CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

9702 PHYSICS

9702/35 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.

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1 (b) (iii) Values of a in range 53.0 cm – 57.0 cm and $b < a$ with unit. [1]

(iv) Value of L in the range 12.0 cm – 16.0 cm with unit. [1]

(d) Six sets of readings of a and b scores 5 marks, five sets scores 4 marks, etc. [5]
Incorrect trend –1 (correct trend is b increases as a increases).
Help from Supervisor –1.

Range: $\Delta a \geqslant 39$ cm. [1]

Column headings: [1]
Each column heading must contain a quantity and unit.
The presentation of quantity and unit must conform to accepted scientific convention, e.g. $(1/b)/\text{m}^{-1}$.

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

Significant figures: [1]
Significant figures for every row of values of $1/b$ same as (or one greater than) b as recorded in table.

Calculation: [1]
Values of a/b 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 must be plotted.
Diameter of plotted points must be $\leqslant$ 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 (at least 5) for this mark to be awarded.
Scatter of points must be less than $\pm$ 0.001 cm^{-1} (0.1 m^{-1}) of $1/b$ 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.

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(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) Value of P = –gradient and value of Q = intercept. [1]

(g) Value of M in range 40–200 g with unit. No POT error allowed. [1]

[Total: 20]

2 (a) (ii) Values of d to the nearest 0.01 mm with unit. [1]
6.00 mm $\leqslant d \leqslant$ 10.00 mm. If out of range allow Supervisor's value $\pm$ 2.00 mm. [1]
Evidence of repeat readings. [1]

(iii) Absolute uncertainty in d in range 0.05 mm–2.00 mm. [1]
If repeated readings have been taken, then the uncertainty could be half the range (but not zero) only if the working is shown.
Correct method of calculation to get percentage uncertainty.

(c) (iv) Value of $x_1 > x$ with unit to the nearest mm. [1]

(v) Correct calculation of e. [1]

(d) (ii) Second value of d. [1]
Second value of x_1. [1]
Second value of $e <$ first value of e. [1]

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

(ii) Justification based on the number of significant figures in e (or $x_1 - x$) and d. [1]

(iii) Valid 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 max)	(ii) Improvements (4 max)	Do not credit
A	Two readings not enough to draw a conclusion	Take many readings for different diameters and plot a graph	Repeat readings Few readings Too few readings / only two readings
B	Large uncertainty in extension because extension small	Use longer / thinner cylinders or thinner central portion / time for hanging longer / greater mass to give greater extension	
C	Difficult to roll uniform cylinder / cylinder not symmetrical / not uniform diameter / density or consistency not the same	Viable suggestion for improvement, e.g. spacers, mould, force through hole	
D	Reading of x_1 is imprecise because marks have widened	Improved method of marking without a dent	
E	Difficulty with clamping the plasticine, e.g. breaks prematurely / twists in clamp	Improved method to attach weight to plasticine, e.g string loop through handles / place clamp lengthways	
F	Micrometer digs into plasticine and may weaken it / gives incorrect diameter reading	Improved method to measure d, e.g. travelling microscope / work out diameter from volume or circumference	
G	Difficulties relating to the properties of the plasticine over time, e.g. high temperature making too soft / picking up impurities / re-breaking at fractured points / as roll temperature increases and affects	Use new piece of plasticine each time / roll and leave until reaches room temperature	

[Total: 20]

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