UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2008 question paper

9702 PHYSICS

9702/31 Paper 31 (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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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1 (c) Value of t in range 8 to 18 s. [1]

Table

(d) Six sets of readings scores 5 marks, five sets scores 4 marks, etc.
Write number of sets (ringed) next to table.
Help from Supervisor then –1.
t should show general increase with l. If not then –1. [5]

Repeated readings for t (do not credit if values identical for every row). [1]

$l_{min} ≤ 0.35$ m and $l_{max} ≥ 0.55$ m. [1]

Table headings – every column should have a label and an appropriate unit. [1]

Consistency in raw data – all values of t should be given to 0.1 or all given to 0.01 s. [1]

Check value of $1/\sqrt{l}$ (for largest l) and tick if correct. [1]

Each value of $1/t$ should be to the same s.f. as (or one more than) the raw value of t. [1]

Quality of data – judge from scatter of all plotted points (at least five) about line of best fit.
Allow scatter of $±0.025$ m$^{-½}$ in the $1/\sqrt{l}$ direction. This mark cannot be scored for wrong
graph or wrong trend, or if all points have not been plotted. [1]

Graph

(e) Points should occupy at least half the grid in both directions and scales should be sensible
(not 3:10, etc.) and labelled with a quantity. Allow reversed axes. [1]

Check that the 'worst' point is correctly plotted.
This mark cannot be scored unless all data from the table has been plotted – write number of
plots (ringed) on the graph.
Do not allow blobs (diameter ⩾ half a small square). [1]

Line of best fit. Allow five trend plots. [1]

(f) Triangle chosen has a hypotenuse at least half the length of the drawn line.
Vertices lie on the line and read-offs are correct (to half a small square in both directions)
and method of calculation of gradient is correct. Ignore POTE. [1]

Intercept calculated using readings from line and a valid method (or read from y-axis
provided there is no FO).
Ignore any POTE. [1]

Conclusions

(g) Gradient equated with p.
Value of p in range 0.400 to 0.600 m^{½}s^{-1} inclusive. [1]

(h) q calculated starting with 'intercept value = $– p/q$', and correct substitution.
q must be opposite sign to intercept unless gradient is negative. [1]

[Total: 20]

2 (a) (i) Raw value(s) of *d* recorded to the nearest mm. [1]

Repeated readings for *d*. [1]

(ii) Absolute uncertainty of 1 or 2 mm (or half the range) used in a correct percentage uncertainty calculation. [1]

(iii) Calculated value of *x* correct. [1]

(c) (i) First value for *n*.
First value for *V* in range $0.5 \leqslant V \leqslant 2.0$.
First value for *I* with $I < 1.0$ A (unit required).
If significant help from Supervisor then –1. [3]

(d) Second set of measurements (with different *n*). [1]

Correct calculation of second *R*. [1]

Calculated value of second *μ* correct (allow e.c.f.). [1]

Quality – the two values of *μ* are within 20% of each other. [1]
(This will require a check calculation of first value of *μ*).

Drawing conclusions

(e) Valid comment on whether *R* proportional to *n*, based on comparison of two calculated ratios (e.g. two values of *μ* or two values of *R/n).*
Validity can be based on the candidate's own stated criterion (e.g. 'values within 10%') or, if not stated, on 20% difference.
Accept reversed trend as evidence for *R* not proportional to *n.* [1]

	(f) (i) Problems [4]	**(f) (ii) Improvements** [4]
A	Two sets of readings are not enough (to draw a conclusion)/only two readings.	Take more readings and plot graph.
B	Tube not circular/tube not rigid.	<u>Repeated</u> measurements of *d* in <u>different directions</u>.
C	Coils not circular (helix inferred)/different turns have different lengths/wire kinked or loosely wound/*x* different to π*d*/turns unevenly spaced.	Measure the length in one turn by wrapping string, then unwrapping and measuring/workable method of getting even spacing of turns.
D	Difficult to judge whole number of turns when positioning contacts/large contact area.	Mark lateral line on tube to give positions for contacts/use knife edge contact or smaller plug.
E	Contact resistance/lead resistance/circuit resistance/fluctuating or changing readings.	Measure lead resistance and subtract from *R*/reposition voltmeter connections closer to contacts/clean the contacts/use shorter leads.
F		Use vernier calipers <u>to measure d</u>.

[Total: 20]