

GCE

Physics A

H156/01: Breadth in physics

AS Level

Mark Scheme for June 2025

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training; OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed-out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed-out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM Assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple-Choice Question Responses

When a multiple-choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only one mark per response)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth two or more marks)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.
7. There is a NR (**No Response**) option. Award NR (No Response):
 - if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g., 'can't do', 'don't know')

- OR if there is a mark (e.g., a dash, a question mark) which is not an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
9. *Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.*
10. For answers marked by levels of response:
 - a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
 - b. **To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. Annotations

Annotation		Meaning
	Correct response	Used to indicate the point at which a mark has been awarded (one tick per mark awarded).
	Incorrect response	Used to indicate an incorrect answer or a point where a mark is lost.
AE	Arithmetic error	Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
BOD	Benefit of doubt given	Used to indicate a mark awarded where the candidate provides an answer that is not totally satisfactory, but the examiner feels that sufficient work has been done.
BP	Blank page	Use BP on additional page(s) to show that there is no additional work provided by the candidates.
CON	Contradiction	No mark can be awarded if the candidate contradicts himself or herself in the same response.
ECF	Error carried forward	Used in <u>numerical answers only</u> , unless specified otherwise in the mark scheme. Answers to later sections of numerical questions may be awarded up to full credit provided they are consistent with earlier incorrect answers. Within a question, ECF can be given for AE, TE and POT errors but not for XP.
L1	Level 1	L1 is used to show 2 marks awarded and L1^ is used to show 1 mark awarded.
L2	Level 2	L2 is used to show 4 marks awarded and L2^ is used to show 3 marks awarded.
L3	Level 3	L3 is used to show 6 marks awarded and L3^ is used to show 5 marks awarded.
POT	Power of 10 error	This is usually linked to conversion of SI prefixes. Do not allow the mark where the error occurs. Then follow through the working/calculation giving ECF for subsequent marks if there are no further errors.
SEEN	Seen	To indicate working/text has been seen by the examiner.
SF	Error in number of significant figures	Where more SFs are given than is justified by the question, do not penalise. Fewer significant figures than necessary will be considered within the mark scheme. Penalised only once in the paper.

Annotation		Meaning
TE	Transcription error	This error is when there is incorrect transcription of the correct data from the question, graphical read-off, formulae booklet or a previous answer. Do not allow the relevant mark and then follow through the working giving ECF for subsequent marks.
XP	Wrong physics or equation	Used in <u>numerical answers only</u> , unless otherwise specified in the mark scheme. Use of an incorrect equation is wrong physics even if it happens to lead to the correct answer.
^	Omission	Used to indicate where more is needed for a mark to be awarded (what is written is not wrong but not enough).

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
Reject	Answers which are not worthy of credit
Not	Answers which are not worthy of credit
Ignore	Statements which are irrelevant
Allow	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. Subject Specific Marking Instructions**CATEGORISATION OF MARKS**

The marking schemes categorise marks on the MACB scheme.

M marks	These are <u>method</u> marks upon which A -marks (accuracy marks) later depend. For an M -mark to be scored, the point to which it refers must be seen in the candidate's answers. If a candidate fails to score a particular M -mark, then none of the dependent A -marks can be scored.
A marks	These are accuracy or <u>answer</u> marks, which either depend on an M -mark, or allow a C -mark to be scored.
C marks	These are <u>compensatory</u> method marks which can be scored 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 it. 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 given.
B marks	These are awarded as <u>independent</u> marks, which do not depend on other marks. For a B -mark to be scored, the point to which it refers must be seen specifically in the candidate's answers.

SIGNIFICANT FIGURES

If the data given in a question is to 2 sf, then allow an answer to 2 or more significant figures.

If an answer is given to fewer than 2 sf, then penalise once only in the entire paper.

Any exception to this rule will be mentioned in the Guidance.

SECTION A

Question 10 has been removed due to an error. The total mark of the paper is now **69**.

Original question numbers and pagination have been maintained.

Question	Answer	Marks	Guidance
1	B	1	
2	C	1	
3	B	1	
4	B	1	
5	C	1	
6	B	1	
7	D	1	
8	B	1	
9	A	1	
11	B	1	
12	A	1	
13	A	1	
14	D	1	
15	C	1	
16	C	1	
17	A	1	
18	C	1	
19	B	1	
20	D	1	
	Total	20	

SECTION B

General rule: For substitution into an equation, allow any subject - unless stated otherwise in the guidance

Question			Answer	Mark	Guidance
21	(a)		different types of force ORA	M1	Ignore named forces, e.g. contact / non-contact; weight / normal reaction
			both forces act on the same object ORA	M1	Ignore reference to direction / same size
			(Therefore) not a Newton's 3 rd law force pair	A1	Note At least one M mark required for A1 mark
21	(b)	(i)	(m = W/g =) 700 / 9.81 (= 71.4 kg)	C1	71.3557...
			(R – 700 =) 71.4 × 2.4 (= 171.3)	C1	Note evidence of mass determination needed Allow (9.81 + 2.4)× 71.4 Allow ecf for use of g = 10 m s ⁻²
			(R = 700 + 71.4 × 2.4 =) 870 (N)	A1	871.25... (use of 71 gives 870.4) Note 530 (N) or 868 (N) scores two marks Note 532 (N) or 168 (N) scores one mark
21	(b)	(ii)	8.5 = (0 +) 0.5 × 2.4 × t ² OR v ² (= 2 × 2.4 × 8) = 40.8	C1	Substitution in to correct equation
			t ² = 7.083 OR v = 6.39	C1	Note use of 9.81 is XP
			$\left(\sqrt{\frac{2 \times 8.5}{2.4}}\right) = 2.7 \text{ (s)}$ OR $\left(t = \frac{6.395}{2.4}\right) = 2.7 \text{ (s)}$	A1	2.66...
21	(c)		resultant / net / total force is zero	B1	Ignore equilibrium
			700 (N)	B1	Ignore stay the same (too vague)
			Total	11	

