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CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **May/June 2026**

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

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General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

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Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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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
A	Information missing or insufficient for credit
AE	Arithmetic error
BOD	Benefit of the doubt given
CON	Contradiction in response, mark not awarded
	Incorrect point or mark not awarded
ECF	Error carried forward applied
I	Ignore the response
MO	Mandatory mark not awarded
POT	Power of ten error
SEEN	Blank page seen
SF	Error in number of significant figures

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

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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>mandatory</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.

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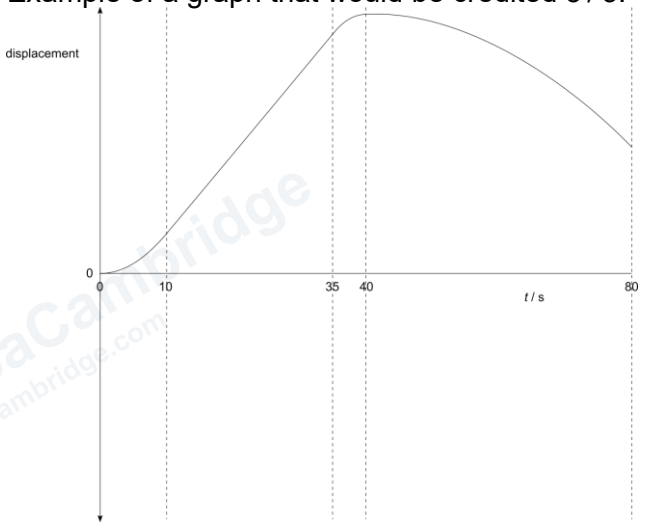
Question	Answer	Marks	Guidance
1(a)	amplitude and power identified as scalars	**B1**	Allow methods for marking the table other than a tick (e.g. ×) provided no ticks are seen
	force and momentum identified as vectors	**B1**	
1(b)(i)	area (under graph line)	**B1**	
1(b)(ii)	distance = 390 m	**A1**	
1(b)(iii)	$a = (v - u) / t$ or $a = \Delta v / (\Delta)t$ or gradient (of graph) e.g. = (0 – 12) / 5	**C1**	Allow $a = (u - v) / t$ or $a = (\Delta)v / (\Delta)t$ or a = –gradient Allow $a = (y_2 - y_1) / (x_2 - x_1)$ Allow a numerical expression equivalent to one of the three non-zero gradients on the graph, e.g. a = 12 / 5 or a = 12 / 10 or a = 10 / 40 No ECF of incorrect velocity from **1(b)(ii)**
	magnitude of acceleration = 2.4 m s^{-2}	**A1**	Allow –2.4 m s^{-2}
1(b)(iv)	$v^2 = 2 \times -0.25 \times -150$ = 75	**C1**	No mark for symbol formulae. For each method, the C1 mark is given for the full substitution of data into the formula. Allow $v^2 = 2 \times 0.25 \times 150$
	speed = 8.7 m s^{-1}	**A1**	Allow speed = –8.7 m s^{-1} for all methods
	Alternative methods: (–150 = ½ × –0.25 × t^2 so t = 34.6) v = –0.25 × 34.6 = –8.7	**(C1)**	Allow v = 0.25 × 34.6 Allow use of t = 35 to imply the C1 mark, but do not credit the A1 mark if leads to incorrect speed (8.8 m s^{-1})
	speed = 8.7 m s^{-1}	**(A1)**	

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Question	Answer	Marks	Guidance
1(b)(iv)	OR $-150 = ½ \times v \times 34.6$ $v = -8.7$	**(C1)**	Allow $150 = ½ \times v \times 34.6$ Allow use of $t = 35$ to imply the C1 mark, but do not credit the A1 mark if leads to incorrect speed (8.6 m s^{-1})
	speed = 8.7 m s^{-1}	**(A1)**	
	OR $-150 = (v \times 34.6) - (½ \times -0.25 \times 34.6^2)$ $v = -8.7$	**(C1)**	Allow $150 = (v \times 34.6) - (½ \times 0.25 \times 34.6^2)$
	speed = 8.7 m s^{-1}	**(A1)**	
	OR $t = 34.6 + 40$ $= 74.6$ At $t = 74.6$, $v = -8.7$ (from graph)	**(C1)**	No tolerance (for consistency with other methods)
	speed = 8.7 m s^{-1}	**(A1)**	

