Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **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)	Final value of L with unit and in the range 9.5–10.5 cm.	**1**
1(b)	Final value of T in the range 0.80–1.20 s.	**1**
1(c)	Five sets of readings of d and time (different values) without help from the Supervisor and with the correct trend (d increases, T increases) scores 5 marks, four sets scores 4 marks etc.	**5**
	Range: Includes $d \leqslant 25.0$ cm and $d \geqslant 40.0$ cm.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of the quantity and the unit must conform to accepted scientific convention e.g. $T/\sqrt{d}$ / s $m^{-½}$.	**1**
	Consistency: Raw values of d must all be given to the nearest mm.	**1**
	Significant figures: All values of $\sqrt{\frac{d-L}{d}}$ must be given to the same number of significant figures as, or one greater than, the least number of number of significant figures in either ($d – L$) or d.	**1**
	Calculation: Correct calculation of $T/\sqrt{d}$ and $\sqrt{\frac{d-L}{d}}$.	**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 *x* and *y* directions. Axes must be labelled with the quantity which 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 ⩽ half a small square. Points must be plotted to an accuracy of half a small square in both the *x* and *y* directions.	**1**
	Quality: All points in the table (at least 4) must be plotted on the grid. Trend of points must be correct. It must be possible to draw a straight line that is within 0.01 on the $\sqrt{\frac{d-L}{d}}$ axis of all plotted points.	**1**
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 4 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 four points left after the 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. 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: Check 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(e)	Value of P = candidate's gradient **and** value of Q = candidate's intercept. Values must not be written as fractions.	**1**
	Unit for P is correct (e.g. s $m^{-½}$) **and** unit for Q is correct (s $m^{-½}$).	**1**

Question	Answer	Marks
2(a)	Final value of H in the range 38.0–42.0 cm.	**1**
2(b)(i)	Value of raw x to the nearest mm.	**1**
	Value of raw θ to the nearest degree and in the range 60°–80°.	**1**
2(b)(ii)	Percentage uncertainty in θ based on absolute uncertainty of 2°–5°. 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)(iii)	Correct calculation of $x \tan \theta$.	**1**
2(b)(iv)	Justification for significant figures in $x \tan \theta$ linked to s.f. in x and θ.	**1**
2(c)	Second value of x.	**1**
	Second value of θ.	**1**
	Second value of θ < first value of θ.	**1**
2(d)(i)	Two values of k calculated correctly. Final values must not be written as fractions.	**1**
2(d)(ii)	Valid comment consistent with calculated values of k, testing against a criterion stated by the candidate.	**1**
2(e)	Correct calculation of M with consistent unit.	**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 *H* with a reason e.g. locating centre of modelling clay/parallax error/locating centre of the hole. C Difficult to measure *H* because the ruler is not long enough. D Difficult to determine if the string is horizontal **or** difficult to set up the string horizontally. E Difficulty measuring θ with reason e.g. parallax error/holding protractor in air/wooden strip moves when knocked by protractor. (Allow parallax error linked to *H* or θ only once.) F The modelling clay falls off. *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 of locating and marking the centre. C Use a half-metre rule or a metre rule. D Use a spirit level/metre rule and set square with detail. E Clamp protractor **or** take a photo and measure angle **or** attach protractor to wooden rod. F Use glue to stick a sphere of clay to end/use a regular shape of mass (instead of the modelling clay). *1 mark for each point up to a maximum of 4.*	**4**