Cambridge International AS & A Level

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PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

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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Question	Answer	Marks
1(b)(ii)	Value of a with unit and in the range 5.00–60.00 s.	**1**
1(b)(iv)	Evidence of repeated readings.	**1**
1(c)	Six sets of readings of m (different values), a and b showing the correct trend (as m increases, a and b also increase) and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: Values of m must include 10 g and 70 g.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of the quantity and unit must conform to accepted scientific convention e.g. a^2 / b / s.	**1**
	Consistency: All raw values of time must be given to 0.1 s or all to 0.01 s.	**1**
	Significant figures: All values of a^2 / b must be given to the same number of s.f. as (or one more than) the number of s.f. in raw values of time. If raw times recorded to nearest 0.01 s, allow number of significant figures of a^2 / b to be one less than the number of significant figures of the raw times.	**1**
	Values of a^2 / b calculated correctly.	**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 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 on the grid for this mark to be awarded. It must be possible to draw a straight line that is within 10 g on the mass axis (*x*-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). 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 should be greater than half the length of the drawn line. The 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: Correct read-off from a point on the line substituted into $y = mx + c$. Read-off must be 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 the *y* direction.	**1**
1(e)	Value of *P* = candidate's gradient **and** value of *Q* = candidate's intercept. The values must not be fractions.	**1**
	Unit for *P* correct ($s\,g^{-1}$ or $s\,kg^{-1}$) **and** unit for *Q* correct (s).	**1**

Question	Answer	Marks
2(a)(ii)	Value of c in the range 95.0–100.0 cm.	**1**
2(c)(ii)	Value of x in the range 75.0–85.0 cm.	**1**
2(c)(iv)	Value(s) of raw z to the nearest mm.	**1**
2(d)	Percentage uncertainty in z 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(e)(i)	Correct calculation of $(x - c / 2)$.	**1**
2(e)(ii)	Correct calculation of $(z - y) / m$ and consistent unit e.g. cm kg^{-1}.	**1**
2(f)	Justification for s.f. in $(z - y) / m$ linked to s.f. in z, y and m **or** $(z - y)$ and m.	**1**
2(g)(ii)	Second value of x.	**1**
	Second value of z.	**1**
	Quality: second value of z greater than first value of z (provided m in **(g)** > **(c)**).	**1**
2(h)(i)	Two values of k calculated correctly.	**1**
2(h)(ii)	Valid comment consistent with calculated values of k, testing against a criterion stated by the candidate.	**1**

Question	Answer	Marks
2(i)(i)	A Two readings/too few readings/only two readings not enough to draw a (valid) conclusion. B Difficult to read *x*/*c* on rule owing to thickness of string. C Difficult to measure *y*/*z*/spring with reason e.g. parallax, difficult to judge where end of coiled section is/easy to knock/difficult to hold ruler still. D Difficult to judge/adjust rule to be parallel to bench/horizontal (**not** 'rule is not parallel to bench'). E Large percentage uncertainty in ($z - y$). *1 mark for each point up to a maximum of 4.*	**4**
2(i)(ii)	A Take more readings (for different added masses) and plot a graph/take more values of *k* and compare. B Use thread/wire/thin(ner) string or any other valid method. C Use clamped ruler/use pointer(s) on rule or spring/use (vernier) calipers. D Use a (spirit) level/use ruler and set square with detail. E Larger difference between masses/larger *x* value/springs with smaller spring constant. *1 mark for each point up to a maximum of 4.*	**4**