
PHYSICS**9702/33**

Paper 3 Advanced Practical Skills 1

May/June 2018

MARK SCHEME

Maximum Mark: 40

Published

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**Cambridge Assessment**
International Education

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Question	Answer	Marks
1(a)	Values of V_1 and V_2 with units and to the nearest 0.01 V.	1
	$ V_2 > V_1 $.	1
1(b)	Six sets of readings of x , V_1 and V_2 (different values) showing the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	5
	Range: $x_{\min} \leq 10.0 \text{ cm}$ and $x_{\max} \geq 70.0 \text{ cm}$.	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. $(V_1/x)/\text{Vm}^{-1}$.	1
	Consistency: All values of x must be given to the nearest mm.	1
	Significant figures: All values of V_1/x must be given to 2 or 3 s.f.	1
	Calculation: Values of V_1/x are correct.	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 in the table must be plotted on the grid. Diameter of plotted points must be $\leq$ 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 0.040 on the $(V_2 - V_1)$ axis of all plotted points.	1

Question	Answer	Marks
1(c)(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 by the candidate. Line must not be kinked or thicker than half a small square.	1
1(c)(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. 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. Sign of gradient must match graph.	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.	1
1(d)	Value of P = candidate's gradient and value of Q = candidate's intercept. The values must not be fractions.	1
	Unit for P correct (e.g. m or cm or mm) and unit of Q correct (e.g. V) unless zero.	1

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Question	Answer	Marks
2(a)	Value of L to the nearest mm with unit and in range 50.0–60.0 cm.	1
2(b)(i)	Value of A to the nearest degree with unit and in the range 11–17°.	1
2(b)(ii)	Percentage uncertainty in A based on absolute uncertainty of 2°–5°. 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(c)(i)	Value of T in the range 1.20–1.60 s with unit.	1
	Evidence of at least two sets of nT where $n \geq 5$.	1
2(c)(ii)	Correct calculation of d .	1
2(c)(iii)	Justification for s.f. in d linked to s.f. in A (or measured angle).	1
2(d)	Second value of A .	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 specified by the candidate.	1

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 measure L with reason e.g. locating centre of bob/parallax/bob or cork gets in the way of the ruler. C Difficult to measure A or 45° or angle with a reason e.g. no indication of vertical/hard to hold and measure from protractor/hard to hold protractor steady/string too thick/parallax error. D Problem with bob moving between setting and releasing. E Difficulty setting rod at $L/2$ with reason e.g. setting rod and angle at the same time/rod moves when tightening the clamp/rod moves when pendulum hits. F Difficulty in judging start/end of oscillation. <i>1 mark for each point up to a maximum of 4.</i>	4
2(f)(ii)	A Take many readings (for different values of A) <u>and</u> plot a graph or take more values of k <u>and</u> compare (not “repeat readings” on its own). B Improved method of measuring L e.g. measure diameter and add on (or take away) radius from length of string from cork to top (bottom) of bob, or e.g. clear use of pointer(s). C Improved method of measuring angle e.g. use a plumb line/clamp protractor/use thinner string, or e.g. shadow projection ideas/photograph and measure angle. D Improved mechanism of releasing the bob e.g. clamp bob/use a card gate/add a stop. E Mark string. F Method of improving timing e.g. put a marker anywhere except at the ends/video with timer (or replay frame by frame). <i>1 mark for each point up to a maximum of 4.</i>	4

PHYSICS**9702/34**

Paper 3 Advanced Practical Skills 2

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Question	Answer	Marks
1(a)	Value of V_s in range 2.00–4.00 V, with unit.	1
1(b)	Value of V less than V_s .	1
	Evidence of repeat readings of V .	1
1(c)	Six sets of readings of n and V with the correct trend and without help from the Supervisor scores 4 marks, five sets scores 3 marks, etc.	4
	Range: $n_{\min} = 1$ or 0 and $n_{\max} \geq 7$.	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. $(1/V)/V^{-1}$ or $1/V (V^{-1})$.	1
	Consistency: All raw values of V must be given to 0.01 V, without trailing zeros.	1
	Significant figures: Significant figures for every value of $1/V$ the same as, or one greater than, the s.f. of V as recorded in the table.	1
	Calculation: Values of $1/V$ calculated correctly.	1
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 in the table must be plotted on the grid. Diameter of plotted points must be $\leq$ half a small square (no “blobs”). Points must be plotted to an accuracy of 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 $\pm 0.025V^{-1}$ from a straight line in the $1/V$ direction.	1

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Question	Answer	Marks
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid 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 by the candidate. There must be at least 5 points left after the anomalous point is disregarded. Line must not be kinked or thicker than half a small square.	1
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. 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. Sign of gradient must match graph.	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 at $n = 0$, accurate to half a small square in the y direction.	1
1(e)	Value of a equal to candidate's gradient and value of b equal to candidate's intercept.	1
	Unit for a is V^{-1} and unit for b is V^{-1} .	1

