

CAMBRIDGE INTERNATIONAL EXAMINATIONS**Cambridge International Advanced Subsidiary and Advanced Level****MARK SCHEME for the May/June 2015 series****9702 PHYSICS****9702/35**Paper 3 (Advanced Practical Skills 1),
maximum raw mark 40

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- 1 (a) (ii) Value of x to the nearest mm with unit, and in range $25.0\text{ cm} < x < 35.0\text{ cm}$. [1]
- (b) (ii) Values of V_1 and V_2 in range $0.100\text{ V} - 2.500\text{ V}$ with unit. Ignore negative sign(s). [1]
- (c) Six sets of readings of x , V_1 and V_2 scores 5 marks, five sets scores 4 marks etc. [5]
 Minor help from supervisor –1, major help –2.
 Inconsistent trend –1 (correct trend is V_2 increases and V_1 decreases as x increases).
- Range: [1]
 Range of values of $x > 60.0\text{ cm}$.
- Column headings: [1]
 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. x/m and V_2/V_1 (no unit).
- Consistency: [1]
 All values of raw V must be given to 0.001 V .
- Significant figures: [1]
 The number of significant figures for V_2/V_1 must be the same as (or one more than) the
 least number of significant figures in the corresponding values of V_2 and V_1 .
- Calculated values: [1]
 V_2/V_1 calculated correctly to the number of s.f. given by the candidate.
- (d) (i) Axes: [1]
 Sensible scales must be used. Awkward scales (e.g. 3:10) are not allowed.
 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.
- Plotting: [1]
 All observations must be plotted.
 Diameter of plotted points must be $<$ half a small square (no “blobs”).
 Plotted points must be accurate to within half a small square.
- Quality: [1]
 All points in the table must be plotted on the grid for this mark to be awarded.
 All points must be ± 0.025 (to scale) on the V_2/V_1 axis of a straight line.
- (ii) Line of best fit: [1]
 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.

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- (iii) Gradient: [1]
 The hypotenuse of the triangle 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.

y -intercept: [1]
 Either:
 Check correct read-off from a point on the line and substituted into $y = mx + c$.
 Read-offs must be accurate to half a small square in both x and y directions.
 Or:
 Check read-off of the intercept directly from the graph
 (accurate to half a small square).

- (e) Value of $A = 15 \times$ candidate's gradient and value of $B = 10 /$ candidate's y -intercept. [1]
 Do not allow fractions or final answer to 1 s.f.

Units for A ($\Omega \text{ m}^{-1}$ or $\Omega \text{ cm}^{-1}$ or $\Omega \text{ mm}^{-1}$) and $B(\Omega)$ dimensionally correct. [1]

- 2 (c) (i) Value of raw θ to the nearest degree, with unit, in range $\theta < 90^\circ$. [1]

- (ii) Percentage uncertainty in θ based on absolute uncertainty of 2 to 5° , and correct method of calculation. [1]
 If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.

- (iii) Correct calculation of $\cos (\theta/2)$ correct to 2 s.f. [1]

- (d) (ii) Value of T_1 with unit and in range $0.5 \text{ s} < T_1 < 1.5 \text{ s}$. [1]

Evidence of repeats here or in (e)(ii) or (f)(ii). [1]

- (e) (ii) Value of T_2 with unit in range $0.5 \text{ s} < T_2 < 1.5 \text{ s}$. [1]

- (f) (ii) Second value of θ . [1]

Second values of T_1 and T_2 . [1]

Second value of $T_1 >$ first value of T_1
 and
 Second value of $T_2 <$ first value of T_2 . [1]

- (g) (i) Two values of k calculated correctly. [1]

- (ii) Correct justification of s.f. in k linked to s.f. in θ and T_1 and T_2 (or θ and raw times) [but not $\cos (\theta/2)$]. [1]

- (iii) Sensible comment relating to the calculated values of k , testing against a criterion specified by the candidate. [1]

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(h)	(i) Limitations (4 max.)	(ii) Improvements (4 max.)	Do not credit
A	Two readings not enough to draw a valid conclusion	Take many readings for different angles <u>and</u> plot a graph/ take more readings and compare k values	“repeat readings”/ “few readings”
B	Difficult to measure <u>angle</u> with reason e.g. hand shakes/curve at bottom/position of zero uncertain/parallax/rod gets in the way/thick string/holding protractor without a stand	Trace on a card/use graph paper/project onto screen <u>and</u> measure angle/use trigonometry/take photo and measure angle/clamp protractor Use thinner string	
C	Difficult to maintain gap (between strings or stands) or angle <u>with</u> <u>reason</u> e.g. stands move/string slips	Method to prevent movement of stands e.g. G clamp stands/mark positions of stands on bench Make indentations around/in the rod(s) so the strings do not slide/method of fixing string to rod	
D	Movement of rod not confined to the wanted oscillation/rod rotating	Electromagnetic release	Fans/air conditioning
E	Difficult to obtain time with reason e.g. high damping/time too short/no. of oscillations too few/friction between string and rod (loses energy) Large uncertainty in time	Video with timer/frame by frame Longer rod/longer string/heavier rod	
F	Difficult to identify/judge end or highest point of oscillation	Count to middle/fiducial/reference <u>marker at middle</u>	