

Cambridge International AS & A Level

PHYSICS**9702/34**

Paper 3 Advanced Practical Skills 2

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.

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This document consists of **9** printed pages.

Question	Answer	Marks
1(a)(i)	Values of h_t and h_b with unit and in range 19.0–24.0 cm.	1
1(a)(ii)	Value of T in range 1.20–2.60 s. Evidence of repeat measurements of T .	1 1
1(b)	Six sets of readings of h_t , h_b and T with correct trend (as h_t increases, T decreases) and without help from supervisor scores 4 marks, five sets scores 3 marks etc. Range: $\max h_t - \min h_t \geq 5.0$ cm.	4 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. $1 / T / \text{s}^{-1}$.	1
	Consistency: All values of h_t and h_b must be given to the nearest mm.	1
	Significant figures: Values of $1 / T$ given to same number of s.f. as (or one more than) number of s.f. in T .	1
	Calculation: Values of $1 / T$ calculated correctly.	1

Question	Answer	Marks
1(c)(i)	<p>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).</p>	1
	<p>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.</p>	1
	<p>Quality: 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 $\pm 0.05 \text{ s}^{-1}$ (to scale) on the $1 / T$ axis (normally the y-axis) of <u>all</u> plotted points. General trend of points must be positive.</p>	1
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 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.</p>	1

Question	Answer	Marks
1(c)(iii)	<p>Gradient:</p> <p>The hypotenuse of the triangle used should be greater than half the length of the drawn line.</p> <p>Both read-offs must be accurate to half a small square in both the x and y directions.</p> <p>Method of calculation must be correct, not $(\Delta x / \Delta y)$.</p> <p>Gradient sign on answer line consistent with graph drawn.</p>	1
	<p>y-intercept:</p> <p>Intercept read directly from the graph, with read-off at $x = 0$, accurate to half a small square in y direction.</p> <p>or</p> <p>Correct read-off from a point on the line substituted correctly into $y = mx + c$ or an equivalent expression.</p> <p>Read-off accurate to half a small square in both x and y directions.</p>	1
1(d)	<p>p equal to candidate's gradient and q equal to candidate's intercept.</p> <p>Values must not be written as fractions, roots or given to only one significant figure.</p>	1
	<p>Units for p and q correct and consistent with readings, e.g. $s^{-1} \text{cm}^{-1}$ for p and s^{-1} for q.</p>	1

Question	Answer	Marks
2(a)(i)	All raw value(s) for r to nearest mm.	1
	Final value of r in range 45.0–49.5 cm.	1
2(a)(ii)	Final value of x less than 15.0 cm.	1
	Evidence of repeat readings of x .	1
2(a)(iii)	Percentage uncertainty based on absolute uncertainty in x in range 0.3–1.0 cm. Correct method of calculation to find percentage uncertainty e.g. (absolute uncertainty / value from (a)(ii)) \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(a)(iv)	Correct calculation of h .	1
2(b)	Second value of x .	1
	Second value of h .	1
	Second $x <$ first x .	1
2(c)(i)	Two values of k calculated correctly. The final k values must not be written as fractions or given to one significant figure.	1
2(c)(ii)	Justification for significant figures in k linked to significant figures in $(M + m)$ and h .	1
2(d)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 15% leading to a consistent conclusion.	1

Question	Answer	Marks
2(e)(i)	<p>A Two readings are not enough to draw a (valid) conclusion (not “not enough for accurate results”, “few readings”).</p> <p>B Difficulty with r with reason e.g. holding ruler in air / rod moves when hit by ruler / estimating magnet’s centre.</p> <p>C Difficulty with the starting position with reason e.g. parallax / knowing which part of the magnet to use as a reference.</p> <p>D Difficulty with x with reason e.g., parallax / judging when at maximum displacement / at maximum displacement for short time / knowing which part of nut to use as a reference point.</p> <p>E Difficulty with picking up the nut.</p> <p><i>1 mark for each point up to a maximum of 4.</i></p>	4
2(e)(ii)	<p>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).</p> <p>B Clamp ruler / measure magnet’s length and distance to top (or bottom) of magnet / measure to top of magnet and to bottom of magnet and average the length.</p> <p>C Use set square on ruler/a stop to set the starting position.</p> <p>D Record/film/video with ruler in view / use grid behind / trial and error with pointer / use position sensor to side of swing.</p> <p>E Lower the magnet / use a strong(er) magnet / reduce the starting displacement / use a low(er) mass nut / different workable method of increasing adhesion.</p> <p><i>1 mark for each point up to a maximum of 4.</i></p>	4