Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/31**

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

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(b)	Value of θ in range 80–100° with unit.	**1**
1(c)	Value of T in range 0.80–2.00 s with unit.	**1**
1(d)	Six sets of readings of θ (different values) and time showing the correct trend (T increases as θ decreases) and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $\theta \geqslant 120°$ **and** $\theta \leqslant 60°$.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of the quantity and the unit must conform to accepted scientific convention e.g. T^2 / s^2 and θ / °. No unit for cos (θ / 2).	**1**
	Consistency: All raw values of time must be given to the nearest 0.1 s or all to the nearest 0.01 s.	**1**
	Significant figures: All values of T^2 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 s.f. of T^2 to be one less than the number of s.f. of the raw times.	**1**
	Values of cos (θ / 2) calculated correctly.	**1**

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Question	Answer	Marks
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 (at least 5) must be plotted on the grid for this mark to be awarded. It must be possible to draw a straight line that is within 0.05 on the cos (θ/2) axis (*x*-axis) of all plotted points.	**1**
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 should be greater than half the length of the drawn line. Both read-offs must be accurate to half a small square in both the *x* and *y* directions. The method of calculation must be correct.	**1**
	y-intercept: Check correct read-off from a point on the line and 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**

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Question	Answer	Marks
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* correct (s^2).	**1**

Question	Answer	Marks
2(a)	Value of *t* in the range 2–9 mm, *t* to the nearest 0.01 cm or 0.001 cm.	**1**
2(b)(i)	Value of *d* to the nearest 0.1 cm or better.	**1**
2(c)(ii)	Value of *h* with unit.	**1**
2(c)(iii)	Correct calculation of *V* with consistent unit.	**1**
2(c)(iv)	Justification for s.f. in *V* linked to s.f. in (d – 2t) and *h*. Allow *d*, *t* and *h* or allow *d* and *h.*	**1**
2(e)(v)	Value of *y* with evidence of repeats.	**1**
2(f)	Percentage uncertainty in *y* based on absolute uncertainty of 2–8 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(g)	Second value of *h*.	**1**
	Second value of *y*.	**1**
	Quality: second value of *y* less than first value of *y.*	**1**

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Question	Answer	Marks
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**
2(i)(i)	A Two readings/too few readings/only two readings <u>not enough to draw a (valid) conclusion</u>. B Difficult to measure *t* with reason e.g. screw thread in way, curved surface, thickness not the same throughout the glass. C Inaccurate *V* with reason e.g. non-cylindrical shape of jar/equation gives an approximate value. D Difficult to judge correct position of nails. E Difficult to measure *y* with reason e.g. holding the nail and ruler in position. *1 mark for each point up to a maximum of 4.*	**4**
2(i)(ii)	A Take more readings (for different volumes) <u>and</u> plot a graph/take more values of *k* <u>and</u> compare. B Improved method of measuring *t* directly e.g. travelling microscope. C Improved method of measuring volume e.g. fill with water and use a measuring cylinder/measure circumference with string to calculate diameter to put into equation for volume. D Use optical pins/thinner nails. E Have scale on side of jar/place both nails on lab jacks/use marker pen instead of nails/clamp ruler/use a marker to mark position of nail. *1 mark for each point up to a maximum of 4.*	**4**

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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**

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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**

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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**

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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**

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PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2017**

MARK SCHEME

Maximum Mark: 40

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Question	Answer	Marks
1(b)(ii)	Value of T with unit in range 1.00–2.00 s.	**1**
	Evidence of repeated readings of nT.	**1**
1(c)	Six sets of readings of m (different values) and T with correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: m_{min} = 50 g **and** $m_{max} \geqslant$ 350 g.	**1**
	Column headings: Each column heading must contain a quantity and a unit. The presentation of quantity and unit must conform to accepted scientific convention e.g. T^2 / s^2.	**1**
	Consistency: All values of time must be given to the nearest 0.1 s or all values to the nearest 0.01 s.	**1**
	Significant figures: Significant figures of every value of T^2 must be the same as, or one greater than, the s.f. of the raw times as recorded in table. If raw times recorded to nearest 0.01 s, allow number of significant figures of T^2 to be one less than the number of significant figures of the raw times.	**1**
	Values of T^2 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 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 ±25 g from a straight line in the *m* direction (*x*-axis).	**1**
1(d)(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. 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. 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 $y = mx + c$ or an equivalent expression. 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 accurate to half a small square in the *y* direction.	**1**
1(e)	Value of a = candidate's gradient **and** value of b = candidate's intercept. The values must not be fractions.	**1**
	Correct units for a (e.g. $s^2\ g^{-1}$) **and** b (s^2).	**1**

