

# Cambridge International AS & A Level

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**PHYSICS****9702/32**

Paper 3 Advanced Practical Skills 2

**May/June 2025**

MARK SCHEME

Maximum Mark: 40

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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This document consists of **11** printed pages.









**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**

<b>Annotation</b>	<b>Meaning</b>
	arithmetic error
AWK	awkward scale used on graph
	benefit of the doubt given
	contradiction in response, mark not awarded
	correct point or mark awarded
	error carried forward applied
FO	false origin used on graph
	incorrect point or mark not awarded
	information missing or insufficient for credit
	power of ten error

<b>Annotation</b>	<b>Meaning</b>
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
<span style="border: 1px solid red; padding: 0 2px;">TE</span>	transcription error
<span style="border: 1px solid red; padding: 0 2px;">IR</span>	value in range
OOB	value out of range

Question	Answer	Marks
1(a)	Value for $x$ in range 8.0–14.0 cm with unit.	<b>1</b>
	Non-zero value for $I$ less than 2.00 mA with unit.	<b>1</b>
1(b)	Six sets of readings of $x$ (different values) and $I$ with correct trend (as $x$ increases, $I$ decreases) and without help from Supervisor scores 5 marks, five sets scores 4 marks etc.	<b>5</b>
	Range: $x_{\min} \leq 5.0 \text{ cm}$ <b>and</b> $x_{\max} \geq 16.0 \text{ cm}$ .	<b>1</b>
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. $\sqrt{I}$ (mA <sup>1/2</sup> ), $\sqrt{I}/\text{mA}^{1/2}$ .	<b>1</b>
	Consistency: All values of $x$ must be given to the nearest millimetre.	<b>1</b>
	Significant figures: Values of $\sqrt{I}$ must be given to the same number of s.f. as (or one more than) the number of s.f. in $I$ .	<b>1</b>
	Calculation: Values of $\sqrt{I}$ calculated correctly.	<b>1</b>
1(c)(i)	Axes: Axes must be labelled with the required quantities. Scales must be chosen so that the plotted points occupy at least half the graph grid in both the $x$ and $y$ directions. Scale markings are no more than 2 cm (one large square) apart. Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions).	<b>1</b>
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points must be $\leq$ half a small square. Points must be plotted to an accuracy of half a small square in both $x$ and $y$ directions.	<b>1</b>
	Quality: General trend of points must be negative. All points in the table must be plotted (at least 5) for this mark to be awarded. It must be possible to draw a straight line that is within $\pm 2.0 \text{ cm}$ (to scale) on the $x$ -axis of all plotted points.	<b>1</b>

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Question	Answer	Marks
1(c)(ii)	<p>Line of best fit:            'Best fit' is judged by the balance of all points on the grid (at least 5 points) about the candidate's line.            There must be an even distribution of points either side of the line along the full length.            Lines must not be kinked or thicker than half a square.</p> <p>Some candidates may choose to identify an anomalous point. If 6 or more points are plotted and they identify <b>one</b> point as anomalous (e.g. by circling or labelling) then this point is to be disregarded when judging the line of best fit.</p>	<b>1</b>
1(c)(iii)	<p>Gradient:            The hypotenuse of the triangle used must be greater than half the length of the drawn line.            Both read-offs must be accurate to half a small square in both the x and y directions.            Method of calculation must be correct, not <math>\Delta x / \Delta y</math>.            Gradient sign on answer line must be consistent with graph drawn.</p>	<b>1</b>
	<p>y-intercept:            Correct read-off from a point on the line is substituted into <math>y = mx + c</math> or an equivalent expression.            Read-off accurate to half a small square in both x and y directions.  <b>Or</b>            Intercept read directly from the graph, with read-off at <math>x = 0</math>, accurate to half a small square in y direction.</p>	<b>1</b>
1(d)	<p><math>a</math> = candidate's gradient value <b>and</b> <math>b</math> = candidate's intercept value.            Values must not be written as fractions or given to only one significant figure.</p>	<b>1</b>
	<p>Units for <math>a</math> and <math>b</math> are correct (e.g. <math>\text{mA}^{\frac{1}{2}} \text{cm}^{-1}</math> for <math>a</math> and <math>\text{mA}^{\frac{1}{2}}</math> for <math>b</math>).</p>	<b>1</b>

