Cambridge International AS & A Level

PHYSICS	**9702/31**
Paper 3 Advanced Practical Skills 1	**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.

This document consists of **10** 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

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)	Final value of n_0 with no unit **and** in the range $10 \leqslant n_0 \leqslant 30$.	1
	Evidence of repeats.	1
1(b)(i)	$n < n_0$.	1
1(b)(ii)	Correct calculation of N.	1
1(c)	Five sets of readings of M (different values) and n with correct trend (M increases, n decreases) and without help from Supervisor scores 4 marks, four sets scores 3 marks, etc.	4
	Range of M: Must include M_{min} = 10 g **and** $M_{max} \geqslant 60$ g.	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. $M/$ g.	1
	Significant figures: All values of N^3 given to 3 significant figures.	1
	Calculation: Correct calculation of N^3.	1
1(d)(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: All N^3 values are positive and trend of points must be positive. All points in the table (at least 4 points) must be plotted on the grid for this mark to be awarded. It must be possible to draw a straight line that is within $\pm$ 5 g on the M-axis of all plotted points.	1

Question	Answer	Marks
1(d)(ii)	Line of best fit: 'Best fit' is judged by the balance of all points on the grid (at least 4 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 5 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(d)(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 $M = 0$, 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
1(e)	Value of P = candidate's gradient value **and** value of Q = candidate's intercept value. Values must not be written as fractions or given to only one significant figure.	1
	Units for P: g^{-1} or kg^{-1} consistent with their readings **and** no units for Q.	1

Question	Answer	Marks
2(a)	At least two values of raw d all to the nearest mm **and** final d in the range 5.9–6.1 cm.	**1**
2(b)(i)	Value of T_A on answer line in the range 2.0−10.0 s with unit.	**1**
	Repeats: At least two measurements of T_A.	**1**
2(b)(ii)	Percentage uncertainty based on absolute uncertainty in T_A in range 0.5–3.0 s. Correct method of calculation to find percentage uncertainty e.g. (absolute uncertainty / value from **(b)(i)**) $\times$ 100. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.	**1**
2(c)(i)	Value of T_B.	**1**
2(c)(ii)	Correct calculation of W with no unit **and** $W > 1$.	**1**
2(c)(iii)	Justification for significant figures in W linked to significant figures in T_A and T_B (only).	**1**
2(d)	Second value of d.	**1**
	Second values of T_A and T_B.	**1**
	Second value of $W >$ first value of W.	**1**
2(e)	Two values of k calculated correctly. The final k values must not be written as fractions or given to only one significant figure.	**1**
2(f)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 20%, leading to a consistent conclusion.	**1**

Question	Answer	Marks
2(g)(i)	A Two (sets of) readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Reason for difficulty in producing the rectangle of paper e.g. hard to make the sides parallel (or perpendicular) / hard to cut the sides straight / difficult to cut lengths accurately / cutting by hand with scissors (produces wavy sides) / paper twists / folds when cutting (because it is thin). C Difficulty with measuring T with reason e.g. two edges are not parallel when they meet / difficult to ensure the stopwatch is started at the same time as the paper is placed (or dropped) on to the water / experiment cannot be repeated using the <u>same</u> piece of paper. D Difficulty with the paper staying central in the bowl e.g. paper floats / moves and touches the edge of bowl. E Reason for difficulty with placing the paper onto the water surface e.g. paper is tilted / is dropped / hard to lower the paper parallel to the water / water surface is disturbed / ripples when placing paper / paper gets wet before entering water / paper is curled before placing on water. *1 mark for each point up to a maximum of 4.*	4
2(g)(ii)	A Take more readings (for different values of d) <u>and</u> plot a graph **or** take more readings <u>and</u> compare k values (**not** "repeat readings" on its own). B (To produce the rectangles) use a template / a grid **or** place tracing paper on graph paper **or** use a set square to draw (the rectangle) **or** use a guillotine / paper or box cutter / knife / scalpel with a straight edge (or ruler). C Video / film / record with timer in view. D Use wider bowl **or** have the water surface further down from the top of the bowl. E Place paper on a flat sheet of metal / glass / filter paper and place that sheet on surface of water **or** valid method of flattening the paper before putting into the water e.g. place weight on paper. *1 mark for each point up to a maximum of 4.*	4