Cambridge International AS & A Level

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PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)(v)	Value of T in the range 0.10–0.90 s.	**1**
	Evidence of repeated readings. Must see nT repeated where $n \geqslant 5$.	**1**
1(b)	Six sets of readings of M, h and T showing the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $M_{max} \geqslant 450$ g **and** $M_{min} \leqslant 200$ g.	**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^3 / s^3.	**1**
	Consistency: All values of h must be given to the nearest mm.	**1**
	Significant figures: Significant figures for every value of T^3 must be the same as (or one greater than) the s.f. of raw times as recorded in table.	**1**
	Calculation: Values of T^3 calculated correctly.	**1**
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. 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 (at least 5) for this mark to be awarded. It must be possible to draw a straight line that is within ± 1.0 cm (to scale) of all the plotted points in the h direction.	**1**

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Question	Answer	Marks
1(c)(ii)	Line of best fit: Judge by balance of all points on the grid (at least 5) about the candidate's line. 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 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. Do not allow $\Delta x / \Delta y$. 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 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 $h = 0$, accurate to half a small square in y direction.	**1**
1(d)	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. $s^3 cm^{-1}$). Unit for b is s^3.	**1**

Question	Answer	Marks
2(a)	Value for x_0 to nearest 0.1 cm.	**1**
2(b)(ii)	x greater than x_0.	**1**
2(b)(iii)	Raw θ in range 91–110° and recorded to nearest degree.	**1**
2(b)(v)	Absolute uncertainty in (ϕ – 90°) of 2–5° and correct method of calculation to obtain percentage uncertainty. If repeated readings of ϕ have been taken, then the absolute uncertainty can be half the range (but not zero) only if working shown clearly.	**1**
2(c)(ii)	Second value of x.	**1**
	Second value of ϕ.	**1**
	Quality: second value of $\phi \geqslant$ first value of ϕ.	**1**
2(d)(i)	Two values of k calculated correctly.	**1**
2(d)(ii)	Justification for s.f. in k linked to s.f. in θ, x and x_0.	**1**
2(d)(iii)	Valid comment consistent with calculated values of k, testing against a criterion specified by the candidate.	**1**
2(e)(ii)	Raw value(s) of D **and** d recorded to the nearest 0.1 cm.	**1**
2(e)(iv)	Value of ρ calculated correctly.	**1**

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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 get/adjust wooden strip so that it is horizontal/parallel to bench. C Difficulty when measuring x (or x_0), with reason e.g. parallax error/thickness of string/difficult to judge centre of nail. D Difficult to measure angle with reason, e.g. parallax error/hard to hold protractor steady/hard not to touch wooden strip/difficult to align protractor correctly. (*Do not credit parallax error twice for both C and D.*) E Large (percentage) uncertainty in (ϕ – 90°) **or** (ϕ – 90°) is small. F Difficult to measure D (or d) with reason linked to use of ruler. *1 mark for each point up to a maximum of 4.*	**4**
2(f)(ii)	A Take more readings and plot a graph/take more readings and compare k values (**not** "repeat readings" on its own). B Use thinner nail/fulcrum/prism. C Mark a scale on the wooden strip/use a thinner string. D Hold protractor in a clamp/ take photograph and measure angle on photo/ trigonometric method with detail e.g. measure height(s) of end(s) of wooden strip E Method to increase (ϕ – 90°) e.g. more paper clips/larger values of x/move pipe and pivot closer. F Use vernier/digital calipers/travelling microscope. *1 mark for each point up to a maximum of 4.*	**4**

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