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CAMBRIDGE
International Education

# Cambridge International AS & A Level

**PHYSICS** **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2026**

MARK SCHEME

Maximum Mark: 40

**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 **17** printed pages.

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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:<br><br>• the specific **content** defined in the mark scheme<br>• the specific **skills** defined in the mark scheme or in the level descriptions<br>• 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:<br><br>• marks are not deducted for errors or omissions<br>• 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<br>• 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<br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• 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.<br>• 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 |
|---|---|
| AE | arithmetic error |
| AWK | awkward scale used on graph |
| BOD | benefit of the doubt given |
| CON | contradiction in response, mark not awarded |
|  | correct point or mark awarded |
| ECF | error carried forward applied |
| FO | false origin used on graph |
|  | incorrect point or mark not awarded |
| ^ | information missing or insufficient for credit |
| POT | power of ten error |

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| Annotation | Meaning |
|---|---|
| RO | read-off from graph |
| SH | supervisor's help given |
| SR | supervisor's report taken into account |
| SV | supervisor's value/sample results taken into account |
| TE | transcription error |
| IR | value in range |
| OOR | value out of range |

**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. |
| SF | Significant figures |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(a) | Final value of $d$ in the range 10.0–35.0 cm with unit. | **1** | Ignore precision. |
| 1(b) | Without help from Supervisor: six sets of data (different values of $M$) scores 3 marks, five sets scores 2 marks, four sets scores 1 mark, three or fewer scores 0 marks. | **3** | Record the total number of sets of readings in a ring to left of table.<br>Allow more than six sets.<br>If help provided: six sets of readings scores 2 marks, five sets of readings scores 1 mark; four or fewer sets of readings scores 0 marks.<br>Indicate with SR on script front, with details near table. |
| | Values recorded in a table for $M$ and $d$. | **1** | |
| | Trend correct ($d$ decreases as $M$ increases). | **1** | Judge trend from table not from graph.<br>Judge trend on mean $d$, if available. If $d$ not available judge trend on $1 / d$. If $M$ not available judge trend on $n$.<br>**Not** equal values.<br>If one or more values in the table is 'out of trend' then this mark not awarded BUT this may not affect quality mark on the graph yet. |
| | Range of $M$: $M_{min} \leqslant 50$ g **and** $M_{max} \geqslant 200$ g. | **1** | Ring minimum and maximum values in table. |
| | Column headings: Each column heading must contain a quantity and a unit where appropriate. No unit for $n$.<br><br>The presentation of quantity and unit must conform to accepted scientific convention, for example $1 / d$ ($m^{-1}$). | **1** | Ignore units in the body of the table. Ignore POT errors.<br>Accept separating mark as a solidus, brackets around units or 'in', but not a comma.<br>Allow 'n / no units' but do not allow 'n / units'. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(b) | Consistency:<br>All raw values of *d* to the nearest mm. | **1** | Do not allow all zero in mm place here. |
| | Significant figures:<br>All values of 1 / *d* given to the same number of s.f. as (or one more than) the number of s.f. in raw *d*. | **1** | Check each row |
| | Values of 1 / *d* calculated correctly. | **1** | Check value in the last line of the table. If incorrect from mean *d*, go back to raw values and recalculate and if still incorrect, write in correct value.<br>Answer should be correct to the number of sf used by the candidate. |
