Cambridge International AS & A Level

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PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)	Value of L with unit to the nearest mm in the range 2.5–3.5 cm.	**1**
1(c)	Value of T with unit in the range 0.7 s to 1.5 s.	**1**
	Evidence of repeated timings. Must see nT repeated where $n \geqslant 5$.	**1**
1(d)	Six sets of readings of n (different values) and time with correct trend and without help from Supervisor scores 4 marks, five sets scores 3 marks etc.	**4**
	Range of $n \geqslant 9$.	**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 / s. No unit for n or $\sqrt{n}$.	**1**
	Consistency: All values of raw time must be given to either 0.1 s or 0.01 s.	**1**
	Significant figures: All values of $\sqrt{n}$ must be given to 3 significant figures.	**1**
1(e)(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 must be plotted on the grid. Diameter of plotted points must be $\leqslant$ half a small square (no “blobs”). Points must be plotted to an accuracy of half a small square.	**1**
	Quality: All points in the table must be plotted for this mark to be awarded. It must be possible to draw a straight line that is within ± 0.10 on the $\sqrt{n}$ axis of all plotted points.	**1**

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Question	Answer	Marks
1(e)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5). 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**
1(e)(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. Do not allow $\Delta x / \Delta y$. Both read-offs must be accurate to half a small square in both 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 $x = 0$, accurate to half a small square in y direction.	**1**
1(f)	Value of P = candidate's gradient **and** value of Q = candidate's intercept. The values must not be fractions.	**1**
	Units for P and Q both s.	**1**
1(g)	Correct calculation of $g = L\pi^2 / P^2$ with consistent unit.	**1**

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Question	Answer	Marks
2(a)	Value(s) of A with unit in the range 97.5–99.5 cm.	**1**
2(b)(ii)	Values of all raw x to nearest mm.	**1**
2(c)(iii)	Value of $y > x$.	**1**
2(c)(iv)	Correct calculation of $(y – x)$.	**1**
2(c)(v)	Percentage uncertainty in $(y – x)$ based on absolute uncertainty of 2–5 mm. If repeated readings have been taken, then the 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(d)(i)	Correct calculation of $m(A – 2y)$.	**1**
2(d)(ii)	Justification for s.f. in $m(A – 2y)$ linked to s.f. in A, y and m **or** $(A – 2y)$ and m.	**1**
2(e)(i)	Second value of y.	**1**
	Quality: second value of $y >$ first value of y.	**1**
2(f)(i)	Two values of k calculated correctly.	**1**
2(f)(ii)	Valid comment consistent with calculated values of k, testing against a criterion specified by the candidate.	**1**
2(g)	Correct calculation of $M = 1/k – B$.	**1**

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Question	Answer	Marks
2(h)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to measure *x* or *y* <u>with reason</u> e.g. markings on rule obscured because of thickness of string/twist in string/ruler oscillating/ruler swinging/rule slides in loop/string not vertical. C Large (%) uncertainty in $(y - x)$ **or** $(y - x)$ is small. D Little difference in *y* values. E Difficult to balance rule. *1 mark for each point up to a maximum of 4.*	**4**
2(h)(ii)	A Take more readings <u>and</u> plot a graph/take more readings <u>and</u> compare *k* values (**not** "repeat readings" on its own). B Use thinner string/tie a knot in loop/use two loops/use a hook/use longer loop/string. C Heavier (added/slotted) masses (**not** heavier hangers). D Use wider range of (added) masses. E Suspend rule from its top edge/balance on fulcrum/use thicker string with reason such as <u>to make easier to balance/prevent rule from slipping</u>. *1 mark for each point up to a maximum of 4.*	**4**

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