Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 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.

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[Turn over

Question	Answer	Marks
1(a)(i)	Value of C to the nearest mm.	**1**
1(a)(ii)	Value of T with unit and in the range 0.50–1.50 s.	**1**
	At least two measurements of nT where $n \geqslant 5$.	**1**
1(b)	Six sets of readings of C and T (different values) with correct trend (T increases as C increases) and without help from the Supervisor scores 4 marks, five sets scores 3 marks etc.	**4**
	Range: $C_{min} \leqslant 18.0$ cm and $C_{max} \geqslant 35.0$ 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. $1/\sqrt{C}$ / $cm^{-½}$, $1/T$ (s^{-1}).	**1**
	Consistency: All values of raw times must be given to the nearest 0.1 s or all to the nearest 0.01 s.	**1**
	Significant figures: Values of $1/\sqrt{C}$ must be given to the same number of significant figures as, or one greater than, the number of significant figures in C.	**1**
	Calculation: Values of $1/\sqrt{C}$ 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. 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 must be plotted (at least 5) on the grid. Trend of points must be correct. It must be possible to draw a straight line that is within $\pm\ 5.0 \times 10^{-3}\,\text{cm}^{-½}$ ($\pm\ 5.0 \times 10^{-2}\,\text{m}^{-½}$) on the $1 / \sqrt{C}$ axis (normally *x*-axis) of all plotted points.	**1**
1(c)(ii)	Line of best fit: Judge by 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 by the candidate. There must be at least five points left after the anomalous point is disregarded. Lines 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. Method of calculation must be correct, i.e. $\Delta y / \Delta x$. Gradient sign on answer line matches graph drawn. 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 and substituted into $y = mx + c$. Read-off must be accurate to half a small square in both *x* and *y* directions. **or** Intercept read directly from the graph at $x = 0$, 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 must not be written as fractions.	**1**
	Units for a and b correct, e.g. $cm^{½}s^{-1}$ for a and s^{-1} for b.	**1**

Question	Answer	Marks
2(a)(i)	Values of D_1 and D_2 both to nearest mm.	**1**
	Evidence of repeat readings for D_1 and D_2.	**1**
2(a)(ii)	Percentage uncertainty based on an absolute uncertainty 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(b)	All values of h_1 and h_2 to nearest 0.1 mm or all to nearest 0.01 mm.	**1**
	Correct calculation of y.	**1**
2(c)(i)	Values of A and B recorded **and** $A < B$.	**1**
2(c)(ii)	Correct calculation of F.	**1**
2(c)(iii)	Justification for significant figures in F linked to s.f. in B and A.	**1**
2(d)	Second values of D_1, D_2, h_1 and h_2.	**1**
	y smaller for smaller D_2.	**1**
2(e)(i)	Two values of k calculated correctly.	**1**
2(e)(ii)	Valid comment relating to the calculated values of k, testing against a criterion specified by the candidate.	**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 judge/determine whether rod is horizontal. C Difficult to measure *h* with reason e.g. parallax error/wooden block or ring getting in way. D Large percentage uncertainty in *y*. E Difficult to measure *A* or *B* with reason e.g. judging centre of slotted mass when measuring *B*/judging centre of nail for *A* or *B*/parallax error in *A* or *B*/difficult to hold ruler steady when measuring *A* or *B*. (Allow parallax error linked to *h* or *A* or *B* only once.) *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 Improved method to determine if rod horizontal e.g. use a spirit level/use set square(s) with description of method. C Method to reduce error in measuring *h* e.g. use wider rod/move ring to edge of block/use travelling microscope. D Method to reduce percentage uncertainty in *y* e.g. measure change in height at end of rod/use larger mass/increase *B*. E Improved method of measuring *A* or *B* e.g. clamp ruler/method to locate and mark centre of slotted mass e.g. measure diameter and halve to find radius. *1 mark for each point up to a maximum of 4.*	**4**