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Question	Answer	Marks
2(a)(i)	Value of $B$ in range 7.50–9.50 cm with unit <b>and</b> to nearest mm.	<b>1</b>
2(a)(ii)	Percentage uncertainty based on absolute uncertainty in range 2–5 mm.  Correct method of calculation to find percentage uncertainty e.g. (absolute uncertainty / value from <b>(a)(i)</b> ) $\times$ 100. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.	<b>1</b>
2(b)(i)	Value for $d$ in range 2.00–6.00 mm with unit <b>and</b> to nearest 0.1 mm.	<b>1</b>
2(b)(ii)	Value for $L$ in range 20.0–40.0 cm with unit.	<b>1</b>
	Value of $T$ in range 2.00–9.00 (s).	<b>1</b>
	Repeat readings for $T$ : at least two values of $nT$ where $n \geq 2$ .	<b>1</b>
2(c)	Second values of $d$ and $L$ .	<b>1</b>
	Second value of $T$ .	<b>1</b>
	Second $d$ smaller than first $d$ .	<b>1</b>
2(d)(i)	Two values of $k$ calculated correctly. Values not written as fractions or given to only one significant figure.	<b>1</b>
2(d)(ii)	Justification for significant figures in $k$ linked to significant figures in $B$ , $L$ , $d$ and $T$ .	<b>1</b>
2(e)	Correct calculation of percentage difference between candidate's two $k$ values. Comparison of percentage difference with 20%, leading to a consistent conclusion.	<b>1</b>

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Question	Answer	Marks
2(f)(i)	<p>A Two (sets of) readings are not enough to draw a (valid) conclusion (<b>not</b> “not enough for accurate results”, “few readings”).</p> <p>B Difficult to measure <math>B</math> with a reason e.g. difficult to judge the position of the centres of the masses / masses not parallel to each other on wire / <math>B</math> changes when clip and masses are suspended.</p> <p>C Difficult to measure <math>L</math> with a reason e.g. parallax error / rubber cord moves <u>when touched by rule</u> / clip moves <u>when touched by rule</u>.</p> <p>D Difficult to measure <math>d</math> with a reason e.g. jaws of calipers compress width of rubber cord.</p> <p>E Difficult to measure <math>T</math> with a reason e.g. because oscillations die away (very) quickly / amplitude of oscillations decreases quickly / oscillations are heavily damped / difficult to judge start and/or end of oscillations.</p> <p>F Difficulty with oscillation (of cord/clip/masses) e.g. oscillations in more than one mode / vertical or side-to-side oscillations / oscillation affected if rubber cord is not attached at centre of lower clip / wire moves in the clip during oscillation.</p> <p><i>1 mark for each point up to a maximum of 4.</i></p>	<b>4</b>

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Question	Answer	Marks
2(f)(ii)	<p>A Take more readings <u>and</u> plot a graph <b>or</b> take more readings <u>and</u> compare <math>k</math> values (<b>not</b> “repeat readings” on its own).</p> <p>B Improved method of measuring <math>B</math> e.g. measure from left (or right) hand side of one mass to left (or right) hand side of the other mass / measure <math>B</math> when clip is suspended.</p> <p>C Method to improve measurement of <math>L</math> e.g. clamp rule (to measure <math>L</math>) / use pointers attached to rule or attached to edges of clips.</p> <p>D Method to improve measurement of <math>d</math> e.g. use a micrometer (to measure <math>d</math>) / use travelling microscope (to measure <math>d</math>).</p> <p>E Method to improve measurement of <math>T</math> e.g. twist masses through larger angle before releasing / use marker placed at midpoint/equilibrium point/rest point of oscillation / record/film/video oscillation <u>with</u> timer in view.</p> <p>F Workable method to improve release of clip/masses e.g. mark centre of clip for attaching to the rubber cord / marker to indicate initial height / marker to indicate initial position of centre of clip vertically under cord.</p> <p><i>1 mark for each point up to a maximum of 4.</i></p>	<b>4</b>