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Question	Answer	Marks	Guidance
1(b)(v)	A line from 0,0 to t = 80 s with increasing displacement then decreasing displacement that does not cross the t-axis	**B1**	For all marking points ignore line after t = 80 s Allow line to have discontinuous gradient at t = 10, 35, 40 Do not allow step change in displacement Allow graph to end up to 5 mm before t = 80 s Allow line to end at the t-axis Do not allow displacement that increases, decreases and then increases again
	A line with a maximum displacement at t = 40 s	**B1**	Allow centre of peak ±3 mm horizontally from t = 40 s
	A line with • increasing gradient from t = 0 to t = 10 s • constant positive gradient between t = 10 s and t = 35 s • decreasing gradient between t = 35 s and t = 40 s • decreasing gradient between t = 40 s and t = 80 s	**B1**	Allow line to have discontinuous gradient at t = 10, 35, 40 Do not allow step change in displacement If unclear whether a section of the line is straight or curved give BOD Allow graph to end up to 5 mm before t = 80 s Example of a graph that would be credited 3 / 3: 

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Question	Answer	Marks	Guidance
2(a)	resultant force (in any direction) is zero	**B1**	Allow 'net force is zero' Allow 'sum of forces is zero' or 'total force is zero' or '$\Sigma F = 0$' Allow 'sum of vertical forces is zero and sum of horizontal forces is zero'. Allow 'resultant force about any point is zero' Ignore 'forces balance' or 'forces cancel' or 'forces are equal' Ignore just 'no (external) forces act' or just 'force is zero' Ignore object stationary / constant velocity / zero acceleration etc
	resultant torque / moment (about any point) is zero	**B1**	Allow 'net moment is zero' Allow 'sum of moments is zero' or 'total moment is zero' Allow 'sum of CW moments = sum of ACW moments' Allow 'sum of CW and ACW moments is zero' Allow 'resultant moment at a point is zero' Allow 'torque' instead of 'moment' throughout Ignore 'moments balance' or 'moments cancel' Ignore 'no moments' or 'moment is zero' Not 'momentum' instead of 'moment'
2(b)(i)	one equation for forces on **either** block **or** plank: $2T\cos\theta = R + W_P$ or $2T\cos\theta + R = W_B$	**M1**	A full equation for the forces on either object must be seen Allow $0 = R + W_P - 2T\cos\theta$ Allow $0 = W_B - R - 2T\cos\theta$ Ignore just $R + W_P - 2T\cos\theta = W_B - R - 2T\cos\theta$ Allow $\sin(90 - \theta)$ for $\cos\theta$ Not $\sin\theta$ for $\cos\theta$
	both equations for forces on block **and** plank **and** ($2T\cos\theta =$) $R + W_P = W_B - R$	**A1**	Second mark for both separate equations seen and 'show that' answer given. Special case: $2T\sin\theta = R + W_P$ and $2T\sin\theta + R = W_B$ and ($2T\sin\theta =$) $R + W_P = W_B - R$ credit 1 / 2

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Question	Answer	Marks	Guidance
2(b)(ii)	$2R = 8.1 \times 9.81 - 4.5 \times 9.81$	**C1**	Allow $2R = 8.1g - 4.5g$ Allow $g = 10$
	$R = 18$ N	**A1**	
2(c)(i)	Hooke's (law)	**A1**	Allow phonetic misspellings of 'Hooke' e.g. Hook, Huk, Hookie
2(c)(ii)	When the tension is removed, the ropes have original length / extension is zero OR when the tension is removed object is not deformed	**A1**	Allow 'it' to mean ropes Allow 'force' / 'load' / 'T' / 'stress' / weight' for tension Ignore 'mass' for tension Allow 'unloaded' for tension is removed Allow 'tension is released' (BOD) but ignore 'object released' Allow 'unstretched' / 'initial' for original Allow 'shape and size' for length Allow 'dimensions' for length Ignore 'state' / 'form' for length

Question	Answer	Marks	Guidance
3(a)	(A wave which) transfers energy (in the direction of propagation)	**B1**	Allow 'it' to mean 'a wave' provided not clearly referring to something else Allow 'propagates / carries / moves' for transfers Ignore references to medium / matter Ignore references to transverse or longitudinal waves
3(b)(i)	$T = 0.33$ s	**A1**	
3(b)(ii)	$\lambda = 3.9 - 2.4$ $= 1.5$	**C1**	The C1 marks may be credited independently of each other
	$v = f\lambda$ or $v = \lambda / T$ $= 3 \times 1.5$ $= 1.5 / 0.33$	**C1**	Allow $c = f\lambda$ ECF T from **3(b)(i)**
	$= 4.5$ m s^{-1}	**A1**	

