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PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **March 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)(iii)	Values of l_1 and l_2, both with units, and $l_2 > l_1$	**1**
1(b)(iii)	Value of m in range 30 to 70 g, with unit.	**1**
1(c)	Six sets of readings of l_1, l_2 and m with correct trend and without help scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $m_{max} \geqslant 80.0$ g and $m_{min} \leqslant 30.0$ 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. $(l_2 - l_1)$ / mm.	**1**
	Consistency: All values of l_1 and l_2 must be given to the nearest mm.	**1**
1(d)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10). 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 which is being plotted. Scale markings should be no more than 3 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). Plots must be accurate to within half a small square in both x and y directions.	**1**
	Quality: All points in the table must be plotted (at least 5) for this mark to be awarded. Scatter of points must be no more than ± 10.0 g in the m direction from a straight line.	**1**

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Question	Answer	Marks
1(d)(ii)	Line of best fit: Judged 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. One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. 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. Both read-offs must be accurate to half a small square in both the x and y directions.	**1**
	y-intercept: **Either** Correct read-off from a point on the line substituted into $y = mx + c$ or an equivalent expression, with 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 in y direction.	**1**
1(e)	Value of a equal to candidate's gradient. Value of b equal to candidate's intercept. The values must not be fractions and must be to at least 2 sig. fig.	**1**
	Unit for a is dimensionally correct. Unit for b is dimensionally correct.	**1**
1(f)	k calculated correctly.	**1**
	k given to 2 or 3 s.f.	**1**
	Total:	**20**

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Question	Answer	Marks
2(a)(ii)	All raw values of *D* to nearest 0.1 cm.	**1**
	Evidence of repeat readings.	**1**
2(b)(ii)	Correct calculation of *W.*	**1**
2(b)(iii)	Justification for s.f. in *W* linked to s.f. in *m* and *g.*	**1**
2(c)(iii)	Raw values of *F* to nearest 0.1 N.	**1**
	Evidence of repeat readings of *F.*	**1**
2(d)	Absolute uncertainty in *F* of 0.2 to 0.5 N and correct method of calculation to obtain percentage uncertainty. If repeated readings have been taken, then the absolute uncertainty can be half the range (but not zero if values are equal).	**1**
2(e)	*D* for second pipe.	**1**
	F for second pipe.	**1**
	Quality: Both $F > 3$ N and < 10 N.	**1**
2(f)(i)	Two values of *k* calculated correctly.	**1**
2(f)(ii)	Sensible comment relating to the calculated values of *k*, testing against a criterion specified by the candidate.	**1**

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Question	Answer	Marks
2(g)(i)	Two readings are not enough to draw a valid conclusion. Difficult to measure diameter with reason, e.g. diameter varies / e.g. ends not square. Large uncertainty in *D*. Difficult to pull hook down steadily. Difficult to estimate average force during movement / *F* changes during movement. Newton-meter collides with mass / observation time too short. String slides off pipe / slides down pipe. *1 mark for each point up to a maximum of 4.*	**4**
2(g)(ii)	Take more readings and plot a graph / calculate more *k* values and compare. Use (vernier) calliper / measure between two blocks / use micrometer. Improved pulling method to give constant speed, e.g. use a motor / e.g. use a known weight. Record images (or video) of the reading (or measurement) and play back. Use longer string with taller stand. Use two stands / support pipe on rod / use spirit level to ensure pipe is horizontal / use groove around pipe (to guide string). *1 mark for each point up to a maximum of 4.*	**4**
	Total:	**20**

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