| 1(c)(i) | Axes:<br>Axes must be labelled with the correct quantities.<br>Scales must be chosen so that the plotted points occupy at least half the graph grid in both the *x* and *y* directions.<br><br>Scale markings are no more than 2 cm (one large square) apart.<br>Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions). | **1** | Accept labels on axes ONLY as 1 / *d* and *n*.<br>Actual numbers need not correspond to label.<br>Ignore units.<br>Do not allow reversed scales.<br>Minimum 6 large squares on long axis and 4 large squares on short axis.<br>Ignore point(s) plotted off the grid and assess on remaining points.<br>Allow 8:10.<br>Do not allow awkward markings (e.g. 2.57, 5.57, 4.57 an awkward offset of a sensible linear scale).<br>Indicate *x*-axis false origin with FO. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(c)(i) | Plotting of points:<br>All observations in the table must be plotted on the grid.<br><br>Diameter of plotted points must be ⩽ half a small square.<br><br>Points must be plotted to an accuracy of half a small square in both *x* and *y* directions. | **1** | Ignoring any point off the grid, write a ringed total of points.<br>Allow correct plotting on a wrong graph.<br>Indicate reason if mark not awarded. Do not award if:<br>• any table value is not plotted;<br>• numbers do not correspond to axes label;<br>• any point has diameter larger than half a small square (blob);<br>• a point is (or should be) off the grid (check point on edge);<br>• the point **furthest** from the line is plotted more than half a small square out.<br><br>Ring and check point furthest from the line. Tick if correct, re-plot if incorrect. If a point on the edge is checked and found correct still check point furthest from the line. |
| | Quality: Trend of points must be positive<br><br>All points in the table (at least 5) must be plotted on the grid for this mark to be awarded.<br><br>It must be possible to draw a straight line that is within ± 1 on the *n* axis of <u>all</u> plotted points. | **1** | Ignore line drawn by the candidate.<br>If examiner has replotted a point judge quality on position of replot.<br>Indicate the tolerance on the graph.<br><u>Indicate reason</u> if mark not awarded.<br>Do not award if:<br>• wrong trend on the graph (i.e. negative gradient);<br>• a point is (or should be) off the grid (check pt on edge);<br>• non-linear scale in region of the points;<br>• wrong <u>quantity</u> plotted or calculated;<br>• 4 or fewer plotted points. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(c)(ii) | Line of best fit:<br><br>'Best fit' is judged by the balance of all points on the grid (at least 5 points) about the candidate's line.<br><br>There must be an even distribution of points either side of the line along the full length.<br><br>Lines must not be kinked or thicker than half a square.<br><br>Some candidates may choose to identify an anomalous point. If they identify **one** point as anomalous (e.g. by circling or labelling) then this point is to be disregarded when judging the line of best fit. There must be at least 5 points left after the anomalous point is disregarded. | **1** | Allow a straight line through a curved trend.<br>Indicate reason if not awarded. Do not award if:<br>• rotation or translation achieves a better fit;<br>• line is kinked;<br>• a curve has been drawn;<br>• line is thicker than 1 mm or 'hairy';<br>• points are too scattered to judge;<br>• there are 4 or fewer points.<br>• Line does not span all plotted points considered in assessing the line (line must span in either the *x* or *y* direction).<br>Assess line on all points if more than one point is identified as anomalous or only 5 points are plotted on the grid. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(c)(iii) | Gradient: gradient sign on answer line consistent with graph drawn.<br><br>The hypotenuse of the triangle used should be greater than half the length of the drawn line.<br><br>Both read-offs must be accurate to half a small square in both the $x$ and $y$ directions.<br><br>Method of calculation must be correct, not $\Delta x / \Delta y$. | **1** | Allow hypotenuse to be exactly half the length of the drawn line.<br><br>Correct substitution must be shown. Do not check beyond the substitution.<br><br>If a read-off is incorrect, write in correct value(s). Ignore POT error if it is the same for all values.