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Question	Answer	Marks	Guidance
3(c)(i)	$(\Delta)E = mg(\Delta)h$	C1	
	$= 0.44 \times 9.81 \times (0.15 \times 2)$	C1	Allow $g = 10$ as leads to same answer to 2SF Allow $0.44 \times 9.81 \times (-0.15 \times 2)$ $0.44 \times 9.81 \times 0.15$ implies 1st C1 mark but not 2nd C1 mark
	= 1.3 J	A1	Allow –1.3 J
3(c)(ii)	The path difference (from A and B) is not a whole number of wavelengths / (The waves at P are) not in phase	B1	Allow '(waves are) out of phase' / 'phase difference not zero' Not '(waves are) 180° out of phase / antiphase' Allow 'not (complete) constructive interference (at P)' (BOD)
	(The amplitude) decreases	B1	Allow 'it' to mean amplitude (unless it clearly refers to something else) Allow 'less' / 'smaller' for decreases

Question	Answer	Marks	Guidance
4(a)	$E_{(K)} = ½ mv^2$	C1	Allow any value of energy equated to $½ mv^2$
	$v^2 = (2 \times 1.3 \times 10^5 / 1.5 \times 10^4)$	C1	When candidates initially state the correct symbol equation, but then at the substitution stage write v instead of v^2, treat this as TE in the 2nd mark and allow ECF to the 3rd mark (max 2/3 marks). When candidates do not initially state a symbol equation, and then at the substitution stage write v instead of v^2, this implies an incorrect symbol equation and so treat as XP (no credit 0/3).
	$v = 4.2\ \text{m s}^{-1}$	A1	

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Question	Answer	Marks	Guidance
4(b)(i)	work (done) / time (taken)	**B1**	Allow 'work (done) per (unit) time' Allow 'ratio of work and time' Allow 'rate of (doing) work' Allow 'work over time' (BOD) Not 'work in unit time' Not 'rate of (doing) work per unit time' Not 'change of work (done) per unit time' Ignore 'work (done) by time' Ignore 'work (done) into time' Allow 'energy transferred / time' or 'energy converted / time' Allow 'change in energy / time' (BOD) Allow 'rate of energy transferred' Ignore just 'energy / time' Ignore symbols unless symbols are explained Ignore any units e.g. ignore 'work done per second' or 'Joules per time'

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Question	Answer	Marks	Guidance
4(b)(ii)	$W = Fs$ or $W = Fvt$ or $W = Pt$ useful work done = change in E_P + Fs	**C1**	Allow $(\Delta)E$ for W and allow 'd' or 'x' for 's' Allow 'WD' for work done (BOD) Allow any value of energy equated to Fs for 1st C1 mark
	$W = (1.1 \times 10^5 \times 52) – (13.0 \times 10^6 – 7.4 \times 10^6)$ $= 1.2 \times 10^5$	**C1**	Allow Fs or Fvt or Pt for W Treat not converting or incorrect conversion of both 13.0 MJ and 7.4 MJ to J as a single POT error ECF speed from **4(a)**
	$F = 1.2 \times 10^5 / (4.2 \times 52)$ = 550 N	**A1**	Allow 555 N (correct to 3SF because use of v=4.16 gives 554.7 N) but do not allow any other value that rounds to 560
	OR $P = Fv$ useful output power = power to raise weight + Fv	**(C1)**	Allow any value of power equated to Fv for this mark
	$P = 1.1 \times 10^5 – [(13.0 \times 10^6 – 7.4 \times 10^6) / 52]$ $= 2.3 \times 10^3$	**(C1)**	Allow Fv for P Treat not converting or incorrect conversion of both 13.0 MJ and 7.4 MJ to J as a single POT error ECF speed from **4(a)**
	$F = (2.3 \times 10^3) / 4.2$ = 550 N	**(A1)**	Allow 555 N (3SF) but Not 560 N
	OR $P = Fv$ driving force = component of weight parallel to slope + F	**(C1)**	

