${}^{0}_{-1}\beta^{(-)}$	**B1**
	${}^{0}_{0}\overline{\nu}_{(e)}$	**B1**
7(c)	(the nuclei are undergoing) β^{+} decay	**B1**
	A correct explanation in terms of charge **and** a correct explanation in terms of energy Explanations in terms of charge: • (particles / decay) positively charged so cannot be β^{-} • (particles / decay) positively charged so could be / is β^{+} • β^{-} (particles / decay) are negatively charged • β^{+} (particles / decay) are positively charged Explanations in terms of energy: • range of energies so not α (particles / decay) • range of energies so is β (particles / decay) • β (particles / decay) have a range of energies • α (particles / decay) have discrete energies / not range of energies	**B1**