UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9702 PHYSICS

9702/35 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, which would have considered the acceptability of alternative answers.

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

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1 (a) (i) Value of d to the nearest 0.01 mm or 0.001 mm with consistent unit. [1]
$0.20 < d < 0.60$ mm.

(b) (iii) Value of x in range 40 cm–60 cm with consistent unit. [1]
Value of I with units.

(c) Six sets of readings of x and I scores 5 marks, five sets scores 4 marks etc. Incorrect trend then –1. Minor help from supervisor –1 ; major help from supervisor –2 [5]

Range [1]
$x_{max} > 70$ cm; $x_{min} < 30$ cm

Column headings [1]
Each column heading must contain a quantity and a unit.
There must be some distinguishing mark between the quantity and the unit
(solidus is expected but accept, for example, $1/I$ (A^{-1}). Do not allow $1/I$ (A))

Consistency of presentation of raw readings. [1]
All values of x must be given to the nearest mm.

Significant figures [1]
S.F. in $1/I$ must be the same as, or one more than, the least number of significant figures used in raw I.

Calculation [1]
Correct calculation of $1/I$.

(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 which is being plotted. Ignore units.
Scale markings should be no more than three large squares apart.

Plotting of points [1]
All observations must be plotted on the grid.
Do not accept blobs (points with diameter > 0.5 small square).
Ring and check a suspect plot.
Work to an accuracy of half a small square.

(ii) Line of best fit [1]
Judge by the balance of at least 5 points about the candidate's line.
There must be an even distribution of points either side of the line along the full length.
Lines must not be kinked. Do not accept lines thicker than half a small square.

Quality [1]
All points in the table (minimum 5) must be plotted for this mark to be scored. All points must be within 2 cm (to scale) in *x* direction of a straight line.

(iii) Gradient [1]
The hypotenuse of the triangle must be at least half the length of the drawn line.
Both read-offs must be accurate to half a small square.

Intercept [1]
Either:
Check correct read-off from a point on the line, and substitution into $y = mx + c$.
Read-off must be accurate to half a small square. Allow ecf of gradient value.

Or:
Check read-off of intercept directly from graph.

(e) Values obtained in **(a)(ii)** and **(d)(iii)** substituted correctly into equation: $\frac{M}{N} = \frac{\rho}{AR}$ [1]

Do not allow substitution methods to find *M* or *N*

Value for ρ in range: $1 \times 10^{-7}\ \Omega\,\text{m} - 5 \times 10^{-6}\ \Omega\,\text{m}$ with consistent unit. [1]

[Total: 20]

2 **(a)** **(ii)** Measurement of x to nearest mm. x ◂ 15.0 cm with consistent unit. [1]
–1 for supervisor's help.

(b) **(iii)** Measurement of θ (less than 90°) with unit. [1]

(iv) Absolute uncertainty in θ in the range 2°–10°. [1]
If repeated readings have been taken, then the uncertainty can be half the range.
Correct method of calculation of percentage uncertainty.

(v) m = 50 g with consistent unit [1]

M = 60 g with consistent unit [1]

(vi) Correct calculation of m/M (0.83 or 0.833). No units. [1]

(c) Measurement of θ [1]

m = 40 g; M = 70 g [1]

Quality: $\theta_2 > \theta_1$ [1]

(d) **(i)** Correct calculation of two values of k. [1]

(ii) Justification of sf in k linked to θ, m and M [1]

(iii) Valid conclusion based on the calculated values of k. [1]
Candidate must test against a stated criterion.

(e) Identifying limitations (4 marks) and suggesting improvements (4 marks)

	(i) Limitations [4]	**(ii)** Improvements [4]	Do not credit
A	Two readings are not enough (to draw a conclusion.	Take more readings and plot a graph/calculate more *k* values (and compare).	Few readings. Take more readings and calculate average. Only one reading.
B	Difficult to balance <u>with reason</u> e.g. unstable or effect of fans/draughts/a.c.	Drill hole higher up/switch off fans/a.c./close windows.	Closed room.
C	Difficult to <u>judge</u> when wooden strip horizontal/parallel (to the bench).	<u>Method</u> of ensuring strip is horizontal/parallel to bench e.g. use a spirit level or metre rule(s) to measure height of both ends/sight against window. Allow <u>detailed</u> use of set square.	Strip not straight/parallel/ horizontal. Use set square.
D	Difficult keeping *x* constant/ weights move.	<u>Method</u> of fixing cotton loop to rule e.g. tape, glue.	
E	Difficult to measure θ <u>because</u> hard to judge vertical/movement of hand.	Use a plumb line/clamped ruler/clamp protractor.	Bigger protractor. Paper behind protractor.
F	<u>Friction</u> at pulley/between nail and wooden strip.	Use lubricant/method of reducing friction.	Friction. Better pulley/ smooth(er) string/thin(ner) string. Friction between string and pulley. Lubrication between string and pulley.
G	Mass (values) not accurate.	Use balance/method of weighing mass.	Weigh masses.

Do not credit 'parallax problems', 'use assistant' or references to sensors, computers or videos.

[Total: 20]