CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9702 PHYSICS

9702/31 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 October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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1 (a) (i) Value for d in the range 0.15 mm ≤ d ≤ 0.25 mm, with unit. [1]

(c) (ii) Values of V_1 and V_2, and $V_1 > V_2$. [1]

(d) Six sets of readings of l, V_1 and V_2 scores 5 marks, five sets scores 4 marks etc. [5]
Major help from Supervisor –2. Minor help from Supervisor –1.

Range: $\Delta l \geq 30$ cm. [1]

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. l / m or l (m)

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

Significant figures: [1]
Significant figures for every row of V_1/V_2 must be the same as, or one more than the least number of significant figures used in V_1 and V_2.

Calculation: [1]
Values of V_1/V_2 calculated correctly.

(e) (i) Axes: [1]
Sensible scales must be used, no awkward scales (e.g. 3:10).
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 in the table must be plotted.
Diameter of plotted point must be ≤ half a small square (no "blobs").
Work to an accuracy of 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 0.05 (to scale) on the y-axis V_1/V_2 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 by the candidate.
Line must not be kinked or thicker than half a small square.

(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 in both the *x* and *y* directions.
The method of calculation must be correct.

y-intercept: [1]
Either:
Check correct read off from a point on the line and substituted into $y = mx + c$.
Read-off 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.

(f) (i) Value of *P* = candidate's gradient. Value of *Q* = candidate's intercept. [1]

(ii) Value of ρ in range $1.0 – 20.0 \times 10^{-7}\ \Omega\,\text{m}$ [1]

[Total: 20]

2 (b) Value of *m* to the nearest 1 g or better with consistent unit. [1]

(c) (ii) Measurement of raw θ to nearest degree with unit. [1]
Evidence of repeat readings for θ. [1]

(iii) Percentage uncertainty in θ based on absolute uncertainty of 2 to 5° (or half the range provided this is not zero), and correct method of calculation. [1]

(iv) Correct calculation of tan (θ / 2). [1]

(d) (i) Second value of *m* > first value of *m*. [1]

(ii) Second value of θ. [1]
Quality: second value of θ < first value of θ. [1]

(e) Value of θ. [1]

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

(ii) Justification of s.f. in *k* linked to significant figures in *m* and θ. [1]

(iii) Sensible comment relating to 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	Two readings not enough (to draw a conclusion	Take more readings and plot a graph / take more readings and calculate more *k* values and compare	repeat readings / 'few readings' / 'take more readings and calculate average' / 'only one reading' / 'repeat readings' on its own
B	Difficult to measure θ because hook of mass (hanger) in the way / thick band	Tie thread to centre of bottom of rubber band and hang mass from it	
C	Difficult to hold the protractor steady / parallax error reading angle / protractor	Improved method to measure θ e.g. project image of stretched rubber band onto a screen / mark on board / measure lengths and calculate θ clamp protractor / take picture or video and measure angle	
D	Rubber band stretches over time	Take readings quickly / remove mass from rubber band between readings	
E	Stands moved / rods twist when loads attached to rubber band	Method of preventing movement of stands / clamp stands to bench / use nails in board	
F	Difficult to locate centre of band	Method of locating and mark centre e.g. measure and mark centre	
G	Change in θ small	Larger range of masses	

[Total: 20]