Cambridge International AS & A Level

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PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

Published

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1 (a) (ii) Value for L to the nearest mm with unit and in range 38.0 cm ≤ L ≤ 42.0 cm. [1]

(b) (iv) Value of I with unit in the range 25 mA to 100 mA. [1]

(c) Six sets of readings of x and I with correct trend scores 4 marks, five sets scores 3 marks etc. [4]
Minor help from Supervisor –1, major help –2.

Range of x: [1]
$\Delta x \geq 30.0$ cm.

Column headings: [1]
Each column heading must contain a quantity and a unit where appropriate.
The unit must conform to accepted scientific convention, e.g. $1/I/A^{-1}$ or $1/I(A^{-1})$ or $1/I$ / 1/A. Do not allow $1/I$(A).

Consistency: [1]
All values of I given to 0.1 mA.

Significant figures: [1]
Every value of $1/I$ must be given to the same number of s.f. as (or one more than) the number of s.f. in the corresponding value of I.

Calculation: [1]
Values of $1/I$ 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 of points: [1]
All observations must be plotted.
Diameter of plotted points must be ≤ half a small square (no "blobs").
Plotted points must be accurate to 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 within 2.0 cm (to scale) on the x-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.
Lines must not be kinked or thicker than half a small square.

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(iii) Gradient: [1]
The hypotenuse of the triangle used must be greater than half of 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:
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:
Intercept read off directly from the graph (accurate to half a small square).

(e) *P* = –value of candidate's gradient *Q* = value of candidate's intercept. [1]
Do not allow fractions.

Unit for *P* correct (e.g. $A^{-1}m^{-1}$, $A^{-1}cm^{-1}$, $A^{-1}mm^{-1}$, $mA^{-1}m^{-1}$, $mA^{-1}cm^{-1}$ or $mA^{-1}mm^{-1}$).
Unit for *Q* correct (e.g. A^{-1} or mA^{-1}) and consistent with value. [1]

(f) Value of *R* in the range 5 Ω to 20 Ω. [1]

2 (a) (ii) Value of *C* in the range 35.0 cm to 40.0 cm with unit. [1]

(iii) Value of *d* to the nearest mm with unit in range 4.0 cm to 6.0 cm. [1]

(iv) Correct calculation of $(C - d)$. [1]

(b) (ii) Value of θ to the nearest degree with unit, and $\theta < 90°$. [1]

(iii) Absolute uncertainty in θ in range 2° to 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]

(c) Correct calculation of $(\tan\theta - 1)$. Do not allow a unit. [1]

Answer given to 2 s.f. or 3 s.f. [1]

(d) Second value of *d*. [1]

Second value of θ. [1]

Quality: Second value of θ > first value of θ. [1]

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

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

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(f)	(i) Limitations [4]	(ii) Improvements [4]	Do not credit
A	Two readings not enough to draw a conclusion	Take more readings and plot a graph/ take more readings and compare *k* values	Repeat readings/ few readings/ only one reading/ not enough readings for accurate value
B	Difficult to measure angle with reason e.g. lack of vertical reference line/parallax/nail in the way/apparatus moves when protractor in place	Method of providing vertical reference e.g. use a plumbline/ drill hole at origin of protractor and mount on nail/ method of fixing protractor/ use a grid with angles marked/ larger protractor	
C	Range of θ is too small	More holes further apart	
D	Difficult to measure *C* whilst balancing strip	Mark position of pivot/ add scale to wooden strip	
E	Difficulty in mechanical set up e.g. alignment of strip and string/horizontal string (parallel to table)	Method of improvement e.g. spirit level linked to string/axle of pulley/ add weights to stands	
F	Friction at nail (or axle of pulley)	Lubricate the nail/pulley axle	

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