Question	Answer	Marks
2(a)	Correct calculation of M .	1
2(b)(i)	Value for T in range 0.50–1.00 s, with unit.	1
	Evidence of repeat readings of time, with at least two sets of nT where $n \geq 5$.	1
2(b)(ii)	Absolute uncertainty in time measurement of 0.20–0.50 s 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 the working is clearly shown.	1
2(c)(i)	Second value of M .	1
2(c)(ii)	Second value of T .	1
	Quality: T greater for greater M .	1
2(d)(i)	Two values of k calculated correctly.	1
2(d)(ii)	Valid comment relating to the calculated values of k , testing against a criterion specified by the candidate.	1
2(e)(i)	Value(s) for D to nearest mm and value for D (on answer line) in range 0.050–0.200 m.	1
2(e)(ii)	Correct calculation of A .	1
2(e)(iii)	Correct calculation of ρ using second value of k .	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 Reason for M not being accurate, e.g. mass of bottle ignored/uncertainty in the volume of water linked to precision of beaker. C Difficulty with oscillation with reason, e.g. masses move/bottle hits side of bucket/does not oscillate vertically/other modes of oscillation. D Difficult to measure D with reason, e.g. bottle flexes when measuring D/non-uniform D/bottle not circular/D varies with depth. E Difficult to judge when an oscillation starts/ends/is completed. <i>1 mark for each point up to a maximum of 4.</i>	4
2(f)(ii)	A Take more readings <u>and</u> plot a graph or take more values of k <u>and</u> compare (not “repeat readings” on its own). B Use electronic balance/top-pan balance or use measuring cylinder. C Method of fixing mass hanger in position in bottle, e.g. Blu-Tack, glue, tape or use suitable alternative to slotted masses, e.g. sand/lead shot/single mass or use wider bucket/larger diameter. D Use vernier/digital calipers or details of alternative method to find D, e.g. use two set squares/two wooden blocks or measure D in different directions/positions and find average. E Use video <u>and</u> timer/video <u>and</u> view frame by frame or position/motion sensor above bucket. <i>1 mark for each point up to a maximum of 4.</i>	4

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Question	Answer	Marks
1(a)(i)	Value of z in the range 29.0–31.0 cm to the nearest mm with unit.	1
1(a)(ii)	Value of y with unit and $y \leq 35.0$ cm.	1
1(b)	Six sets of readings of x and y (different values) showing the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	5
	Range: values of x must include at least one negative value.	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. x/m .	1
	Consistency: All raw values of x and y must be given to the nearest mm.	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 in the table must be plotted on the grid. Diameter of plotted point must be $\leq$ half a small square (no “blobs”). All 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 1.0 cm (to scale) on the y -axis of all plotted points.	1
1(c)(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 by the candidate. Line must not be kinked or thicker than half a small square.	1

Question	Answer	Marks
1(c)(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. 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. Sign of gradient must match graph.	1
	y-intercept: 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.	1
1(d)	Value of A = candidate's gradient and value of B = candidate's intercept. The values must not be fractions.	1
	No unit for A and unit for B correct (m, cm, mm).	1
1(e)	Correct calculation of p to the number of s.f. given by the candidate.	1
1(f)	Line W drawn with the same gradient but lower value of y-intercept.	1

Question	Answer	Marks
2(a)(i)	Value of T less than 1.0 s with unit and evidence of at least two sets of nT where $n \geq 5$.	1
2(a)(ii)	Correct calculation of f to the number of s.f. given by the candidate.	1
2(a)(iii)	Justification for s.f. in f linked to s.f. in time or period.	1
2(b)(i)	Value of n .	1
2(b)(ii)	Value of I .	1
2(b)(iii)	Percentage uncertainty in I based on absolute uncertainty $\geq 0.2 \mu\text{A}$. 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(c)(i)	Second value of T .	1
	Second value of $T >$ first value of T .	1
2(c)(ii)	Values of n and I .	1
	Quality: second $I <$ first I .	1
2(d)(i)	Two values of k calculated correctly.	1
2(d)(ii)	Valid comment consistent with calculated values of k , testing a criterion specified by the candidate.	1

Question	Answer	Marks
2(e)(i)	A Two readings are not enough to draw a (valid) conclusion (not “not enough for accurate results”, “few readings”). B Reason for difficulty with oscillation e.g. magnet struck top of tube/magnet not passing through all turns/some turns are not near magnet/magnet oscillates outside of coil. C Difficulty in judging end/start of (complete) oscillation. D Difficulty with the current readings with reason e.g. because of positive and negative values/meter does not refresh quickly enough/current small/resistance of connecting leads high/maximum current lasts for short time. E Difficulty with the practical setup e.g. tube fell over/magnet fell off/spring moving along rod. F n is not a whole number. <i>1 mark for each point up to a maximum of 4.</i>	4
2(e)(ii)	A Take many readings (for different values of n or f) <u>and</u> plot a graph or take more values of k <u>and</u> compare (not “repeat readings” on its own). B Method of improving difficulty with oscillation e.g. use wider tube/use shorter tube/bunch up coils/longer magnet. C Method of improving timing e.g. put a marker with position (except at the ends)/video with timer (or replay frame by frame)/position or motion sensor placed below. D Method to reduce difficulties with current e.g. use (centre-zero) analogue meter/use c.r.o./galvanometer/use more turns of wire/smaller masses/stiffer spring/stronger magnet/sand contacts/video ammeter and replay to find maximum current. E Named method of attaching to table/holder e.g. clamp tube/tape magnet to weight/tape spring to rod/tape tube to table. F Calculate n from the length of the wire and the diameter of the tube. <i>1 mark for each point up to a maximum of 4.</i>	4