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Question	Answer	Marks
2(b)(iii)	Value of *u* with unit in range 30.0–34.0 cm.	**1**
2(b)(v)	(Raw) value(s) of *v* to nearest 0.1 cm.	**1**
2(c)	Absolute uncertainty in *v* in range 0.2–0.8 cm and correct method of calculation to obtain percentage uncertainty. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.	**1**
2(d)	Correct calculation of *f*.	**1**
2(e)(iii)	Value of v_w.	**1**
	Quality: $v_w > v$.	**1**
2(f)	Justification for s.f. in f_w linked to s.f. in *u* and v_w.	**1**
2(g)(ii)	Second value of *u* in range 20.0–24.0 cm.	**1**
	Second value of *v*.	**1**
	Quality: second value of v_w > first value of v_w.	**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**

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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 judge/obtain sharp image/hard to focus. C Difficult to keep screen steady/vertical (to measure *v*) **or** difficult to hold screen and measure distance (at the same time). D Difficult to measure *u* (or *v*) with reason e.g. parallax error/judging front of torch/judging centre of lens. E LEDs not at the front of torch/*u* should be measured to the LEDs. F Difficult to align torch, lens and screen **or** torch and lens at different heights **or** lens not vertical. *1 mark for each point up to a maximum of 4.*	**4**
2(i)(ii)	A Take more readings and plot a graph/calculate more *k* values and compare. B Use dark(ened) room/turn off lights **or** use improved 'object' e.g. cross-hairs/filament lamp/smaller LEDs. C Mount screen in holder/clamp screen **or** clamp ruler/fix ruler to bench. D Make alignment mark on container **or** use set squares with explanation of use. E Use LEDs outside the torch/remove glass from torch. F Use optical bench **or** draw line/scale/grid on bench **or** use lens holder to keep lens vertical. *1 mark for each point up to a maximum of 4.*	**4**

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Question	Answer	Marks
1(a)(iii)	Value of raw *V* with unit in the range 0.50–2.00 V and to nearest 0.01 V.	**1**
1(b)(iv)	Values of *p* and *q* with consistent unit, *q* > *p* and both values < 1 m.	**1**
1(c)	Six sets of readings of *R* (different values), *p* and *q* with correct trend (as *R* increases, *q* decreases) and without help from Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: Values of *R* include 10 Ω and 33 Ω.	**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. *q* / cm, *q* / *R* (cm / Ω), *q* / *R* (cm Ω^{-1}). No unit given for *q* / *p*.	**1**
	Consistency: All values of *p* and *q* must be given to the nearest mm.	**1**
	Significant figures: All values of *q* / *R* must be given to 2 or 3 s.f.	**1**
	Calculation: Values of *q* / *p* 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 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 ± 0.10 on the q/p 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 (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**

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Question	Answer	Marks
1(d)(iii)	Gradient: Gradient sign on answer line matches graph drawn. 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: 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 the *y* direction.	**1**
1(e)	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. $\Omega\,m^{-1}$ or $\Omega\,cm^{-1}$ or $\Omega\,mm^{-1}$ or Ω / m etc.) **and** *b* stated without a unit.	**1**

Question	Answer	Marks
2(a)	Value of *L* with unit and *L* < 50.0 cm.	**1**
2(b)(ii)	All value(s) of raw *x* to nearest mm with unit.	**1**
	Repeat values of *x*.	**1**
2(b)(iii)	Percentage uncertainty in *x* based on absolute uncertainty in *x* in range 2–8 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(b)(iv)	Correct calculation of *G* where *x* and *L* have the <u>same</u> unit.	**1**
2(b)(v)	Justification for s.f. in *G* linked to s.f. in *L* and *x*, or *L* and (2*x* – *L*).	**1**
2(c)(ii)	Value of *T* with unit in range 0.8–2.0 s.	**1**
2(d)	Second values of *L* and *x*.	**1**
	Second value of *T*.	**1**
	Quality: second value of *T* < first value of *T*.	**1**
2(e)(i)	Two values of *k* calculated correctly.	**1**
2(e)(ii)	Valid comment consistent with calculated values of *k*, testing against a criterion stated by the candidate.	**1**

