Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2022**

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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[Turn over

Question	Answer	Marks
1(a)(i)	All values of T to the nearest 0.1 mm or all values to the nearest 0.01 mm, with unit **and** in the range 2.50–3.50 mm.	**1**
1(a)(ii)	Value of w with unit in the range 25.0–35.0 cm.	**1**
1(b)	Evidence of repeated measurements of z.	**1**
1(c)	Six sets of readings of T and z with correct trend and without help from the Supervisor scores 4 marks, five sets scores 3 marks, etc. Correct trend is z increases as T increases.	**4**
	Range: $T_{min} \leqslant 2.00$ mm **and** $T_{max} \geqslant 9.00$ mm.	**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. θ/°; cos θ must not have a unit.	**1**
	Consistency: All values of <u>raw</u> z must be given to the nearest mm.	**1**
	Significant figures: All values of cos θ should be to three s.f.	**1**
	Calculation: Values of cos θ calculated correctly.	**1**

Question	Answer	Marks
1(d)(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 must be no more than 2 cm (one large square) 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 must be plotted (at least 5) on the grid for this mark to be awarded. Trend of points must be negative. It must be possible to draw a straight line that is within ± 0.5 mm (to scale) on the *T* axis of <u>all</u> plotted points.	**1**
1(d)(ii)	Line of best fit: 'Best fit' is judged by the balance of all points on the grid (at least 5) about the candidate's line. There must be an even distribution of points either side of the line along the full length. Candidates do not need to identify an anomalous point. However if there is a point off trend, it may be identified as anomalous by circling or labelling it. There must be at least 5 points left after one anomalous point is disregarded. Lines must not be kinked or thicker than half a small square.	**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 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 $T = 0$, accurate to half a small square.	**1**

Question	Answer	Marks
1(e)	Value of a = candidate's intercept **and** value of b = minus candidate's gradient. Values must not be written as fractions.	**1**
	Units for a (no unit) and b (mm^{-1}, cm^{-1} or m^{-1}) correct.	**1**

Question	Answer	Marks
2(a)(i)	Value for h_0, with unit, to the nearest mm and in the range 30.0–50.0 cm.	**1**
2(a)(ii)	Value for h, smaller than h_0.	**1**
2(a)(iii)	Absolute uncertainty of 2–8 mm. 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(b)(i)	Correct calculation of S.	**1**
2(b)(ii)	Justification for number of significant figures in S linked to significant figures in m, g and d_m.	**1**
2(c)(i)	Value for H.	**1**
	I obtained without help from the Supervisor **and** with unit and to the nearest 0.01 A.	**1**
2(c)(ii)	Second value of H.	**1**
	Second value of I.	**1**
	Second value of H (for larger I) smaller than first value.	**1**
2(d)	Two values of k calculated correctly. The final k values must not be written as fractions.	**1**
2(e)	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(f)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Pointer oscillates. C Difficult to measure height (of pointer) <u>with a reason</u>, e.g. pointer thick/rule not vertical/ruler (is held by hand so) moves. D Large percentage uncertainty in deflection / d_m **or** deflection / d_m is (very) small so uncertainty is large. E Change in height due to current / (h – H) is (very) small. F Current/ammeter reading fluctuates/changes. G Magnet hits side of tube. *1 mark for each point up to a maximum of 4.*	**4**
2(f)(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 Take video with a scale/ruler/grid in view (to estimate mean value) **or** turn off fans/air-conditioning or use wind shield/close windows/doors or add damping with method. C Improvement for measuring height, e.g. use pointed pointer/thinner pointer/pin or clamp the ruler. D Method to increase deflection d_m, e.g. use heavi<u>er</u> magnet/use less stiff spring/use long<u>er</u> spring. E Method to increase h – H, e.g. use larg<u>er</u> current/use <u>more</u> turns on the coil or use stronger magnet. F Named method of cleaning connections/crocodile clips/end of wire, e.g. wire wool/use soldered connections. G Use wider tube (**not** "larger"). *1 mark for each point up to a maximum of 4.*	**4**