Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 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)	Value of T with unit and in the range 1.0–1.5 s.	**1**
	nT measured at least twice with $n \geqslant 5$.	**1**
1(b)	Six sets of readings of m and time with correct trend (T increases as m increases) and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: Values of m include $m \geqslant 400$ g and $m \leqslant 150$ g.	**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. $T / m /$ s kg^{-1} and $1 / m /$ kg^{-1}.	**1**
	Consistency: All raw values of time given to the nearest 0.1 s or all given to the nearest 0.01 s.	**1**
	Significant figures: All values of T / m must be given to the same number of significant figures as (or one more than) the least number of s.f. in the raw time and m.	**1**
	Calculation: Correct calculation of T / m.	**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 are 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 (at least 5) must be plotted on the grid for this mark to be awarded. Trend of the points must be positive. It must be possible to draw a straight line that is within $\pm$ 0.2 kg^{-1} on the 1 / *m* 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 5 points left after the anomalous point is disregarded. Lines must not be kinked or thicker than half a small square.	**1**
1(c)(iii)	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 1 / *m* = 0, accurate to half a small square.	**1**

Question	Answer	Marks
1(d)	Value of P = candidate's gradient **and** value of Q = candidate's intercept. The values must not be fractions.	**1**
	Unit for P: s **and** unit for Q: s kg^{-1}.	**1**

Question	Answer	Marks
2(a)(i)	Value(s) of raw *d* to the nearest 0.01 mm or 0.001 mm with unit **and** final value in the range 0.43–0.49 mm.	**1**
2(a)(ii)	Value of raw *L* to the nearest mm **and** final value in the range 43.0–49.0 cm.	**1**
2(a)(iii)	Percentage uncertainty in *L* based on absolute uncertainty of 2–6 mm. If several readings have been taken, then the absolute uncertainty can be half the range (but not zero) provided the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(a)(iv)	Correct calculation of *C*.	**1**
2(a)(v)	Justification for significant figures in *C* linked to significant figures in *d* and *L*.	**1**
2(b)	Value of θ to the nearest 1° or 0.5° **and** 80 °C $\geqslant \theta \geqslant$ 70 °C.	**1**
	Correct calculation of $\Delta\theta$.	**1**
2(c)(i)	Second value of *d* < first value of *d*.	**1**
	Second value of *L*.	**1**
2(c)(ii)	Second value of *I* with unit.	**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 30% 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 Difficult to measure *L* with a reason e.g. unclear where the junction starts/wire not straight. C Difficulty in reading θ or temperature with a reason e.g. temperature not the same throughout/time lag of thermometer/reading thermometer and ammeter simultaneously. D Difficulty in reading I with reason e.g. readings fluctuate/(variable contact) resistance of wires and clips. E Problem identified with setup e.g. wires came apart at the junctions/wires short-circuiting/keeping second junction away from hot beaker. *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 Method to improve measurement of *L* e.g. tape/glue wire onto ruler. C Use a stirrer to ensure the water temperature is constant throughout/use water bath to control temperature **or** use a digital thermometer (with a lower response time) **or** use video with thermometer and ammeter in view. D Improved method of joining wires e.g. solder. E Method to limit movement of wires e.g. clamp the wires **or** use insulated wire to prevent short circuit. *1 mark for each point up to a maximum of 4.*	**4**