



Oxford Cambridge and RSA

GCE

Physics B (Advancing Physics)

H157/01: Foundations of physics

Advanced Subsidiary GCE

Mark Scheme for November 2020

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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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Annotations

| Annotation | Meaning |
|---|---|
|  | Benefit of doubt given |
|  | Contradiction |
|  | Incorrect response |
|  | Error carried forward |
|  | Benefit of doubt not given |
|  | Power of 10 error |
|  | Omission mark |
|  | Technical error (includes rounding & arithmetic errors) |
|  | Error in number of significant figures |
|  | Correct response |
|  | Incorrect response |
|  | Wrong physics or equation |
|    | Indicates level of response in extended response questions indicated * by the question number |

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 |
| (1) | Separates marking points |
| 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 |

MARKING INSTRUCTIONS**Section A: MCQs**

| Question | Answer | Marks | Guidance |
|-----------------|---------------|--------------|-----------------|
| 1 | C | 1 | |
| 2 | A | 1 | |
| 3 | B | 1 | |
| 4 | C | 1 | |
| 5 | C | 1 | |
| 6 | D | 1 | |
| 7 | A | 1 | |
| 8 | D | 1 | |
| 9 | B | 1 | |
| 10 | B | 1 | |
| 11 | B | 1 | |
| 12 | B | 1 | |
| 13 | B | 1 | |
| 14 | A | 1 | |
| 15 | C | 1 | |
| 16 | B | 1 | |
| 17 | C | 1 | |
| 18 | A | 1 | |
| 19 | D | 1 | |
| 20 | D | 1 | |
| | Total | 20 | |

SECTION B

| Question | | Expected Answer | Mark | Rationale/Additional Guidance |
|----------|---|--|------------|--|
| 21 | a | $(b = \log_2 256) = 8$ ✓ | 1 | Bare answer scores mark |
| | b | $457 \times 353 / 1024$ ✓ $= 158$ (kilobytes) ✓ | 1 1 | Method Evaluation. ALLOW 161 kB (using 1000B = 1kB) |
| | | Total | 3 | |

| Question | | Expected Answer | Mark | Rationale/Additional Guidance | |
|----------|---|-----------------|----------|---|--|
| 22 | a | C B A ✓✓ | 2 | Answers in the order shown 2 marks if all three correct ALLOW 1 mark for one correct | |
| | b | i | A ✓ | 1 | |
| | b | ii | A ✓ | 1 | |
| | | Total | 4 | | |

| Question | | Expected Answer | Mark | Rationale/Additional Guidance |
|--------------|---|---|----------|---|
| 23 | a | $(P = VI) = 12 \times 2.4$ ✓ | 1 | |
| | | $= 28.8$ ✓ | 1 | ALLOW 29 |
| | | W ✓ | 1 | ALLOW Js ⁻¹ but no other alternatives |
| | b | $t = 2 \times 60 = 120$ (s) ✓ | 1 | Conversion to seconds anywhere seen in solution |
| | | $(E = V^2t/R) = 12^2 \times 120 / 4$ ✓ | 1 | ALLOW other equivalent e.g. $E=VIt$ if correct |
| | | $= 4320$ (J) ✓ | 1 | ALLOW 72 (J) for 2 marks |
| | c | Energy dissipated/lost <u>to surroundings</u> ✓ | 1 | DO NOT ALLOW just “energy lost” |
| | | so less energy goes to heating the block ✓ | 1 | |
| Total | | | 8 | |

| Question | | Expected Answer | Mark | Rationale/Additional Guidance |
|------------------------|---|--|-----------|--|
| 24 | a | Light dependent resistor ✓ | 1 | ALLOW LDR |
| | b | $(V1/V2 = R1/R2) = 2/6 = R/18\ 000$ ✓ | 1 | Valid method and correct substitution. |
| | | $R = 6000$ (Ω) ✓ | 1 | ALLOW alternative methods e.g. potential divider equation and substitution. ALLOW one mark for calculation of current in circuit (3.3×10^{-4} A as part method) |
| | c | Adjust lighting to the required level (on/off point) ✓ | 1 | ALLOW until light just turns on |
| | | Adjust variable resistor until reading on V is 6.0V ✓ | 1 | |
| Total | | | 5 | |
| Total Section B | | | 20 | |

