Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/33**

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)	Values of raw diameter either all recorded to 0.01 cm or all to 0.001 cm **and** final value in range 1.00–10.00 cm.	**1**
	Evidence of repeat measurements.	**1**
1(b)	p in range 15.0 cm $\leqslant p \leqslant$ 19.0 cm **and** F in range 1.0 N $\leqslant F \leqslant$ 5.0 N.	**1**
1(c)	Six (or more) sets of readings of p and F (different values of non-zero p) with the correct trend and without help from the Supervisor scores 3 marks, five sets scores 2 marks, etc.	**3**
	Range: Must include values of $p \leqslant$ 8.0 cm and $p \geqslant$ 42.0 cm.	**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. ($p + r$) / cm	**1**
	Consistency: All raw values of p must be given to the nearest 0.1 cm.	**1**
	Consistency: All raw values of F must be given to the nearest 0.1 N.	**1**
	Calculation: Values of ($p + r$) 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 (at least 5) must be plotted on the grid. Trend of points must be correct. It must be possible to draw a straight line that is within ±0.20 N (to scale) on the *F* axis (normally *y*-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 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(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 Δx / Δy. 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 $p + r =$ zero, accurate to half a small square.	**1**

Question	Answer	Marks
1(e)	$Q = \frac{W}{\text{gradient}} = \frac{3.00}{\text{gradient}}$	**1**
	$S = Q \times y\text{-intercept} = \frac{3.00 \times y\text{-intercept}}{\text{gradient}}$	**1**
	Units for Q and S correct (e.g. m and N m).	**1**

Question	Answer	Marks
2(a)(i)	Raw L to the nearest 0.1 cm **and** final value in the range 11.5–12.5 cm.	**1**
2(a)(ii)	Percentage uncertainty based on an absolute uncertainty ΔL in the range 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)(i)	All raw times measured either to the nearest 0.1 s or all to the nearest 0.01 s.	**1**
	Evidence of measurement of nT repeated where $n \geqslant 5$.	**1**
	Value of T in the range $0.5\,\text{s} \leqslant T \leqslant 1.0\,\text{s}$.	**1**
2(b)(ii)	Calculation of T^2 correct.	**1**
2(b)(iii)	Justification of the number of significant figures in terms of the number of s.f. in (raw) time only.	**1**
2(c)	Second values of L and T.	**1**
	Second value of T < 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**
2(e)	Correct calculation of g using candidate's second k **and** in range $2.0\,\text{m s}^{-2} \leqslant g \leqslant 20.0\,\text{m s}^{-2}$.	**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 Difficulty in measuring time or *T* with a reason, e.g. judging when to start or stop the stop-watch, judging start/end/complete oscillation. C Difficulty in measuring *L* with a reason, e.g. wire is not straight/is kinked/has rounded corners. D Corners are not at right angles **or** square not complete/joined **or** shape changes when suspended/during oscillation. E Oscillations are not in one plane **or** square catches on drawing pin. *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 improving time or *T*, e.g. fiducial marker at centre/video (or record or film) <u>and</u> timer (or frame-by-frame)/place a grid behind the apparatus. C Method of improving *L*, e.g. use thicker/stiffer wire or use a former/shaping block. D Method of improving the setting of 90° corners, e.g. use a set square or protractor with appropriate reason **or** method of fixing ends, e.g. use adhesive putty/tape with appropriate reason. E Method of improving oscillation, e.g. longer pin/use of guide with detail/groove in pin/use a nail/use a hook. *1 mark for each point up to a maximum of 4.*	**4**