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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 cm < x < 35.0 cm. [1]

(b) (ii) Values of V_1 and V_2 in range 0.100 V – 2.500 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 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 ($\Omega\,m^{-1}$ or $\Omega\,cm^{-1}$ or $\Omega\,mm^{-1}$) and B (Ω) dimensionally correct. [1]

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

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

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

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

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

(e) (ii) Value of T_2 with unit in range $0.5\,s < T_2 < 1.5\,s$. [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 and plot a graph/ take more readings and compare *k* values	"repeat readings"/ "few readings"
B	Difficult to measure angle 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 and 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 with reason 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 marker at middle	

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