GCE

Physics B

H157/01: Foundations of 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 **required number** of 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 or the RM Assessor messaging system, or by email.

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 a tick to confirm that the work has been seen.

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.**
   If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

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
BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
✓	Tick
✗	Cross
CON	Confused (replaces the question mark)
BOD	Benefit of doubt
KU	AO1 – Knowledge and understanding
APP	AO2 – Apply knowledge and understanding
AN	AO3 - Analyse
EVAL	AO4 - Evaluation
^	Omission
NAQ	Not answered question
SEEN	Noted but no credit given
TV	Too vague
OFR	Own figure rule

Annotation	Meaning
REP	Repetition

Annotation	Meaning
DO NOT ALLOW	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

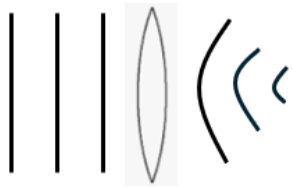
SECTION A

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

SECTION B

Question			Grid	Answer	Mark	Rationale/Additional Guidance
21	**(a)**			$F_{horizontal}$ (= F x cosθ) = 420 x cos53°	**1**	
				= 250 (N)	**1**	**ALLOW** 253
21	**(b)**			W (= F x d) = 253 x 50	**1**	**ALLOW** ECF from (a)
				= 13000 (12650)	**1**	**ALLOW** 12500
				J	**1**	Standalone unit mark **ALLOW** lower case j, clear misspellings of joule **ALLOW** kg m^2 s^{-2}
				Total	**5**	

Question			Grid	Answer	Mark	Rationale/Additional Guidance
22	(a)			Sum / difference of I_2 and I_3 $(I_1 =)\ I_2 - I_3$	1 1	 Correct answer scores both marks
22	(b)			Current is (rate of) flow of charge Current entering junction equals current leaving junction / charge cannot be created or destroyed /	1 1	**ALLOW** Idea that current is movement of charge **ALLOW** Idea that "change going in equals charge coming out" **IGNORE** use of word "conservation" in response
				Total	**4**	

Question			Grid	Answer	Mark	Rationale/Additional Guidance
23	(a)			$1/u = 0$ or u is infinite/very large AND $v = 35$ (cm)	1	Can be seen in calculation
				$P = 1/f = 1/0.35$	1	
				$P = (+)\ 2.9$ D	1	Must be to at least 2sf Lens formula must be used for any credit in this question
23	(b)					Expect at least three wavefront on either side of the lens
				Plane wavefronts to the left of the lens	1	**ALLOW** correct <u>slight</u> curvature on wavefronts to the left of the lens provided curvature is correct and clearly <u>significantly</u> greater on the right
				Correct and constant curvature to the right of the lens (as shown)	1	**IGNORE** length of wavefronts
				Approximately equally spaced on both sides	1	Equal spacing of <u>all</u> wavefronts drawn, by eye
				Total	**6**	

Question			Grid	Answer	Mark	Rationale/Additional Guidance
24	(a)			**Class of material** / **Mobile charge carriers per m^3** Metal • • 10^{16} Semiconductor • • 10^{28} Insulator • • ~ 0	2	All correct = 2 marks One correct = 1 mark
24	(b)			0.28 – 0.32 (nm)	1	
24	(c)			Volume of 1 atom = (length)^3 = eg (0.30nm)^3 = 2.7 x 10^{-29} m^3	1	**ALLOW** ECF from (b) **ALLOW** POT error at this point
				Number density = (1 / 2.7 x 10^{-29}) / 20 = 3.7 x 10^{28} / 20 m^{-3} = 1.9 x 10^{27} m^{-3}	1	Expect between 2.3 x 10^{27} and 1.5 x 10^{27} if (b) correct **ALLOW** slight variation for rounding differences
				Total	5	

Question			Grid	Answer	Mark	Guidance
25	(a)			Refraction / Diffraction / Interference / Dispersion / Polarisation	1	**DO NOT ALLOW** reflection **ALLOW** reference to experiments e.g. Young's slits or description of diffraction patterns.
25	(b)			No photons emitted until voltage across it / energy provided is above a certain amount (Once above the threshold) increasing the current increases brightness / does not change frequency/energy/colour OR same photon energy / single wavelength emitted (above threshold)	1 1	**ALLOW** the idea of a threshold voltage **ALLOW** concept of a single colour
25	(c)	(i)		(photon energy =) 3.86 (frequency =) 5.96	1 1	Allow 3.85 (assume value of the calculated Planck constant used)
25	(c)	(ii)		Mean = (6.03 + 7.16 + 6.76 + 6.10) / 4 = 6.51 (x 10^{-34} Js)	1 1	 Correct answer to 3sf only
25	(d)			Range of values within uncertainty is 6.18 – 6.84 (x 10^{-34}) (Accepted value is 6.63 (x 10^{-34}) and is in this range) so it is consistent	1 1	**ALLOW** maximum value only to be calculated (6.51 + 5%) = 6.84 **ALLOW** complete correct response with conclusion for incorrect value from (c)

Question			Grid	Answer	Mark	Guidance
						Alternative approach: Calculation of percentage difference between calculated and true value (6.63 – 6.51)/6.63 x 100 = 1.8 % So it is consistent **ALLOW** correct conclusion drawn from ecf on (c)(ii)
				Total	**9**	

Question			Grid	Answer	Mark	Guidance
26	(a)			Can be processed by computer / can be sent over a digital network such as internet / can apply error correction techniques (to improve quality at receiver) / takes up less storage / easier to compress	1	**ALLOW** acceptable alternatives
26	(b)	(i)		Maximum displacement (from equilibrium/position of no vibration)	1	
26	(b)	(ii)		n = $\log_2 1024$ = 10 (bits)	1 1	
26	(c)			minimum rate of sampling (> 2 × maximum frequency of signal) >= 2 x 2 (kHz) = 4000 (s^{-1})	1 1	
26	(d)			Bandwidth per sensor = (15 + 9) bits x 8000 samples/s = 192 kb/s 48M / 192k = 250	1 1	 **ALLOW** single mark for 48M / 120k = 400 (for not using error correction)
26	(e)			Computer won't get tired / computer can work faster / It can process much more data in a short time interval / It can compare a much greater range of data as memory capacity much greater / more reliable	1	**ALLOW** plausible alternatives
				Total	9	

Question			Grid	Answer	Mark	Guidance
27	(a)			Speed of light in vacuum divided by speed of light in medium	1 1	**DO NOT ALLOW** formula in symbols unless defined **ALLOW** correct formulations described with 'ratio' or 'proportion'
27	(b)			Points plotted correctly	1	Within ½ small square
27	(c)			Line of best fit and gradient triangle drawn (or implied by readings) Correct reading of pairs of points (on gradient triangle) with triangle at least 8cm x 8cm 1.46-1.50	1 1 1	Gradient triangle can be implied by pair of readings Read to within ½ small square – do not allow points from table unless line goes through that point Must be to at least 3sf. No credit for answer with no working
27	(d)			Any two from: rays not narrow enough / rays too faint / normal difficult to place / protractor only reads to 1 degree / position of the block may shift during the experiment /	2	**ALLOW** other reasonable suggestions **DO NOT ALLOW** "human error"
27	(e)			Accuracy is how close the result is to the true value Student A is <u>correct</u> as their value can be compared to the book value Student B is <u>incorrect</u> as their description is about precision / consistent Student B may have the wrong gradient (despite points being close to the line)	1 1 1 1	

Question			Grid	Answer	Mark	Guidance
				Total	12	
				Total Section C	30	
				Total Sections B & C	50	

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