CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 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 May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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1 (b) (i) Value of d in the range 0.480 – 0.500 m, with unit. [1]

(c) Six sets of readings of d and F scores 6 marks, five sets scores 5 marks etc. [6]
Incorrect trend or no d data –1.
Minor help from Supervisor –1, major help –2.

Range: $d_{max} - d_{min} \geq 30$ cm. [1]

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

Consistency: [1]
All values of d must be given to the nearest mm and all values of F must be given to the nearest 0.1 N.

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

Calculation: [1]
Values of $1/d$ calculated correctly.

(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 in the table must be plotted on the grid.
Points must be plotted to an accuracy of half a small square.
Diameter of plotted points must be ≤ half a small square (no blobs).

Quality: [1]
All points in the table must be plotted on the grid (at least 5) for this mark to be awarded. Judge by the scatter of all the points about a straight line.
Scatter of points must be less than ± 0.001 cm^{-1} from a straight line in the $1/d$ direction.

(ii) Line of best fit: [1]
Judge by balance of all the 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.
One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate.
Line must not be kinked or thicker than half a 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:
Correct read-off from a point on the line substituted into $y = mx + c$ or an equivalent expression, with read-off accurate to half a small square in both *x* and *y* directions.
Or:
Intercept read directly from the graph, with read-off accurate to half a small square in both *x* and *y* directions.

(e) Value of *a* = candidate's gradient. Value of *b* = candidate's intercept. [1]

Unit for *a* correct and consistent with value, e.g. N cm.
Unit for *b* is correct and consistent with value, e.g. N. [1]

[Total: 20]

2 (a) (i) All values of *D* to nearest 0.01 cm or all to nearest 0.001 cm, and in range 3.0 to 5.0 mm. [1]

Evidence of repeat readings of *D*. [1]

(ii) Absolute uncertainty in *D* in range 0.02 to 0.05 cm and correct method of calculation to obtain percentage uncertainty. [1]
If repeated readings have been taken, then the absolute uncertainty can be half the range (but not zero if values are equal).

(c) (i) l in range 19.0 to 21.0 cm, with unit, to nearest mm. [1]

(iii) *t* in range 2.0 to 10.0 s and value(s) to nearest 0.1s or 0.01s. [1]

(iv) Correct calculation of *v*. [1]

(d) Justification for s.f. in *v* linked to s.f. in *D* and *t*. [1]

(e) (ii) Second value of l. [1]
Second value of *t*. [1]
Second value of *t* > first value of *t*. [1]

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

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

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(g)

	(i) Limitations **4 max.**	**(ii)** Improvements **4 max.**	Do not credit
A	two readings are 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" on its own / few readings / only one reading / take more readings and (calculate) average *k*
B1	large uncertainty in *D* because *D* is small	measure outside diameter and wall thickness / measure an image showing the cross-section and a scale	use micrometer
B2	tube distorts when measuring *D*	use travelling microscope / measure volume and calculate *D*	
C	tube not straight so difficult to make tube vertical / tube not straight so difficult to measure length	tape to a straight rod / increase attached mass	use stiffer tube
D	difficult to judge moment (or operate stopwatch) when level reaches syringe graduations	use video with timer / view video frame by frame / collect water for a timed interval and measure volume / use light gates and timer with practical detail / use different diameter syringe with reason / use position sensor above water surface	'reaction time' on its own / human error / 'light gates' on its own / slow motion (or high speed) camera
E	difficult to see water level	use coloured water (or dye) / use clear syringe / view against black background	
F	clay stretches (or squashes) tube	measure length after attaching clay	

References to parallax error are ignored for this experiment.

[Total: 20]

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