Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2021**

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.

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[Turn over

Question	Answer	Marks
1(a)(i)	Value of p in range 35.0–45.0 cm.	**1**
1(a)(ii)	Value of q in range 50.0–70.0 cm	**1**
1(b)	Six sets of readings of p and q (different values) with correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $p_{min} \leqslant 25.0$ cm **and** $p_{max} \geqslant 65.0$ 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. $1/q$ (cm^{-1}). p/q must have no unit.	**1**
	Consistency: All values of q and p must be given to the nearest mm.	**1**
	Significant figures: All values of $1/q$ should have the same number of s.f. as, or one more than, the number of s.f. in the corresponding raw q value(s).	**1**
	Calculation: Values of $1/q$ calculated correctly	**1**

Question	Answer	Marks
1(c)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions). Scales must be chosen so that the plotted points occupy at least half the graph grid in both the *x* and *y* directions. Axes must be labelled with the quantity that is being plotted. Scale markings should be no more than three large squares apart.	**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 points in the table (at least 5) must be plotted on the grid. Trend of points must be correct. It must be possible to draw a straight line that is within $\pm$ 0.001 cm^{-1} ($\pm$ 0.1 m^{-1}) on the $1/q$ axis (normally *y*-axis) of all plotted points.	**1**
1(c)(ii)	Line of best fit: Judge by the balance of all points on the grid about the candidate's line (at least 5 points). There must be an even distribution of points either side of the line along the full length. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least five points left after the anomalous point is disregarded. Line must not be kinked or thicker than half a small square.	**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, e.g. $\Delta y/\Delta x$. Gradient sign on answer line matches graph drawn.	**1**
	y-intercept: Correct read-off from a point on the line and substituted into $y = mx + c$ or an equivalent expression. Read-off accurate to half a small square in both *x* and *y* directions. **or** Intercept read directly from the graph, with read-off at $p/q = 0$, accurate to half a small square.	**1**

Question	Answer	Marks
1(d)	Value of *a* equal to candidate's gradient **and** value of *b* equal to candidate's intercept. Values are not written as fractions.	**1**
	Units for *a* **and** *b* correct (e.g. cm^{-1}).	**1**

Question	Answer	Marks
2(a)(i)	Raw value(s) of y to nearest 0.1 cm and final value in range 44.0–48.0 cm.	**1**
2(a)(ii)	Raw value(s) of θ to nearest degree and final value in range 40–60°.	**1**
2(a)(iii)	Percentage uncertainty based on an absolute uncertainty in the range 2–5°. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if working is clearly shown. Correct method of calculation to find percentage uncertainty.	**1**
2(a)(iv)	Correct calculation of D.	**1**
2(a)(v)	Justification based on significant figures in y and θ.	**1**
2(b)(i)	Final value of S with unit and in range 1.00–1.50 s.	**1**
	Repeats: at least two values of nS, where $n \geqslant 5$.	**1**
2(b)(ii)	All raw times to nearest 0.1 s or all to nearest 0.01 s.	**1**
2(c)	Second values for θ, S and B.	**1**
	Quality: B decreases as θ decreases.	**1**
2(d)(i)	Two values of k calculated correctly. The final k values must not be written as fractions.	**1**
2(d)(ii)	Valid comment relating to the calculated values of k, testing against a criterion stated by the candidate.	**1**

Question	Answer	Marks
2(e)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to set or keep rod horizontal **or** string slips on pin. C Difficult to measure θ with reason e.g. rod moves if touched/parallax error/difficult to hold protractor steady in hand. D Difficulty with mode of oscillation e.g. rod oscillates in more than one plane/different modes of oscillation/rod twists as it oscillates from side to side. E Difficulty with <u>*B*</u> oscillation with reason e.g. rod hits stand/difficult to release both ends at the same time/hands get in the way at release. F Difficult to judge/determine/tell/know start of/end of/complete oscillation. *1 mark for each point up to a maximum of 4.*	**4**
2(e)(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 Notch in pin/use rough pin. C Clamp protractor/take a photograph and measure θ on photo/measure lengths and use trigonometry. D Method of restricting other modes of oscillation e.g. two sheets placed either side of rod. E Improved method of release for *B* oscillation, e.g. pull towards you/use card gate to release both ends at the same time **or** use longer pin. F Video/film/record with timer in view/view frame-by-frame **or** use (fiducial) marker at <u>midpoint</u> of oscillation. *1 mark for each point up to a maximum of 4.*	**4**