CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/24**

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.

This document consists of **16** printed pages.

[Turn over

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.

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.

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.

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

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

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.

Question	Answer	Marks	Guidance
1(a)	displacement, velocity and acceleration underlined only.	**A1**	Allow other methods of indicating such as circling, ticking, but not crossing through. All three need to be indicated by the same notation
1(b)(i)	$(E_{(K)})$ $= ½mv^2$ $= ½ \times 1400 \times 15^2$	**C1**	
	$= 1.6 \times 10^5$ J	**A1**	
1(b)(ii)	$0 = 15^2 + (2 \times a \times 35)$	**C1**	Allow any subject.
	$a = -3.2$ m s^{-2}	**A1**	
	OR $(35 = ½ \times 15 \times t$ so $t = 4.7$ so) $0 = 15 + (a \times 4.7)$ or $35 = -½ \times a \times 4.7^2$ or $35 = 15 \times 4.7 + (½ \times a \times 4.7^2)$	**(C1)**	
	$a = -3.2$ m s^{-2}	**(A1)**	

Question	Answer	Marks	Guidance
1(b)(iii)	$F = ma$ $= 1400 \times 3.2$	**C1**	ecf a from **1(b)(ii)**
	$= 4500$ N	**A1**	Allow $\pm$ 4500 N
	OR $F = W / s$ $= 1.6 \times 10^5 / 35$	**(C1)**	Allow E / E_K / KE for W. Allow d or x for s
	$= 4600$ N	**(A1)**	Allow $\pm$ 4600 N ecf E_K from **1(b)(i)** **Allow** 4500 or 4600 for either method.
1(c)(i)	This will remain the same as ($F = ma$ and) the force and the mass are the same	**A1**	Allow no change / constant / equal for 'the same' allow F and m as symbols
1(c)(ii)	The (initial) kinetic energy is four times greater	**B1**	Allow kinetic energy is proportional to speed squared
	(So for the same applied force) the distance travelled will be four times greater	**B1**	Allow distance = 140 m
	OR acceleration is the same and using $s = (-)u^2 / 2a$	**(B1)**	Not $v^2 = u^2 + 2as$ unless $v = 0$ also given Allow acceleration the same and distance is proportional to initial speed squared
	The distance will be four times greater	**(B1)**	Allow distance = 140 m

Question	Answer	Marks	Guidance
2(a)	Extension is proportional to (applied) force	**B1**	Ignore symbols unless defined. allow 'force is proportional to extension' Allow force $\propto$ extension allow load / tension for force ignore reference to the elastic limit ignore force = spring constant $\times$ extension
2(b)(i)	(11.9 ± 0.2) cm	**A1**	
2(b)(ii)	$k = F / x$	**C1**	Allow e / Δx / ΔL for x
	$= (0.300 \times 9.81) / 0.119$	**C1**	ecf of extension from **2b(i)** Do not allow $g = 10$
	$= 24.7$ N m^{-1}	**A1**	Allow 25
2(b)(iii)	0.2 / 11.9 or 0.005 / 0.300 % uncertainty $= [(0.2 / 11.9) + (0.005 / 0.300)] \times 100$	**C1**	ecf of extension from **2b(i)** 1.68% and 1.67% imply the C mark
	$= 3\%$	**A1**	
	OR $k_{max} = (0.305 \times 9.81) / 0.117$ or $k_{min} = (0.295 \times 9.81) / 0.121$ $= 25.6$ $= 23.9$	**(C1)**	Allow answers to two or more SF that are correct when rounded by the examiner to 1SF.
	% uncertainty $= [(25.6 - 23.9) / 2] / 24.7$ $= 3\%$	**(A1)**	allow (25.6 - 24.7) / 24.7 and (24.7 - 23.9) / 24.7 which lead to 4% and 3% respectively.
2(c)(i)	The extension will be less for Y as the spring constant is greater (and the applied force is the same).	**B1**	or vice-versa Assume refers to Y unless otherwise stated Allow syllabus symbols not defined, x / k / F Allow the extension is less as extension is inversely proportional to spring constant Allow $x \downarrow$ and $k \uparrow$

Question	Answer	Marks	Guidance
2(c)(ii)	(elastic potential energy) will be less for Y	**B1**	or vice-versa. Assume refers to Y unless stated otherwise Allow *EPE* / *E* / ΔE / E_P
	As the extension is less (for the same force) and $E_P = (\frac{1}{2}Fx) / (\frac{1}{2}mgx)$	**B1**	Allow syllabus symbols *x* / *k* / *F* not defined
	OR As the spring constant is greater (for the same force) and $E_P = \frac{1}{2}F^2 / k$	**(B1)**	Allow $k \uparrow$ Allow $E_P = \frac{1}{2}(mg)^2 / k$ ignore $E = \frac{1}{2}kx^2$

Question	Answer	Marks	Guidance
3(a)	wave reflects at fixed point	**B1**	Ignore rebound / bounces back
	incident and reflected waves superpose	**B1**	Allow 'wave from (vibration) generator / initial / original wave' for 'incident wave' Allow 'two progressive / travelling waves in opposite directions' for 'incident and reflected waves' (BOD), but ignore just 'different directions' Allow 'overlap / superimpose / interfere / combine' for 'superpose' Allow 'destructive / constructive interference' to imply 'superpose' Ignore 'meet / interact / collide / coincide / intersect' Ignore reference to phase difference Ignore reference to coherence
3(b)	cross vertically aligned with a node	**A1**	within one dash length