<br>Allow use of points from the table ONLY if they are less than or equal to half a small square from the line. Check points.<br>Ignore units.<br><br>Other valid methods:<br>1 Using simultaneous equations;<br>2 Counting squares $\times$ scale factor (must see a triangle);<br>3 Using only $\Delta y$ and $\Delta x$ (without read-offs) – check these values to one small square using their triangle (triangle must be shown). |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(c)(iii) | *y*-intercept:<br><br>Intercept read directly from the graph, with read-off at $n = 0$, accurate to half a small square in 1 / *d* direction.<br>**or**<br>Correct read-off from a point on the line is substituted into $y = mx + c$ or an equivalent expression.<br><br>Read-off accurate to half a small square in both *x* and *y* directions. | **1** | Check for *x*-axis false origin (FO) i.e. $n \neq 0$.<br>Allow read off for curve.<br><br>Allow ecf of gradient value, *m*.<br>Check correct substitution in $y = mx + c$. Do not check beyond the substitution.<br><br>If read-off used is incorrect and gradient mark not awarded because of this incorrect read-off, then check 2nd read-off in the gradient substitution. If this 2nd read-off is also incorrect, do not allow the intercept mark. If correct, allow ecf and award the mark.<br>Ignore POT. |
| 1(d) | *P* = candidate's gradient value **and** *Q* = candidate's intercept value.<br><br>Values must not be written as fractions or given to only one significant figure. | **1** | Special case when *Q* is read off the axis: allow 1 sf for *Q* if it is close to the origin and can only be read to 1 sf.<br><br>Allow POT adjustment if consistent with unit.<br>Ignore any working.<br>If axes are inverted, this mark cannot be awarded unless the candidate makes a correction at this point (true gradient = 1 / candidate's gradient and true intercept = – candidate's intercept / candidate's gradient). |
| | Unit for *P* consistent with readings: $cm^{-1}$ or $m^{-1}$.<br>Unit for *Q* consistent with readings: $cm^{-1}$ or $m^{-1}$. | **1** | |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(e) | Calculation of $S = \frac{10Q}{P} - 10$<br>using candidate's values of $P$ and $Q$ **and** with consistent unit. | **1** | Check unit first.<br>Check calculation when rounded to 2 sf is the same as the examiner's value when rounded to 2 sf.<br><br>Allow $S$ to 1 sf only if credit not awarded in **1(d)** because of a 1 sf value. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(a)(i) | Absolute uncertainty in $L$ in range 3–8 mm.<br>Correct method of calculation to find percentage uncertainty e.g. absolute uncertainty / $L \times 100$.<br><br>If repeated readings have been taken, then the uncertainty can be half the range if the working is clearly shown, but NOT zero if values are equal | **1** | With $\times$ 100 seen or implied |
| 2(a)(ii) | 45.0 cm < both $D_B$ and $D_C$ measurements < 50.0 cm with unit **and** to the nearest mm. | **1** | |
| 2(b)(i) | Raw value(s) and final value of $R$ to at least the nearest 0.1 Ω with unit.<br>**and**<br>final value ⩾ 1.0 Ω. | **1** | Allow answer line value to the nearest 0.01 Ω only if repeats are seen to the nearest 0.1 Ω. |
| 2(b)(ii) | Correct calculation of ($D_B - x$) and ($D_C + x$). | **1** | Check used consistent units in calculation. |
| 2(b)(iii) | $R_X < R$. | **1** | Ignore precision. If unit missing, assume same unit as $R$. |
| 2(b)(iv) | Correct calculation of $R_X / R$. | **1** | Value of $R_X / R$ correct to the same number of sf as the candidate's answer. Ignore unit if given. |
| 2(b)(v) | Justification for significant figures in $R_X / R$ linked to significant figures in $R_X$ and $R$. | **1** | Ignore the actual sf used in calculation.<br>Do not allow reference to $L$, $D_B$ or $D_C$.<br>Do not allow 'raw readings'.<br>Any additional numerical justification must be valid. |
| 2(c) | Second values of ($D_B - x$) and ($D_C + x$). | **1** | Different values of ($D_B - x$) and ($D_C + x$). |
| | Second value of $R_X$. | **1** | |
