CAMBRIDGE
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Cambridge International AS & A Level

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2024**

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 October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

Question	Answer	Marks
1(a)	Final value of s is greater than a **and** $(a + s) \leqslant 70.0$ cm.	**1**
1(b)	Six (or more) sets of readings of a (different values) and s with the correct trend (as a increases, s decreases) **and** without help from supervisor scores 5 marks, five sets scores 4 marks, etc.	**5**
	Range: $s_{min} \leqslant 10.0$ 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. $1/a$ / cm^{-1} and no unit for s / a.	**1**
	Consistency: <u>All</u> raw values of a <u>and</u> s must be given to the nearest mm.	**1**
	Significant figures: All values of s / a must be given to the same number of s.f. as (or one more than) the least number of s.f. in raw a and s values.	**1**
	Calculation: Values of s / a are correct.	**1**
1(c)(i)	Axes: Axes must be labelled with the correct 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) on the grid for this mark to be awarded. It must be possible to draw a straight line that is within $\pm$ 0.2 m^{-1} (0.002 cm^{-1}) on the 1 / a axis (normally x-axis) of <u>all</u> plotted points.	**1**

Question	Answer	Marks
1(c)(ii)	Line of best fit: 'Best fit' is judged by the balance of all points on the grid (at least five 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 small square. 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 five points left after the anomalous point is disregarded.	**1**
1(c)(iii)	Gradient: The hypotenuse of the triangle used should 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 consistent with graph drawn.	**1**
	y-intercept: Intercept read directly from the graph, with read-off at $1 / a = 0$, accurate to half a small square in y direction. **or** Correct read-off from a point on the line 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(d)(i)	Value of P = candidate's gradient value **and** value of Q = candidate's y-intercept value. The values must not be written as fractions, roots or given to one significant figure.	**1**
	Correct unit for P: m or cm or mm **and** no unit for Q.	**1**
1(d)(ii)	Correct calculation of R with correct unit, e.g. g.	**1**

Question	Answer	Marks
2(a)(i)	Final L value in the range 89.0–91.0 cm with unit **and** L to nearest mm.	**1**
	Final d value in the range 8.00–12.00 mm with unit **and** all raw values to the nearest 0.01 mm or all to the nearest 0.001 mm.	**1**
2(a)(ii)	Justification for significant figures in V linked to significant figures in L and d.	**1**
2(b)(i)	S_0 in the range 0.030–0.150 m.	**1**
2(b)(ii)	Percentage uncertainty based on an absolute uncertainty in S_0 in range 0.2 cm (0.002 m) to 0.6 cm (0.006 m). Correct method of calculation to find percentage uncertainty e.g. (absolute uncertainty / value from **2(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(b)(iii)	Correct calculation of k.	**1**
2(c)	Final T in range 0.30 s $\leqslant T \leqslant$ 0.70 s.	**1**
	At least two measurements of nT where $n \geqslant 5$.	**1**
2(d)	Second value of M **and** second value of T.	**1**
	Second value of T > first value of T.	**1**
2(e)	Two values of r calculated correctly. The final r values must not be written as fractions or given to only to one significant figure	**1**
2(f)	Calculation of percentage difference between candidate's two ρ values. Comparison of percentage difference with 15% leading to a consistent conclusion.	**1**

Question	Answer	Marks
2(g)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to measure S_0 or S_1 with a reason e.g. ruler disturbs lower rod while measuring / parallax error / ruler moves during measurement as hand-held. C S_0 and/or S_1 vary along the length of the rods with reason e.g. springs are of different lengths / rods bend / rod(s) not uniform. D Difficult to measure time or T with reason e.g. difficult to judge / identify / tell / know the start or end of an oscillation. E Difficulty with oscillation(s) with reason e.g. springs move on rod / other modes of oscillation are present / mass hanger swings (or moves) on rod / mass (hanger) hits the stand. *1 mark for each point up to a maximum of 4.*	**4**

Question	Answer	Marks
2(g)(ii)	A Take more readings <u>and</u> plot a graph **or** take more readings <u>and</u> compare ρ values (**not** "repeat readings" on its own). B Clamp ruler / pointers on rule **or** use calipers **or** measure between middles of rods / measure diameter of rod and take account in measurement. C Use springs of identical length (and spring constant) **or** adjust positions of springs so that the extensions of each spring are the same **or** move mass hanger to make rods parallel. D Fiducial mark <u>at the centre</u> of the oscillation **or** video / record / film with timer in view or view frame by frame **or** motion / position sensor located under the lower rod / mass hanger E Carve / use grooves in rod **or** method of attachment <u>to rod</u> e.g. tape / glue / use adhesive putty for the springs or string *1 mark for each point up to a maximum of 4.*	**4**