Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2023**

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 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

Question	Answer	Marks
1(a)	Value for *R* with unit.	**1**
	Value for *a* with unit in range 10.0–75.0 cm.	**1**
1(b)	Six (or more) sets of readings of *R* (different values) and *a* and *b* with correct trend (as *R* increases, *a* increases and *b* decreases) and without help from the Supervisor scores 5 marks, five sets scores 4 marks, etc.	**5**
	Range: *R* values include 220 Ω **and** 4700 Ω.	**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. $1 / R$ ($k\Omega^{-1}$) and b / a (no unit)	**1**
	Consistency: Values of *a* and *b* must all be given to the nearest 0.1 cm.	**1**
	Significant figures: All values of b / a must be given to the same number of s.f. as (or one more than) the lowest number of s.f. in the corresponding *a* and *b* values.	**1**
	Calculation: Values of $1 / R$ are calculated correctly.	**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. Scales must not be awkward (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). It must be possible to draw a straight line that is within ± 0.2 on the b / a axis of all 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 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. 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 5 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. The method of calculation must be correct, not $\Delta x / \Delta y$. The gradient sign on the answer line must be consistent with the graph drawn.	**1**
	y-intercept: Intercept read directly from the graph, with read-off at $1 / R = 0$, accurate to half a small square in y direction. **or** Correct read-off from a point on the line and substituted correctly 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)	Value of M = candidate's gradient **and** value of N = candidate's y-intercept. The values must not be written as fractions or given to only one significant figure.	**1**
	Unit for M correct (e.g. Ω) **and** no unit for N.	**1**

Question	Answer	Marks
2(a)	Values for *A*, *B* and *C*.	**1**
	B in range 16.0–24.0 cm.	**1**
	Correct calculation of *x*.	**1**
2(b)(i)	Value(s) of *h*, with unit, to nearest mm.	**1**
	Evidence of repeat readings of *h*.	**1**
2(b)(ii)	Percentage uncertainty in *h* based on an absolute uncertainty in the range 0.2–0.8 cm. Correct method of calculation to obtain percentage uncertainty, e.g. (absolute uncertainty × 100 / final value from **(b)(i)**). If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is shown clearly.	**1**
2(c)	Second set of values for *A* and *B*.	**1**
	Second value for *h*.	**1**
	Second value of *h* less than first value of *h*.	**1**
2(d)(i)	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(d)(ii)	Justification for significant figures in *k* linked to significant figures in *x*, *h* and *s*.	**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 Difficulty when measuring *B* with reason e.g. difficult to judge centre of rod **or** difficult to align hole with ruler. C Difficulty when measuring *A* or *C* with reason e.g. parallax error, difficult to hold/maintain ruler vertical. D Difficulty with water jet with a description e.g. too thick, multiple streams, jet spreads out. E Difficulty with judging/marking water level because of needing to look at the rod and water at the same time **or** water level is (quickly) changing. F Difficult to see/mark/judge water level with reason e.g. water is colourless/ribbed bottle. G Difficulty with paper strip e.g. ink on strip can be washed away. *1 mark for each point up to a maximum of 4.*	**4**

Question	Answer	Marks
2(f)(ii)	A Take more readings (for different values of *h*) <u>and</u> plot a graph **or** take more readings <u>and</u> compare *k* values (**not** "repeat readings" on its own). B Use string or measuring tape **or** use a thinner rod **or** use rule(r) with scale starting at end **or** measure horizontal distance and vertical distance and calculate a value for *B*. C Improved method to ensure vertical e.g. use clamped ruler/plumb line/spirit level. D Decrease diameter of hole **or** use a hole with smoother edge. E Improved method to determine water level e.g. record/film/video <u>with scale/ruler in view</u> **or** put cap/cork on bottle top or cover hole at moment jet hits rod. F Use coloured water/smooth bottle. G Use permanent marker/waterproof strip. *1 mark for each point up to a maximum of 4.*	**4**