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CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/23**

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	‘List rule’ guidance 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)	product of mass and velocity	**B1**	not speed for velocity
1(b)(i)	a = $\Delta v / (\Delta)t$ or =$(v - u) / (\Delta)t$ or = gradient of slope	**C1**	
	acceleration = $(-0.8 - 1.6) / (0.12 - 0.09)$ = (–)80 m s^{-2}	**A1**	No tolerance.
1(b)(ii)	0.15 × 1.6 or 0.15 × 0.8	**C1**	No tolerance. ECF from **(b)(i)** for *v* read-offs
	change in momentum = 0.15 × (–0.8 – 1.6) = (–)0.36 kg m s^{-1}	**A1**	Ignore sign
	OR *F* = 0.15 × (–)80 = (–)12	**(C1)**	ECF *a* from **(b)(i)**
	Change in momentum = (–)12 × (0.12 – 0.09) = (–)0.36 kg m s^{-1}	**(A1)**	
1(b)(iii)	½×1.60 × 0.020 or $1.6^2 / (2 \times 80)$ or 1.6 × 0.02 – ½ × 80 × 0.02^2 or ½ × 80 × 0.02^2 =0.016	**C1**	ECF from **(b)(i)** for *v* read-offs ECF *a* from **(b)(i)**.
	OR ½×0.80 × 0.010 or $0.8^2 / (2 \times 8)$ or –0.8×0.01 + ½ × 80 × 0.01^2 or ½ × 80 × 0.01^2 = 0.004	**(C1)**	
	distance = 0.016 + 0.004 = 0.020 m	**A1**	Allow 0.02 (1SF) treat finding displacement as XP e.g. $(-0.8)^2 - 1.6^2 / 2 \times 80$ = 0.12 m

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Question	Answer	Marks	Guidance
1(c)(i)	relative speed of approach = relative speed of separation	**B1**	Allow 'relative speed before collision = relative speed after collision' Allow $u_1 – u_2 = v_2 – v_1$ not relative <u>velocity</u> for speed, but allow relative velocity of approach = – relative velocity of separation
	(speed of separation = 1.6 m s^{-1} so) $v_Y – (–0.80) = 1.6$, so $v_Y = 0.80$ m s^{-1}	**B1**	Allow $v_Y + 0.80 = 1.6$ Allow 0.80 + 0.80 = 1.6 BOD Ignore $v_Y = 1.6 / 2$
1(c)(ii)	a straight horizontal line from (0, 0) to (0.09, 0) or a straight horizontal line from (0.12, 0.8) to (0.20, 0.8)	**B1**	tolerance ± ½ small square
	Both horizontal lines correct <u>and</u> straight diagonal line from (0.09, 0) to (0.12, 0.8)	**B1**	Allow horizontal line from (0, 0) to (0.09, 0) to be missing if diagonal line starts at (0.09, 0)
1(c)(iii)	$(0.15 \times 1.6) = (0.15 \times (–0.80)) + 0.80m$ $0.36 = 0.8m$	**C1**	ECF from **(b)(i)** for v read-offs
	OR $(½ \times 0.15 \times 1.6^2) = (½ \times 0.15 \times 0.80^2) + (½ \times m \times 0.80^2)$ $0.192 = 0.048 + 0.32m$	**(C1)**	Allow with the ½ factor missing from all three terms.
	OR $m = 0.15 \times 80 / [\,0.80 / (0.12 – 0.09)]$ $m = 12 / 26.7$	**(C1)**	
	mass = 0.45 kg	**A1**	