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Question	Answer	Marks	Guidance
4(b)(ii)	$1.1 \times 10^5 / 4.2 = F + 1.5 \times 10^4 \times 9.81 \sin\theta$ and $\sin\theta = (13.0 \times 10^6 - 7.4 \times 10^6) / (1.5 \times 10^4 \times 9.81 \times 4.2 \times 52)$ $1.1 \times 10^5 / 4.2 = F + (13.0 \times 10^6 - 7.4 \times 10^6) / (4.2 \times 52)$]	**(C1)**	ECF speed from **4(a)** Treat not converting or incorrect conversion of both 13.0 MJ and 7.4 MJ to J as a single POT error
	$F = 2.619 \times 10^4 - 2.564 \times 10^4$ $= 550$ N	**(A1)**	Allow 555 N (3SF) but not 560 N
4(b)(iii)	$P = IV$ $= 95 \times 1400$ $= 1.33 \times 10^5$	**C1**	For both methods C1 marks may be credited independently Allow $V = IR$ and either $P = V^2 / R$ or $P = I^2R$
	efficiency = useful output power / (total) input power (× 100)	**C1**	Ignore 'useful output/total input' but allow 'power' to be implied by substituted values of power Candidates may use useful output power = $(13.0 \times 10^6 - 7.4 \times 10^6) / 52 = 1.07692 \times 10^5$ so Allow $(1.08 \times 10^5 / (95 \times 1400))$ (× 100) to imply both C1 marks (but will lead to incorrect final answer 81%)
	$= [1.1 \times 10^5 / (95 \times 1400)]$ (× 100) = 83%	**A1**	
	OR $E = VIt$ $= 95 \times 1400 \times 52$ $= 6.92 \times 10^6$	**(C1)**	
	efficiency = useful output energy / (total) input energy (× 100)	**(C1)**	Ignore 'useful output/total input' but allow 'energy' to be implied by substituted values of energy Candidates may use useful output energy = $(13.0 \times 10^6 - 7.4 \times 10^6) = 5.6 \times 10^6$ so Allow $(5.6 \times 10^6 / (95 \times 1400 \times 52))$ (× 100) to imply both C1 marks (but will lead to incorrect final answer 81%)
	$= [(1.1 \times 10^5 \times 52) / (1400 \times 95 \times 52)]$ (× 100) = 83 %	**(A1)**	

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Question	Answer	Marks	Guidance
5(a)	$I_T = I_1 + I_2 + I_3$ either $(V / R_T) = (V / R_1) + (V / R_2) + (V / R_3)$ or $(I_T / V) = (I_1 / V) + (I_2 / V) + (I_3 / V)$	**B1**	Throughout allow I and R without subscript to mean I_T and R_T respectively, and allow V_T for V
	and $1 / R_T = 1 / R_1 + 1 / R_2 + 1 / R_3$	**B1**	If uses V_1, V_2, V_3 must also explicitly state that $(V =) V_1 = V_2 = V_3$. For the second mark, the associated working and final answer must both be shown A fully correct answer in terms of two rather than three resistors credit 1 / 2
5(b)(i)	$R_{(T)} = (1 / 2.8 + 1 / 2.8)^{-1}$ $= 1.4$ current in battery $= V / R_{(T)}$ $= 12 / 1.4$	**C1**	Allow any correct expression for the parallel combination e.g. $1 / R_{(T)} = 1 / 2.8 + 1 / 2.8$ or $R_{(T)} = (2.8 \times 2.8) / (2.8 + 2.8)$
	$= 8.6$ A	**A1**	
	OR $I = 12 / 2.8$ $= 4.3$	**(C1)**	
	current in battery $= 4.3 + 4.3$ $= 8.6$ A	**(A1)**	Special case: A final answer of 4.3 A without any supporting working credit 1 / 2

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Question	Answer	Marks	Guidance
5(b)(ii)	$v = I / Anq$ $= (8.6 / 2) / (6.1 \times 10^{-6} \times 8.5 \times 10^{28} \times 1.6 \times 10^{-19})$	**C1**	no mark for symbol formula as given in the formula sheet ECF current from **5(b)(i)** Allow $(12 / 1.4) / (2 \times 6.1 \times 10^{-6} \times 8.5 \times 10^{28} \times 1.6 \times 10^{-19})$ if treats as a single wire of double area
	$= 5.2 \times 10^{-5}$ m s^{-1}	**A1**	Special case: candidates that do not half their current from **5(b)(i)** can be credited 1 / 2 if working is shown e.g. $= 8.6 / (6.1 \times 10^{-6} \times 8.5 \times 10^{28} \times 1.6 \times 10^{-19})$ $= 1.0 \times 10^{-4}$ m s^{-1}
5(c)(i)	light-dependent resistor	**B1**	Allow LDR
5(c)(ii)	$I_{(X)} = 5 – 12 / 2.8$ $= 0.71$	**C1**	Allow $I_{(X)} = 5 – (8.6 / 2)$ (= 0.70) and allow ECF of current from **5(b)(i)**
	$R_{(\text{top branch})} = 12 / 0.71$ $= 16.8$	**C1**	
	$R_{(X)} = 16.8 – 2.8$ $= 14\ \Omega$	**A1**	
	OR $I_{(X)} = 5 – 12 / 2.8$ $= 0.71$	**(C1)**	Allow $I_{(X)} = 5 – (8.6 / 2)$ (= 0.70) and allow ECF of current from **5(b)(i)**
	$V_{(\text{resistance wire})} = 0.71 \times 2.8$ $= 2.0$ $V_{(X)} = 12 – 2.0$ $=10$	**(C1)**	
	$R_{(X)} = 10 / 0.71$ $= 14\ \Omega$	**(A1)**	

