CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 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 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 (a) Value of L in the range 0.790–0.810 m. [1]

(c) (ii) Value of d to the nearest mm and $d < 0.600$ m. [1]

(d) Six sets of readings of m and d scores 5 marks, five sets scores 4 marks etc. [5]
Correct trend is d decreases as m increases.
Help from Supervisor –1.

Range of m: $m_{min} = 0$ g or 10 g; $m_{max} \geq 100$ g. [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. $1/d\,/\text{m}^{-1}$.

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

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.

(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 points 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 (at least 5) for this mark to be awarded.
Scatter of points must be less than ± 0.05 m^{-1} of $1/d$ 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 (i.e. circled or labelled) 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:
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.

(f) Value of *P* = candidate's gradient. Value of *Q* = candidate's intercept.
Unit for *P* (e.g. $kg^{-1}\,m^{-1}$) and *Q* (m^{-1}). [1]

(g) Value of *k* in range 1.0–2.0. [1]

[Total: 20]

2 (a) (ii) Value of θ with unit. Help from Supervisor –1. [1]
θ in range 72°–92°. [1]

(iii) Absolute uncertainty in θ in range 2º–10º.
If repeated readings have been taken, then the uncertainty can be half the range (but NOT zero if values are equal). Correct method of calculation to obtain percentage uncertainty. [1]

(iv) Correct calculation of sin θ. Ignore unit. Do not allow sin θ = O/H ideas as triangle not a right-angled triangle. [1]

(b) Value of *T* with unit in range $1.0 \leq T \leq 2.0$ s. [1]
Evidence of repeats here or in **(c)(ii)**. [1]

(c) (ii) Second value of θ. [1]
Second value of *T*. [1]
Second value of *T* < first value of *T*. [1]

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

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

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

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(e)

	(i) Limitations **max. 4**	**(ii)** Improvements **max. 4**	Do not credit
A	two readings not enough (to draw a conclusion)	take more readings and plot a graph/ calculate more *k* values and compare	"repeat readings" on its own /few readings/only one reading /take more readings and (calculate) average *k*
B	end of nail slips in bracket/bracket moves/is not stable	use something with a sharper point e.g. cocktail stick/dent in bracket (to seat head of nail) valid method to fix bracket e.g. use blu-tack/glue/use bigger/heavier bracket/fix bracket/ clamp to bench	method of fixing nail
C	difficult to measure *T* with reason e.g. heavily damped/oscillations die away quickly		'too few oscillations' on its own/ *T* small
D	difficult to judge start of/end of/complete oscillation	use a fixed/fiducial marker /improved timing method e.g. video with timer/video and view frame-by-frame multiflash photography with strobe rate	human error/ reaction time /record time for more oscillations marker fixed to rod /marker placed at extreme of oscillation use light gate
E	difficult to read θ/angle/protractor with reason e.g. difficult to hold steady in the air	clamp protractor	parallax error use a larger protractor
F	fans/air conditioning affect oscillations		

[Total: 20]

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