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Question	Answer	Marks
2(f)(i)	A Two readings are <u>not enough to draw a conclusion</u>. B <u>Difficult to measure *x*</u> with a reason e.g. holding ruler <u>and</u> pulling down on loop at the same time/holding string and rule/measuring at an angle/holding rule steady/stands move or tilt when loop pulled/judging end points. C Difficulty linked to the length of the pendulum e.g. knot slips/tying a knot/measuring to the centre of the bob. D Difficult to measure *L* with a reason e.g. finger gets in the way/thickness of string. E Difficulty linked to oscillation e.g. strings on rods move/stands move as the pendulum oscillates **or** difficult to judge the end of an oscillation. *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/take more readings <u>and</u> compare *k* values. B Improved method to measure *x* e.g. clamp rule/clamp stands/hang mass on loop. C Use glue (not knots)/mark the string/attach hook or loop to pendulum/measure string and add radius to length. D Improved method to measure *L* e.g. use pins/nails/tape to table. E Clamp stands/use tape to fix strings to rods/idea of a groove **or** film/video camera with timer/frame by frame/marker at centre of oscillation. (Do not award 'clamp stands' twice for both B and E.) *1 mark for each point up to a maximum of 4.*	**4**

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PHYSICS **9702/36**

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Question	Answer	Marks
1(c)(ii)	T with unit in range 0.1–1.0 s.	**1**
	Evidence of repeated readings of nT where n = 5 or more.	**1**
1(e)	Six sets of readings of x and T showing the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $0 \leqslant (x - L/2)_{min} \leqslant 1.0$ cm.	**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. $1/T^2$ / s^{-2}.	**1**
	Consistency: All values of x must be given to the nearest mm.	**1**
	Significant figures: Significant figures for every value of $1/T^2$ same as, or one greater than, the s.f. of raw time as recorded in table. If raw times recorded to nearest 0.01 s, allow number of significant figures of $1/T^2$ to be one less than the number of significant figures of the raw times.	**1**
	Values of $(x - L/2)$ calculated correctly.	**1**

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Question	Answer	Marks
1(f)(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 ⩽ half a small square (no "blobs"). Points 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 ± 0.25 cm from a straight line in the ($x - L / 2$) direction.	**1**
1(f)(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. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. Lines must not be kinked or thicker than half a square.	**1**
1(f)(iii)	Gradient: The hypotenuse of the triangle used must 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(g)	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. $cm^{-1}s^{-2}$) **and** unit for *b* correct (e.g. s^{-2}).	**1**

Question	Answer	Marks
2(a)(iv)	Value of D with unit to nearest mm and in range 10.0–150.0 cm.	**1**
2(b)(ii)	Value of h_1 with consistent unit and in range 6.0–10.0 cm.	**1**
2(c)	Absolute uncertainty in h_1 of 1 mm and correct method of calculation to obtain percentage uncertainty. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.	**1**
2(d)(ii)	Correct calculation of d.	**1**
2(f)(ii)	Values of t and w to nearest mm, with unit.	**1**
2(f)(iii)	Correct calculation of E.	**1**
2(g)	Second values of h_1 and h_2.	**1**
	Quality: Second value of d < first value of d.	**1**
	Second values of h_3 and h_4.	**1**
2(h)(i)	Two values of k calculated correctly.	**1**
2(h)(ii)	Justification for s.f. in k linked to s.f. in d and p, or linked to s.f. in h_1, h_2, h_3 and h_4.	**1**
2(h)(iii)	Valid comment relating to the calculated values of k, testing against a criterion stated by the candidate.	**1**

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Question	Answer	Marks
2(i)(i)	A Two readings/too few readings/only two readings <u>not enough to draw a (valid) conclusion</u>. B Difficult to pile masses in centre, with reason. C Blocks move/slip/tilt. D *d* (or *p* or *t*) small so large uncertainty/ large % uncertainty in *d* (or *p* or *t*). E Permanent deformation of strip. F Difficult to mark ends of *D* due to curvature of masses. *1 mark for each point up to a maximum of 4.*	**4**
2(i)(ii)	A Take more readings <u>and</u> plot a graph/calculate more *k* values and <u>compare</u>. B Improved method for point load, e.g. suspend masses below strip/named method for sticking masses together. C Named means of stabilising blocks, e.g. stick to bench/stick to strip/stops on bench/clamp blocks to bench. D Use calipers or travelling microscope **or** use micrometer for <u>*t* value</u> **or** measure stack of MDF pieces. E Use 8 masses before 10 **or** turn strip over. F Use set square <u>with detail</u>/measure length of 10 masses then mark strip. *1 mark for each point up to a maximum of 4.*	**4**

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