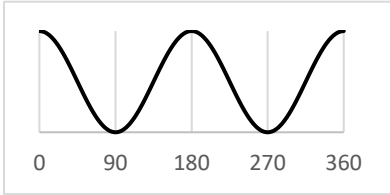
Question			Answer	Mark	Guidance
22	(a)	(i)	layer of liquid on the glass would change the <u>refractive index</u>	B1	
22		(ii)	frequency / wavelength (of light)	B1	Allow temperature of the liquid / density of liquid Ignore density of glass
22	(b)		(absolute uncertainty =) 0.015×1.52 (= 0.0228) OR 0.985×1.52 (range from) 1.497(2) (to 1.5428) range includes glass Y (and glass Z) (therefore conclusion is invalid)	C1 M1 A1	
22	(c)	(i)	the angle (of incidence) when the angle of refraction is 90°	B1	Allow refracted ray travels along the boundary Ignore (minimum) angle for total internal reflection
22	(c)	(ii)	shine ray towards curved side so that it is directed towards the (middle of) straight edge of the dish by eye move ray (box) / rotate dish until the critical case is observed any two from: - place dish on paper and draw outline of dish or draw normal at mid-point (by eye) - mark / trace the path of the (incoming) ray (on paper) - use a protractor to measure the angle - correct critical angle described or shown in diagram.	B1 B1 B1 × 2	Allow credit from clear diagram Allow position of ray box on a diagram Allow change angle of incidence Ignore calculation methods
22	(c)	(iii)	$\sin 42 = \frac{1}{n}$ $\left(n = \frac{1}{\sin 42^\circ} =\right)$ 1.49 or 1.5	C1 A1	1.494...

Question			Answer	Mark	Guidance
				12	

Question			Answer	Mark	Guidance
23	(a)		(input power = VI =) 230×5 (= 1150 W)	C1	No ecf for incorrect power
			(efficiency = useful out $\div$ total in =) $700 \div 1150$	C1	Note 0.61 scores two marks
			61 %	A1	60.8695652...
	(b)		(use of time = energy / power =) $100\,000 / 700$	C1	Allow one mark only for 100 instead of 100 000
			140 (s)	M1	
			Appropriate conclusion based on numerical comparison	A1	
			OR		
			(use of energy = power x time) 700×180	C1	Allow one mark only for 3 instead of 180
			= 126 000 (J) / 126 kJ	M1	
			Appropriate conclusion based on numerical comparison	A1	
			OR		
			(use of power = energy / time =) $100\,000 / 180$	C1	Allow one mark only for 100 instead of 100 000 and/or 3 instead of 180
			556 (W)	M1	
			Appropriate conclusion based on numerical comparison	A1	

Question			Answer	Mark	Guidance
	(c)	(i)	(micro)waves <u>reflect</u> from (metal) walls / sides (incident and reflected) (micro)waves <u>interfere</u> / <u>superpose</u> (to form a pattern of nodes and antinodes)	B1 B1	Ignore reference to coherence
		(ii)	antinodes have high / maximum amplitude or nodes have low / minimum amplitude energy transfer / heating is maximum at antinodes or energy transfer is a minimum at nodes (leading to uneven heating)	B1 B1	Allow intensity for amplitude Ignore maxima and minima points
			Total	10	

Question			Answer	Mark	Guidance
24	(a)		for equilibrium	B1	
			sum of / total clockwise moments (about a point) = sum of / total anticlockwise moments (about the same point) OR net /resultant moment = 0	B1	
	(b)	(i)	$340 \times 4.5 = T \times 1.5$	M1	Not 4.5 – 1.5; XP so no further credit
			(force constant =) $\frac{1020}{12 \times 10^{-3}}$	M1	
			85 000 (N m ⁻¹)	A1	
		(ii)	$0.5 \times 85000 \times (12 \times 10^{-3})^2$ or $0.5 \times 90000 \times (12 \times 10^{-3})^2$	C1	Possible ECF from k Allow use of $E = \frac{1}{2} Fx$ and $F = kx$
			6.1 (J) or 6.5 (J)	A1	
	(c)		T unchanged (to produce same extension)	B1	
			<u>perpendicular</u> distance to T has increased	M1	
			(therefore) F must increase (to produce the same moment of T)	A1	
			Total	10	

25	(a)		<u>oscillations</u> / <u>vibrations</u> are perpendicular to the direction of propagation / energy transfer <u>oscillations</u> / <u>vibrations</u> are in one direction / one plane	B1	Ignore waves
	(b)	(i)	any two peaks 180° apart and any two troughs 180° apart and peaks and troughs 90° apart $\cos^2$ wave shape with clear correct curves drawn at the peaks and troughs initial maximum at 0° and returns to maximum value at 180° and 360° (by eye) and minimum values close to zero close at 90° and 270° (by eye)	B1 B1 B1	Allow named direction e.g. vertical Allow $\sin^2$ wave 
		(ii)	(similar pattern but with) reduced intensity detector receives a smaller component of the transmitted wave	B1 B1	Allow named proportion Ignore angle the pattern shifts
			Total	15	

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