CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2025**

MARK SCHEME

Maximum Mark: 40

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.

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.

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

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

Question	Answer	Marks
1(a)(i)	Values of L_1 and L_2 with consistent unit **and** L_2 in the range 15.0–18.0 cm.	**1**
1(a)(ii)	Value of T on answer line in the range 0.70–1.50 s with unit.	**1**
	Repeats: At least two measurements of $\underline{n}T$ where $n \geqslant 5$.	**1**
1(b)	Six sets of readings of L_1 (different values), L_2 and T with correct trend (as L_1 decreases, L_2 **and** average T decreases) and without help from Supervisor scores 3 marks, five sets scores 2 marks etc.	**3**
	Range: At least one value of $L_2 \leqslant 6.0$ cm.	**1**
	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. $(\sqrt{L_1} + \sqrt{L_2}) / \text{cm}^{½}$.	**1**
	Consistency: All values of L_1 and L_2 must be given to the nearest mm.	**1**
	Significant figures: All values of $(\sqrt{L_1} + \sqrt{L_2})$ given to 3 significant figures.	**1**
	Calculation: $(\sqrt{L_1} + \sqrt{L_2})$ calculated correctly.	**1**

Question	Answer	Marks
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).	**1**
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points must be $\leqslant$ half a small square. Points must be plotted to an accuracy of half a small square in both *x* and *y* directions.	**1**
	Quality: Trend of points must be positive. All points in the table must be plotted (at least 5 points) for this mark to be awarded. It must be possible to draw a straight line that is within ± 0.5 $cm^{½}$ on the $(\sqrt{L_1} + \sqrt{L_2})$-axis of all plotted points.	**1**
1(c)(ii)	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. Some candidates may choose to identify an anomalous point. If 6 or more points are plotted and 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.	**1**
1(c)(iii)	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 $\Delta x / \Delta y$. Gradient sign on answer line must be consistent with graph drawn.	**1**
	y-intercept: Intercept read directly from the graph, with read-off at $x = 0$, accurate to half a small square in *y* direction. **or** Correct read-off from a point on the line is substituted into $y = mx + c$ or an equivalent expression. Read-off accurate to half a small square in both *x* and *y* directions.	**1**

Question	Answer	Marks
1(d)	*a* = candidate's gradient value **and** *b* = candidate's intercept value. Values must not be written as fractions or given to only one significant figure.	**1**
	Units for *a* and *b* correct (e.g. s $cm^{-½}$ for *a* and s for *b*).	**1**
1(e)	Correct calculation for *g* with consistent unit.	**1**

Question	Answer	Marks
2(a)(i)	Value for D in range 5.00–7.00 mm, with unit	**1**
	Evidence of repeated measurements of D.	**1**
2(a)(ii)	Value for d in range 4.50–5.50 mm with unit **and** to at least the nearest 0.1 mm.	**1**
2(b)(i)	Value of time in the range 0.8–20.0 s with unit **and** to the nearest 0.1 s or better.	**1**
	Evidence of repeated measurements of t.	**1**
2(b)(ii)	Percentage based on absolute uncertainty in t of 0.2–0.5 s. Correct method of calculation to obtain percentage uncertainty e.g. (absolute uncertainty / value from **(b)(i)**) × 100. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.	**1**
2(c)	Second value of d.	**1**
	Second value of t.	**1**
	Value for second t < first t.	**1**
2(d)(i)	Two values of k calculated correctly. The final k values must not be written as fractions.	**1**
2(d)(ii)	Justification based on the significant figures in t and $(D^2 - d^2)$.	**1**
2(e)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 10%, leading to a consistent conclusion.	**1**

Question	Answer	Marks
2(f)(i)	A Two (sets of) readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Large <u>percentage</u> uncertainty in *t* / time. C Difficult to measure *t* / fall time / time between markers since it is difficult to judge when ball reaches the tape / marker. D Difficult to measure *D* with reason e.g. tube cross section not circular / tube changes shape when measuring / internal jaws of calipers too big. E Difficult to measure *d* with reason e.g. difficult to hold ball in jaws of calipers. F Difficulty with balls e.g. difficult to remove balls with magnet / balls hit side of tube when falling. *1 mark for each point up to a maximum of 4.*	**4**
2(f)(ii)	A Take more readings <u>and</u> plot a graph **or** take more readings <u>and</u> compare *k* values (**not** "repeat readings" on its own). B Increase the fall distance / use a long(er) tube. C Record / film / video with timer in view. D Use glass / rigid tube / use travelling microscope. E Use micrometer screw gauge. F Use strong(er) magnet / have more balls (of each size). *1 mark for each point up to a maximum of 4.*	**4**