Question	Answer	Marks	Guidance
3(c)	λ = 1.80 / 2 = 0.90	C1	The C marks are independent.
	v = $f\lambda$ = 26 × 0.90	C1	Allow use of $T = 1/f$ and $v = \lambda / T$
	= 23 m s^{-1}	A1	
3(d)	Line touches both fixed points and crosses the dotted line once in the middle	B1	Middle judged by eye below the 1.8 m label Allow line to be ±2 mm from fixed point ignore amplitude
	Line with sinusoidal shape from fixed point to fixed point	B1	Ignore a second correct solid or dashed line (candidate mirroring presentation in Fig 3.1). *Allow a sinusoid to include a 'half-loop' for the fundamental mode*

Question	Answer	Marks	Guidance
4(a)	force: increases / stays the same / decreases *W*: ✓ stays the same *D*: ✓ increases *U*: ✓ stays the same	B1 B1 B1	Allow any other consistent ways of indicating choice provided no other marks seen. One tick on each line only.
4(b)	$W = D + U$	A1	Allow any subject.

Question	Answer	Marks	Guidance
4(c)	$W = 0.070 \times 9.81$ $= 0.69$	**C1**	treat use of $g = 10$ as TE unless already noted (**2(b)(ii)** ecf for second and third marks (gives 0.59 N)
	$U = 1100 \times 9.81 \times 1.0 \times 10^{-5}$ $= 0.11$	**C1**	C1 marks are independent
	D =0.69 – 0.11 = 0.58 N	**A1**	No ecf for incorrect expression in **4(b)**

Question	Answer	Marks	Guidance
5(a)	(semiconductor) diode	**A1**	Allow any other type of diode. E.g. LED
5(b)	straight line through the origin	**B1**	Tolerances ±½ small square for both marks
	a line passing through (0.8, 20)	**B1**	Ignore line continuing outside graph past 0.80 V Check for a candidate's graph drawn in space below Fig. 5.1. Allow one mark for straight line from a labelled origin (0,0)

Question	Answer	Marks	Guidance
5(c)	(p.d. across component X =) 0.70 (from graph)	C1	Allow 0.7
	(p.d. across 20 Ω resistor = 0.005 × 20) = 0.10	C1	Allow 0.1 C1 marks are independent
	(e.m.f. =) 0.70 + (0.005 × 20) = 0.80 (V)	A1	Allow 0.8 Need 0.005 or 5×10^{-3} not 5 mA
	OR (resistance of diode) = 140	(C1)	
	total resistance = 20 + 140	(C1)	
	(e.m.f. =) (0.7 / 5 × 10^{-3} + 20) × 5 × 10^{-3} = 0.80 V	(A1)	Allow 0.8
5(d)	0 A	A1	Allow 'approximately zero' but not '-'
5(e)	(current in resistor =) 0.80 / 20 = 0.040	C1	C1 marks are independent
	(current in component X) = 0.040 (A) / 40 (mA) (from graph)	C1	Allow 0.04 A
	current in ammeter = 0.080 A	A1	Allow 0.08 A
	or resistance of diode is 0.8 / 40 × 10^{-3} = 20 Ω	(C1)	
	total resistance in parallel is 10 Ω	(C1)	
	current = 0.8 / 10 = 0.080 A	(A1)	Allow 0.08 A

Question	Answer	Marks	Guidance
6(a)	$P = V^2 / R$	C1	Allow any subject. Must see full working and answer in all cases. Not 1 kW need $1000 / 10^3$
	so $R = (V^2 / P) = 230^2 / 1000 = 53\,\Omega$	A1	
	Or $P = IV$ **and** $V = IR$	(C1)	
	$R = 230 / (1000 / 230) = 53\,\Omega$	(A1)	
	Or $P = IV$ **and** $P = I^2R$	(C1)	
	$R = 1000 / (1000 / 230)^2 = 53\,\Omega$	(A1)	
6(b)	$R = \rho L / A$ $L = (53 \times 5.7 \times 10^{-8}) / 1.3 \times 10^{-6}$	C1	Allow any subject.
	$= 2.3$ m	A1	
6(c)	$n = I / qAv$ $I = 1000 / 230$ *or* $230 / 53$ $= 4.35$	C1	Allow current of 4.3 to imply the C mark
	$n = 4.35 / (1.6 \times 10^{-19} \times 5.7 \times 10^{-8} \times 5.4 \times 10^{-3})$	C1	
	$= 8.8 \times 10^{28}\,m^{-3}$	A1	

Question	Answer	Marks	Guidance
7(a)(i)	(different forms of the same) element / atom / nuclei with the same proton number	**B1**	Allow atomic number Ignore particle Ignore reference to electron number Allow mass number Allow number to be included once only
	and different nucleon number / number of neutrons	**B1**	
7(a)(ii)	minimum number of α particles = 1	**A1**	
	minimum number of β^- particles = 2	**A1**	
7(a)(iii)	$^{228}_{90}\mathrm{Th}$	**A1** **A1**	No ecf from **7(a)(ii)**
7(b)(i)	up, up, down	**B1**	Allow u, u, d Allow any combination of words and symbols Allow arrows Ignore charges
7(b)(ii)	an up quark changes to a down quark	**B1**	Allow u → d Allow uud → udd Allow it changes to udd if **7b(i)** is correct Ignore neutrino / antineutrino / beta-plus / beta-minus Allow arrows.