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Question	Answer	Marks	Guidance
5(c)(ii)	OR $R_{(T)}$ = 12 / 5 = 2.4	**(C1)**	
	1 / 2.4 = 1 / 2.8 + 1 / $R_{(top\ branch)}$ $R_{(top\ branch)}$ = 16.8	**(C1)**	Allow 1 / 2.4 = 1 / 2.8 + 1 / (2.8 + $R_{(X)}$)
	$R_{(X)}$ = 16.8 – 2.8 = 14 Ω	**(A1)**	
5(c)(iii)	(current in battery decreased, total resistance increased,) resistance (of X) increased	**M1**	Allow 'LDR' instead of X Allow *V*, *I*, *R* to mean potential difference, current and resistance respectively Allow ↓ for decreases and ↑ for increases (BOD) Ignore all comments about p.d. and emf
	light intensity (incident on X) decreased	**A1**	Allow '(environment is) darker / dimmer / less light / less bright' Allow 'temperature (of X/LDR) has decreased'

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Question	Answer	Marks	Guidance
6(a)	Most of the α-particles pass straight through (the atom) OR Most of the α-particles have (very) small deviations	**B1**	Allow 'majority' / 'nearly all' / 'large proportion' for 'most' Allow 'particles' / 'them' to mean α-particles (BOD) Allow 'no deviation' / 'undeviated' / 'deviate by small / insignificant / minimal angles' instead of small deviations Allow 'deflection' instead of deviation Allow 'gold / leaf' for atom Ignore 'some' instead of 'most' Ignore 'a large number' as this is not comparative Ignore just 'pass through' for 'pass straight through' Ignore 'only a (very) small proportion of alpha particles had (very) large deviations' as this does not necessarily mean the rest had little or no deviation
6(b)(i)	(p =) mv	**C1**	Allow any mass $\times$ any velocity e.g. 4(u) $\times$ 5.60 $\times$ 10^6 or 1.66 $\times$ 10^{-27} $\times$ 5.60 $\times$ 10^6 or 1.67 $\times$ 10^{-27} $\times$ 5.60 $\times$ 10^6
	= 4 $\times$ 1.66 $\times$ 10^{-27} $\times$ 5.60 $\times$ 10^6 = 3.72 $\times$ 10^{-20} (kg m s^{-1})	**A1**	As this is a 'show that' question the full working and answer must be seen Not 1.67 $\times$ 10^{-27} or 1.6 $\times$ 10^{-27} for A1 mark

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GradeMax

Question	Answer	Marks	Guidance
6(b)(ii)	$4(u) \times 5.60 \times 10^6 = 197\,(u)v - 4(u) \times 5.38 \times 10^6$ $3.72 \times 10^{-20} = (197 \times 1.66 \times 10^{-27} v) -$ $(4 \times 1.66 \times 10^{-27} \times 5.38 \times 10^6)$	**C1**	If u is present in equation it must be present in all terms Allow 1.67 instead of 1.66 as gives correct answer to 2SF
	speed = 2.2×10^5 m s^{-1}	**A1**	Special case: $4(u) \times 5.60 \times 10^6 = 197(u)v + (4(u) \times 5.38 \times 10^6)$ leading to 4500 m s^{-1} credit 1 / 2 working must be seen Alternative method if candidates (correctly) assume elastic collision and use speed of approach = speed of separation speed = $5.60 \times 10^6 - 5.38 \times 10^6$ (C1) $= 2.2 \times 10^5$ (A1)
6(b)(iii)	(absolute uncertainty =) $5 \times 10^4 + 5 \times 10^4$ $= 1 \times 10^5$	**C1**	Allow $2 \times 5 \times 10^4 = 1 \times 10^5$ Allow Δv to mean absolute uncertainty in v
	percentage uncertainty = $(1 \times 10^5 / (5.60 \times 10^6 + 5.38 \times 10^6)) \times 100$ = 0.9%	**A1**	Allow answers to 2 or more SF that round to 0.9
6(c)	3	**A1**	Allow '3 up' or '3u'
6(d)	One quark and one antiquark	**B1**	Allow 'quark and antiquark' (assume 1 of each) Allow $q\bar{q}$ BOD Ignore named quarks whether correct or incorrect e.g. 'up quark and antidown quark' as general composition required Ignore '2 quarks'

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