CAMBRIDGE
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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.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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 For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • 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. • 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

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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**

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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**

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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)**) × 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**

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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 same 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*) and plot a graph **or** take more readings and 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**

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