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

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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2015 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

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.

(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 × 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 (θ/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 (θ/2)]. [1]

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

(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	