CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9702 PHYSICS

9702/34 Paper 3 (Advanced Practical Skills 2), 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) (ii) Value of $h_2 < h_1$, with consistent unit. [1]

(b) (iv) First values of L_A and L_B, with unit, and value of $L_A - L_B$ in range 1.0 to 6.0 cm. [1]

(c) Six sets of values for x, L_A and L_B scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend –1.
Help from Supervisor –1.

Range: x values must include 20.0 cm or less and 80.0 cm or more. [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. x/cm or x (cm).

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

Significant figures: [1]
Every value of $(L_A–L_B)/C$ must be given to the same s.f. as (or one more than) the least s.f. in C or in $(L_A–L_B)$.

Calculation: $(L_A–L_B)/C$ calculated correctly. [1]

(d) (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 ≤ half a small square (no “blobs”).
Plots must be accurate to half a small square.

Quality: [1]
All points in the table must be plotted for this mark to be scored.
All points must be within ± 4 scale cm, 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.
Line must not be kinked or thicker than half a small square.

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(iii) Gradient: [1]
The hypotenuse must be at least half the length of the drawn line.
Both read-offs must be accurate to half a small square in both *x* and *y* directions.
The method of calculation must be correct.

y–intercept: [1]
Either:
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:
Correct read-off of the intercept directly from the graph.

(e) Value of *a* = candidate's gradient and value of *b* = candidate's intercept. [1]
A value presented as a fraction is not allowed.

Correct units for *a* (e.g. cm^{-1}) and *b* (no unit), and gradient in range
-0.050 to $-0.150\,cm^{-1}$ (-5.0 to $-15.0\,m^{-1}$). [1]

[Total: 20]

2 **(a)** **(i)** Raw value(s) for *d* to nearest 0.1 mm or nearest 0.01 mm. [1]
d in range 10.0 to 15.0 mm. [1]

(ii) Correct calculation of *R*. [1]

(b) Valid justification for s.f. in *R* based on s.f. in *d* and *D*. [1]

(d) **(iv)** θ in range 10^o to 50^o, with unit. Raw reading(s) must be integer value(s). [1]
Evidence of repeated readings of θ. [1]

(e) Estimate of percentage uncertainty based on an absolute uncertainty of 2^o to 10^o [1]
(or half the range provided this is not zero), and correct method of calculation.

(f) Second values for *d* and *D*. [1]
Second value of θ. [1]
Quality: Second θ less than first θ. [1]

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

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

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(h)

	(i) Limitations (4 max)	**(ii)** Improvements (4 max)	Do not credit
A	Two readings are not enough (to draw a valid conclusion)	Take many *R* values and plot a graph/ calculate more *k* values and compare	'few readings'/ 'take more readings and calculate average'/'only one reading'
B	Spool does not roll straight/ spool topples over/ jerky motion	Roll spool between guides/ use wider spool	Lubricate bench or spool
C	Difficult to judge θ as it varies, equilibrium position not maintained		
D	Difficult to measure θ due to parallax	Method to reduce parallax (e.g. shadow method)	
E	Difficult to pull thread when measuring θ/ difficult to watch spool and protractor at same time	Specified thread guiding method (e.g. pulley or rod)	
F	Difficult to align thread with centre of protractor	Take photo or video and measure θ on image (e.g. photo or screen)	
G	Difficult to make protractor vertical	Use plumb-line/detail of another sensible method (e.g. use set square on bench)	

Do not allow 'repeated readings'
Do not allow 'use a computer to improve the experiment'

[Total: 20]

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