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Question	Answer	Marks	Guidance
2(a)	stress per unit strain	**B1**	Allow stress per (unit) strain Allow stress divided by strain Allow stress over strain Allow stress/strain Allow ratio of stress by strain (BOD) Allow ratio of stress and/to strain Ignore stress by strain or stress into strain Ignore symbols unless defined Ignore reference to 'object' or 'material' etc. Ignore any units Ignore 'stiffness'
2(b)(i)	$\rho = m / V$ $V = 0.018 / 960 = 1.875 \times 10^{-5}$	**C1**	Allow *d* or *D* for density
	(length =) $0.018 / (960 \times 2.6 \times 10^{-6}) = 7.2$ (m)	**A1**	Full substitution and answer needed.
2(b)(ii)	(σ =) F / A	**C1**	
	$= (0.018 \times 9.81) / (2.6 \times 10^{-6}) = 6.8 \times 10^{4}$ (Pa)	**A1**	Full substitution and answer needed. not $g = 10$ as leads to 6.9×10^{4}
2(b)(iii)	weight (of thread supported at a point) decreases as distance (from top of thread) increases	**B1**	Allow weight depends on distance / length Allow weight varies with distance / length Not weight is proportional to distance
	(uniform cross-section so) stress (at a point in the thread) is proportional to the weight (of thread below the point)	**B1**	Not stress is proportional to distance Allow 'force'/'mass' instead of 'weight' throughout
2(c)(i)	$\varepsilon = x / L$ or $E = \sigma / \varepsilon$ or $x = \sigma L / E$	**C1**	Allow *e* or ΔL for *x*
	extension $= 7.2 \times (6.8 \times 10^{4}) / (8.0 \times 10^{8})$ $= 6.1 \times 10^{-4}$ m	**A1**	

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Question	Answer	Marks	Guidance
2(c)(ii)	$E = ½Fx$ or $E = ½kx^2$ or $E = ½F^2 / k$ $= ½ \times 6.8 \times 10^4 \times 2.6 \times 10^{-6} \times 6.1 \times 10^{-4}$ or $= ½ \times 0.018 \times 9.81 \times 6.1 \times 10^{-4}$ or $= ½ \times (6.8 \times 10^4 \times 2.6 \times 10^{-6}/6.1 \times 10^{-4}) \times (6.1 \times 10^{-4})^2$ or $= ½ \times (0.018 \times 9.81/6.1 \times 10^{-4}) \times (6.1 \times 10^{-4})^2$ or $= ½ \times (6.8 \times 10^4 \times 2.6 \times 10^{-6})^2 / (6.8 \times 10^4 \times 2.6 \times 10^{-6} / 6.1 \times 10^{-4})$ or $= ½ \times (0.018 \times 9.81)^2 / (0.018 \times 9.81 / 6.1 \times 10^{-4})$	**C1**	Allow W or E_P or EPE for E ECF x from **(c)(i)**. $k = 6.8 \times 10^4 \times 2.6 \times 10^{-6}/6.1 \times 10^{-4} = 290$
	$= 5.4 \times 10^{-5}$ J	**A1**	
2(d)	(extension in **2(b)** is) less (than in **2(c)(i)**) because stress (in vertical thread) is less (than 6.8×10^4 Pa everywhere except the top)	**B1**	Allow ‘force’ for ‘stress’ ignore ‘weight’ / ‘mass’ for stress

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Question	Answer	Marks	Guidance
3(a)	(when two or more) waves meet / overlap (at a point)	**B1**	Allow 'waves intersect / merge' Ignore 'waves superpose / interfere / combine / interact' Allow answer given in the context of two waves forming a stationary wave. E.g. 'waves travelling in opposite directions'
	(resultant) displacement is sum of the individual displacements	**B1**	Allow 'resultant wave' or 'total displacement' for 'resultant displacement' Ignore just 'resultant displacement is the sum of the waves' Ignore 'sum of displacement is the sum of the individual displacements' but allow 'sum of resultant displacement is the sum of the individual displacements' Not 'amplitude' instead of 'displacement' ignore 'waves of same speed / frequency / wavelength' ignore the word 'algebraic' (as in 'algebraic sum') ignore 'coherent / identical waves'
3(b)(i)	constant phase difference	**B1**	Ignore 'same frequency/wavelength/speed' Ignore 'have the same phase difference' Ignore 'phase relationship' for 'phase difference' Ignore 'in phase'
3(b)(ii)	(the light) diffracts	**B1**	Ignore 'spreads'