| | Second value of $R_X$ < first value of $R_X$. | **1** | |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(d) | Two values of $k$ calculated correctly.<br><br>The final $k$ values must not be written as fractions or given to one significant figure. | **1** | Do not allow either $k$ to 1 sf.<br>Check $k$ value for values from **2(c)** on page 9 when rounded to 2 sf is the same as the examiner's value when also rounded to 2 sf. If incorrect, record correct value.<br>Ignore POTs if same for both $k$ values.<br>Allow values of $k$ to be written on either line.<br>If no working shown still award mark if $k$ value correct. |
| 2(e) | Calculation of percentage difference between candidate's two $k$ values.<br><br>Comparison of percentage difference with 15% leading to a consistent conclusion. | **1** | 1 % difference calculation. Allow the use of half the % difference calculation e.g. $(k_1 - k_2) / (k_1 + k_2)$.<br>2 Comparison to 15(%) or 'the (suggested/percentage) uncertainty'. Do not allow any other uncertainty e.g. their own or the uncertainty in **2(a)(i)**.<br>3 Valid comment linking points 1 and 2. The candidate's conclusion must be consistent with the criterion 15%.<br>Special Cases:<br>Allow the statement $k_1 = k_2$ only if the values are the same to 3 s.f. with a valid conclusion stated. Allow use of 15% criterion with one or both $k$ values to determine whether there is an overlap or not with a valid conclusion stated. |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(f)(i) | A<br>Two (sets of) readings are not enough to draw a valid conclusion<br>**or**<br>two *k* values are not enough to draw a conclusion. | **4** | Do not allow 'Two readings not enough for (accurate) results'.<br>Allow not enough k values to draw a conclusion.<br>Allow '(one or) two readings are not enough to draw a conclusion'.<br>Allow 'too few readings for a conclusion'.<br>Allow '…. to conclude (the experiment)'.<br>Do not allow '… to conclude the results'.<br>Allow reference to 'relationship' to mean 'conclusion'. |
| | B<br>Difficulty with determining $\underline{L}$ with a reason related to start of the wire e.g. width of solder blob, determining where the wire twist finishes, determining the length of the curved section of the wire. | | |
| | C<br>Difficult with determining *L*, $D_B$ or $D_C$ with reason e.g. width of crocodile clips / kinked wires / resistance wire is loose on metre rule. | | Ignore 'loose or poor connections' on its own.<br>Accept 'lengths' instead of *L*, $D_B$ or $D_C$.<br>Do not allow 'distances'. |
| | D<br>Difficulty determining $\underline{R \text{ or } R_X}$ with reason e.g. fluctuating / unstable reading owing to poor connections between crocodile clip(s) and wire. | | Accept 'resistance' or 'ohmmeter reading' to mean *R* or $R_x$. Ignore 'loose or poor connections' on its own. |
| | E<br>Precision of ohmmeter is only 0.1 Ω<br>**or**<br>both values of $R_X$ are similar. | | |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(f)(ii) | A<br>Take more readings (for different values of *x*) and plot a graph<br>**or**<br>take more readings and compare *k* values. | **4** | Do not allow 'Repeat readings' on its own.<br>Do not allow 'take more readings and (calculate) average *k*.<br>Allow 'repeat readings and plot a graph'.<br>Do not allow 'repeat readings and draw a line' without reference to a graph. |
| | B<br>Method of improving the measurement of *L* e.g. use a single wire (with no join), use a connection box, measure and mark *L* before putting onto the rule. | | Do not allow 'put end on ruler'. |
| | C<br>Method of improved connection at B or C e.g. use jockey<br>**or**<br>method of ensuring the wire remains straight e.g. wrap wire around screws at both ends of rule. | | Accept a thinner crocodile clip.<br>Accept clamp wire to both ends of ruler.<br>Do not accept soldering the crocodile clip to the wire.<br>Do not allow (more) tape. |
| | D<br>Improved method to reduce stability of resistance reading e.g. use sandpaper on crocodile clips or wire or use tighter crocodile clips. | | Allow 'new crocodile clips with less rust on'.<br>Do not allow 'clean the crocodile clips'. |
| | E<br>Use ohmmeter with precision 0.01 Ω or greater or ammeter and voltmeter with higher precision than ohmmeter.<br>**or**<br>use larger values of *x*. | | Allow more precise ohmmeter. |

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