CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9702 PHYSICS

9702/34 Paper 3 (Advanced Practical Skills 2), 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.

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CAMBRIDGE
International Examinations

1 **(b)** **(i)** Value of θ to the nearest degree and in the range 135° to 165°. [1]

(ii) Value of L in range 5.0 to 10.0 cm, with unit. [1]

(d) Six sets of readings of θ and L scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend –1. Help from Supervisor –1.

Range: [1]
$\theta_{max} \geqslant 160°$ and $\theta_{min} \leqslant 140°$.

Column headings: [1]
Each column heading must contain a quantity and a unit. The presentation of quantity and unit must conform to accepted scientific convention e.g. θ/ °.
1/sin(θ – 90°) must have no unit.

Consistency: [1]
All values of L must be given to the nearest mm.

Significant figures: [1]
Every value of 1/sin(θ – 90°) must be given to 2 or 3 significant figures only.

Calculation: [1]
Values of 1/sin(θ – 90°) calculated correctly to the number of significant figures given by the candidate.

(e) **(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 in the table must be plotted on the grid.
Diameter of plotted points must be ⩽ half a small square (no "blobs").
Points must be plotted to an accuracy of half a small square.

Quality: [1]
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 ±0.3 (to scale) cm in the L direction from 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 (i.e. circled or labelled) by the candidate.
Lines must not be kinked or thicker than half a square.

(iii) Gradient: [1]
The hypotenuse of the triangle must be greater than half the length of the drawn line.
Do not allow $\Delta x / \Delta y$. Sign of gradient must match graph drawn.
Both read-offs must be accurate to half a small square in both the *x* and *y* directions.

y-intercept: [1]
Either:
Correct read-offs from a point on the line substituted into $y = mx + c$ or an equivalent expression.
Read-offs 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.

(f) Value of *a* = candidate's gradient and value of *b* = candidate's intercept. [1]

Unit for *a* is correct (e.g. cm^{-1}) and no unit for *b*. [1]

2 **(a)** **(i)** All values of *d* to nearest mm, with unit, in range 5 to 30 mm. [1]

Value of *l* greater than value of *d*. [1]

(ii) Correct calculation of *V* with consistent unit. [1]

(b) Justification for significant figures in *V* linked to significant figures in *d* and *l*. [1]

(c) **(iii)** *t* in range 5.00 s to 30.00 s, with unit. [1]

Evidence of repeat readings of *t*. [1]

(d) Absolute uncertainty in *t* in range 0.5 s to 5.0 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 working is clearly shown. [1]

(e) Second values of *d* and *l*. [1]

Second value of *t*. [1]

Second value of *t* < first value of *t*. [1]

(f) **(i)** Two values of *k* calculated correctly. [1]

(ii) Valid comment consistent with the calculated values of *k*, testing against a criterion specified by the candidate. [1]

(g)	(i) Limitations (4 max.)	(ii) Improvements (4 max.)	Do not credit
A	Not enough readings to draw a conclusion	Take more readings <u>and</u> plot a graph/ obtain more *k* values and <u>compare</u>	Few readings/ only one reading/ not enough readings for an accurate result/ "repeat readings" on its own/ take more readings and (calculate) average *k*
B	*d* is small/large uncertainty in *d*	Improved method of measuring *d* e.g. micrometer/vernier calipers/digital calipers/travelling microscope	Difficult to measure *d*/ parallax error/ "calipers" on its own/ use bigger/larger components
C	Volume of component not accurate, with reason e.g. component not cylindrical/has groove.	Method to find volume of component e.g. use liquid displacement method	
D	Difficult to judge/know/see when LED goes out.	Use dark(ened) room/ light meter/ light sensor/ cardboard tube over LED/ voltmeter to measure time for p.d. to fall below specific value	Use video
E	Poor/dirty/loose contacts	Method of cleaning contacts e.g. iron wool	