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Question	Answer	Marks	Guidance
3(b)(iii)	waves (from each slit) meet / superpose (at the screen)	**B1**	Allow 'overlap / superimpose / interfere / combine' for 'superpose' Ignore 'interact / collide / coincide / intersect'
	waves have 0 path difference / 0 phase difference	**B1**	Allow 'in phase' Ignore 360°
	constructive interference occurs / (resultant wave has) maximum amplitude	**B1**	Ignore 'intensity is maximum' Ignore references to nodes and antinodes
3(b)(iv)	$\lambda = ax / D$	**C1**	
	$x = (560 \times 10^{-9} \times 0.43) / (1.4 \times 10^{-5})$ $= 0.017$	**C1**	
	distance $= 0.017 / 2$ $= 0.0086$ m	**A1**	
3(c)(i)	*either*: B marked above Y at same distance above Y as XY *or*: B marked below 0.43 m arrow, at a distance from X that is 2XY	**B1**	tolerance ± 3 mm
3(c)(ii)	D marked below X at distance below X equal to XY	**B1**	tolerance ± 3 mm
3(d)	$c = f\lambda$	**C1**	Allow v for c
	frequency $= (3.00 \times 10^{8}) / (560 \times 10^{-9})$ $= 5.4 \times 10^{14}$ Hz	**A1**	ECF POT error in the wavelength from **3(b)(iv)** if same POT error made

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Question	Answer	Marks	Guidance
4(a)	correct circuit symbol used for cell with internal resistance	**B1**	Allow just a cell symbol, without the resistor. Ignore presence or absence of dotted box around it. not a battery symbol
	correct symbol for LDR connected to terminals of cell	**B1**	
	correct symbol for voltmeter connected in parallel with LDR	**B1**	If symbol for LDR incorrect, allow voltmeter connected in parallel with component drawn, provided only one component drawn.
4(b)(i)	zero error / calibration error	**B1**	Allow 'contact resistance error in the connections'. Allow 'resistance of connecting wires' Allow 'not calibrated' BOD Apply List Rule
4(b)(ii)	$P = V^2 / R$ or $P = VI$ and $V = IR$ or $P = I^2R$ and $V = IR$ $= 4.78^2 / 230$ or $= 4.78 \times (4.78 / 230)$ or $= (4.78 / 230)^2 \times 230$	**C1**	
	$= 0.099$ W	**A1**	
4(b)(iii)	$E = V + Ir$ $r = (4.90 - 4.78) \times 230 / 4.78$ or $4.78 / 4.90 = 230 / (230 + r)$ or $(4.90 - 4.78) / 4.90 = r / (230 + r)$ or $(4.90 - 4.78) / 4.78 = r / 230$ or $4.90 / (4.78 / 230) = r + 230$	**C1**	Allow $E = I(R + r)$
	internal resistance = 5.8 Ω	**A1**	

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Question	Answer	Marks	Guidance
4(b)(iv)	<table><tr><td></td><td>decreases</td><td>unchanged</td><td>increases</td></tr><tr><td>resistance of LDR</td><td></td><td></td><td>✓</td></tr><tr><td>current in cell</td><td>✓</td><td></td><td></td></tr><tr><td>p.d. across LDR</td><td></td><td></td><td>✓</td></tr></table>	**B1** **B1** **B1**	Allow symbols other than ticks if no ticks seen

Question	Answer	Marks	Guidance
5(a)	(a hadron consisting of) 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'
5(b)	quark charges have magnitudes of either ⅔(e) or ⅓(e)	**C1**	May be implied by the use of these magnitude of charge (and only these charges) in the reasoning below.
	–1e *: either*: –⅓(e), –⅓(e) and –⅓(e) *or*: –⅔(e), –⅔(e) and +⅓(e)	**A1**	Allow in terms of specific quarks provided magnitudes of charge are stated e.g. d has charge –1 / 3(e) so ddd. Not e^- for e
	+2e: +⅔(e), +⅔(e) and +⅔(e)	**A1**	Not e^- for e
5(c)(i)	P = 18 and R = 0	**A1**	
	Q = 7 and S = (+)1	**A1**	
5(c)(ii)	(electron) neutrino	**B1**	

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Question	Answer	Marks	Guidance
5(c)(iii)	up to down	**B1**	Allow u to d Allow uud to udd ignore any charges
5(c)(iv)	total energy emitted (in each decay) is constant	**B1**	
	one of : • particle Z takes some of the energy • the energy (emitted) is shared between Z and the β^+ particle • the way the total energy is distributed is different for each decay	**B1**	Ignore momentum arguments unless linked to KE Allow 'neutrino' for Z

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