SECTION C

| Question | | Expected Answer | Mark | Rationale/Additional Guidance |
|----------|---|---|----------|--|
| 25 | a | Distance travelled = 2 mm AND Time taken = 800ms ✓ | 1 | Identification of <i>both</i> values |
| | | (Speed = $2/800$) = $0.0025 \text{ (ms}^{-1}\text{)}$ ✓ | 1 | Evaluation |
| | b | The ball is <u>accelerating</u> ✓ | 1 | Second mark for some idea that the instantaneous speed varies between $n = 2$ and $n = 3$ but that at 1s it is closer to the $n = 2$ frame |
| | | 1s (1000 ms) is less than halfway between $n = 2$ and $n = 3$ ✓ | 1 | |
| | c | The distance travelled between frames is constant ✓ | 1 | Second mark must be clear that the distance travelled is constant for every frame past $n = 5$ |
| | | And remains constant for all subsequent frames ✓ | 1 | |
| | d | $(3 \times 10^{-3} / 0.8) = 0.00375 \text{ (ms}^{-1}\text{)}$ ✓ | 1 | ALLOW statement that as the distance between all four frames is the same then $(3 \times 10^{-3} / 0.8)$ is valid. |
| | | uses all four frames to get values (e.g. $9 \times 10^{-3} / 2.4$) ✓ | 1 | |
| | | Total | 8 | |

| Question | | Expected Answer | Mark | Rationale/Additional Guidance |
|----------|---|--|----------|--|
| 26 | a | No variation (in brightness) ✓ | 1 | ALLOW stays the same brightness |
| | b | Decreases <u>to zero</u> ✓ | 1 | |
| | | Then increases (rapidly) ✓ | 1 | |
| | c | 56 ✓ | 1 | Only this value |
| | d | (Completely plane) polarised ✓ | 1 | |
| | | Perpendicular (to the axis of the polarising filter) ✓ | 1 | ALLOW horizontally |
| | e | (±) 1 degree ✓ | 1 | Insist on unit |
| | f | (Yes) – a curve with <u>minimum at 58</u> ✓ | 1 | REJECT 'the point at 58 has an error bar that touches zero' |
| | | Would pass through all the error bars ✓ | 1 | |
| | | Total | 9 | |

| Question | | Expected Answer | Mark | Rationale/Additional Guidance |
|----------|---|---|------|--|
| 27 | a | 2.05 ✓ | 1 | Check in table and on answer space |
| | b | i | 1 | ECF from part a. ALLOW ½ square tolerance on plotting |
| | | | 1 | |
| | b | ii | 1 | Method mark for large range being used. ALLOW max ½ square misread |
| | | | 1 | |
| | c | $E (= 2.40 \times 1.60 \times 10^{-19}) = 3.84 \times 10^{-19}$ (J) ✓ | 1 | 3sf answer only. |
| | d | $1 \text{ Vs} = 1.6 \times 10^{-19}$ (Js) ✓ | 1 | Must use gradient in calculation, or zero marks. |
| | | $h = \text{gradient} \times 1.6 \times 10^{-19}$ ✓ | 1 | |
| | | $= 6.9$ (6.856) $\times 10^{-34}$ (Js) ✓ | 1 | |
| | e | They may not be identical ✓ | 1 | ALLOW check the one in use wasn't somehow anomalous |
| | | This improves accuracy/precision ✓ | 1 | ALLOW find an average p.d. |

| | | | | | |
|--|---|--|--|--|---|
| | f | | <p>Any one pair from:</p> <p>Darken the room / shield the LED / view through black paper tube ✓</p> <p>To improve contrast ✓</p> <p>To go from unlit to lit and back again to find turn on point</p> <p>Sometimes get flickering at turn-on point</p> <p>Any suggestion to get finer control of p.d. e.g. to use potential divider</p> <p>Because the LVU control is too coarse</p> | <p>1</p> <p>1</p> | <p>1 for suggestion</p> <p>1 for explanation</p> <p>ALLOW any other reasonable pairs of suggestion / explanation</p> |
| | | | <p>Total</p> <p>Total Section C</p> <p>Total Sections B & C</p> | <p>13</p> <p>30</p> <p>50</p> | |

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