Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **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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[Turn over

Question	Answer	Marks
1(a)	Value(s) of p in the range 9.0–15.0 cm with unit.	**1**
1(b)	Value of m in the range 10.0–14.0 g.	**1**
1(c)	Six sets of readings of m (different values) and p with correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks, etc.	**5**
	Range: $\Delta m \geqslant 80$ g.	**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. m / g, $\sqrt{p}$ / m^{½}.	**1**
	Consistency: All values of p must be given to the nearest mm.	**1**
	Significant figures: All values of $\sqrt{m}$ must be given to the same number of significant figures as, or one greater than, the number of s.f. of the m values as recorded in table.	**1**
	Calculation: Values of $\sqrt{p}$ are correct.	**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. 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 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.	**1**
	Quality: All points in the table must be plotted on the grid. Trend of points must be correct. It must be possible to draw a straight line that is within ±0.1 on the $\sqrt{p}$ 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 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 five points left after the anomalous point is disregarded. Lines must not be kinked or thicker than half a small square.	**1**

Question	Answer	Marks
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, e.g. not $\Delta x / \Delta y$. 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 substituted correctly 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 *x* = zero, accurate to half a small square.	**1**
1(e)	Value of *A* = candidate's gradient **and** value of *B* = candidate's intercept. The values must not be fractions.	**1**
	Unit for *A* correct (e.g. $cm^{0.5}\ g^{-0.5}$ or $cm^{½}\ g^{-½}$) **and** unit for *B* correct (e.g. $cm^{0.5}$ or $cm^{½}$).	**1**

Question	Answer	Marks
2(a)(i)	Value(s) of raw θ to the nearest degree.	**1**
2(a)(ii)	Correct calculation of $\sin\theta$.	**1**
2(a)(iii)	Justification for significant figures in $\sin\theta$ linked to s.f. in θ.	**1**
2(b)(i)	Value of time t in range 0.5–3.0 s.	**1**
	Evidence of repeat values of t.	**1**
2(b)(ii)	Percentage uncertainty based on an absolute uncertainty in t in range 0.2–0.5 s. 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)(i)	Second value of θ recorded.	**1**
	Second value of θ less than 70.0°.	**1**
2(c)(ii)	Second value of t recorded.	**1**
	Second value of t greater than first value of t.	**1**
2(d)(i)	Two values of k calculated correctly. The final k values must not be fractions.	**1**
2(d)(ii)	Valid comment consistent with the calculated values of k, testing against a criterion stated by the candidate.	**1**

Question	Answer	Marks
2(e)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficulty in measuring time *t* with a reason, e.g. time interval is short/percentage uncertainty is large/difficult to release shape and start stop-watch simultaneously/difficult to judge when to stop timing. C Difficulty linked to the practical set up of the board, e.g. holding with one clamp, board is not square to bench/board is not stable/board tilts to side. D Difficulty linked to release, e.g. force applied varies/starting position may vary/adhesive putty sticks (affects friction). E Difficulty with the angle with reason, e.g. setting or adjusting the angle when changing the clamp/difficult to make fine adjustments to the angle. *1 mark for each point up to a maximum of 4.*	**4**
2(e)(ii)	A Take more readings and plot a graph or take more readings and compare *k* values (**not** "repeat readings" on its own). B Improved method to measure *t*, e.g. timer and pressure/contact switch at release point and/or at bottom or video with timer/frame-by-frame. C Improved method to support board, e.g. use more than one clamp/clamp both sides/support with a block. D Improved method of release, e.g. use of a stop/use of a card gate. E Improved method to make fine adjustments to angle, e.g. scissor jack/use of screw thread on a clamp. *1 mark for each point up to a maximum of 4.*	**4**