Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **October/November 2020**

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)	Value of y in range 5.0–50.0 cm.	**1**
1(b)	Six sets of readings of R and y with correct trend and without help from the Supervisor scores 4 marks, five sets scores 3 marks etc.	**4**
	Range: R values must include 100 Ω and 820 Ω.	**1**
	Column headings: Each column heading must contain a quantity, a unit and a separating mark where appropriate The presentation of quantity and unit must conform to accepted scientific convention e.g. $1 / y$ (cm^{-1}).	**1**
	Consistency: All values of raw y must be given to the nearest mm.	**1**
	Significant figures: All values of $1 / y$ should have the same number of s.f. as (or one more than) its corresponding raw y value.	**1**
	Calculation: Values of $1 / y$ 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 *x* and *y* directions. Scales 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 must be plotted on the grid. Diameter of plotted points must be ≤ half a small square. Plots must be accurate to within half a small square in both *x* and *y* directions.	**1**
	Quality: All points in the table must be plotted (at least 5) for this mark to be awarded. Trend must be correct. Scatter of plotted points must be no more than ± 25 Ω from a straight line in the *R* direction.	**1**
1(c)(ii)	Line of best fit: Judge by 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. One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. Lines must not be kinked or thicker than half a square.	**1**
1(c)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. Method of calculation must be correct. Sign of the gradient value must match the gradient of the graph. Both read-offs must be accurate to half a small square in both the *x* and *y* directions.	**1**
	y-intercept: 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. **or** Intercept read directly from the graph, with read-off at *R* = zero accurate to half a small square in *y* direction.	**1**

Question	Answer	Marks
1(d)	Value of *a* equal to candidate's gradient **and** value of *b* equal to candidate's intercept. Values must not be written as fractions.	**1**
	Units for *a* (e.g. $cm^{-1}\,\Omega^{-1}$) and *b* (e.g. cm^{-1}) correct and consistent with values.	**1**
1(e)(i)	*W* to the nearest mm and in the range 88.0–92.0 cm.	**1**
1(e)(ii)	*P* calculated correctly.	**1**

Question	Answer	Marks
2(a)	Value of L to nearest mm and in range 28.0–30.0 cm.	**1**
	Value of H to nearest mm.	**1**
2(b)	Percentage uncertainty based on an absolute uncertainty in H value of 2–5 mm. If repeat readings have been taken, then the absolute uncertainty can be half the range (but not zero) if the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(c)	Raw values of times all to 0.1 s or all to 0.01 s **and** value of T in range 0.90–1.60 s.	**1**
	Repeated readings: at least two values of $5T$ or more.	**1**
2(d)(i)	Second values of L and H.	**1**
2(d)(ii)	Second value of T.	**1**
	Quality: second value of T > first value of T.	**1**
2(e)(i)	Two values of k calculated correctly.	**1**
2(e)(ii)	Justification based on the number of significant figures in <u>all</u> of: raw times, L and H.	**1**
2(e)(iii)	Valid comment relating to the calculated values of k, testing against a criterion specified by the candidate.	**1**
2(f)	Correct calculation of g with consistent unit.	**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 hold ruler in bent position while sticking on the tape. C Tape difficult to handle because of stickiness. D Difficulty measuring *H* (or height) with detail e.g. *H* varies across width of curved ruler/difficulty locating highest point of curved ruler/parallax problem/ruler not vertical/zero not at end of vertical ruler. E Difficulty measuring *T* (or time) with detail e.g. judging complete oscillation/judging start of oscillation/judging end of oscillation. F Difficulty measuring *L* with detail e.g. *L* varies across width of curved ruler/*L* hidden behind tape. G *H* changes when strip is put on top of curved ruler. *1 mark for each point up to a maximum of 4.*	**4**
2(g)(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 Push ruler against stop fixed to bench (when fixing tape). C Hold ruler between clamped blocks (instead of using tape). D Measure *H* using e.g. travelling microscope/set square/ruler with scale starting at end/ruler and set square (or spirit level)/depth gauge on calipers/measure from zero mark to end of ruler and add to reading. E Video (or record or film) with timer in view (or frame-by-frame)/position (fiducial) marker at centre of motion. G Measure *H* with strip in place/use lower mass strip/use stiffer (curved) ruler. *1 mark for each point up to a maximum of 4.*	**4**