UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

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.

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1 (a) (ii) Value of k in range: 50 cm ≤ k ≤ 100 cm. [1]

(b) (iii) Values of d and D both with unit and d in range 4.0 ≤ d ≤ 6.0 cm. [1]

(c) Six sets of readings of d and D scores 5 marks, five sets scores 4 marks etc.
Incorrect trend then –1. Supervisor's help –1. [5]

Range of d: $\Delta d \geq 40$ cm. [1]

Column headings: [1]
Each column heading must contain a quantity and a unit where appropriate.
There must be some distinguishing mark between the quantity and the unit, for example d / m, d (m), $1/D$ (m^{-1}).

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

Significant figures: [1]
Significant figures for $1/D$ must be the same as, or one more than, the number used in D.

Calculation: $(D - d)/D$ calculated correctly. [1]

(d) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) are not allowed.
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 which is being plotted.
Scale markings must be no more than three large squares apart.

Plotting of points: [1]
All observations in the table must be plotted.
Check that the points are correctly plotted. Work to an accuracy of half a small square in both x and y directions.
Do not accept 'blobs' (points with diameter greater than half a small square).

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be scored. Scatter of points must be less than ± 0.05 m^{-1} (0.0005 cm^{-1}) of $1/D$ of a straight line.

(ii) Line of best fit: [1]
Judge by balance of all the points on the grid (at least 5) about the candidate's line.
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.

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(iii) Gradient: [1]
The hypotenuse of the triangle used 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.

Intercept: [1]
Either:
Check correct read-off from a point on the line and substitution into $y = mx + c$. Read-off must be accurate to half a small square in both *x* and *y* directions. Allow ecf of gradient value.
Or:
Check the read-off of the intercept directly from the graph.

(e) A = value of gradient, B = – (value of *y*-intercept). [1]

$|A/B| = k \pm 5$ cm with consistent unit. [1]

[Total: 20]

2 **(a)** Measurement of all raw values of t to nearest 0.01 mm or 0.001 mm and t in range $0.10 \leq t \leq 0.50$ mm. [1]

(b) **(i)** Value of L in range $26.0\,\text{cm} \leq L \leq 30.0\,\text{cm}$ with consistent unit to nearest mm. [1]

(ii) Absolute uncertainty in L in range 1–2 mm (but if repeated readings have been taken then the absolute uncertainty could be half the range unless zero).
Correct method shown to find the percentage uncertainty. [1]

(c) **(ii)** Correct calculation of V with consistent unit. Allow ecf. [1]

(e) Value of T in range $0.7\,\text{s} \leq T \leq 1.5\,\text{s}$ with consistent unit. Supervisor help –1. [1]

Evidence of repeats. [1]

(f) Second value of L in range $5\,\text{cm} \leq L \leq 15\,\text{cm}$. [1]

(g) Second value of T. [1]

Quality: second value of T < first value of T. [1]

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

(ii) Justification of s.f. in k linked to raw data in L and T/t. [1]

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

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(i)

	(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/calculate more *k* values (and compare)	'Few readings'/'take more readings and calculate average *k*'/'only one reading'
B	Card does not swing freely/ friction between pivot and card	Make hole bigger/bush or bearing idea	
C	Difficult to judge end/start/a complete swing	Use of fiducial marker/pointer	Reaction time error/human reaction/difficult to know when to start/stop timer
D	Irregular/uneven/unusual swings/not in same vertical plane/centre of bottom rule not fixed	Method of keeping shape aligned vertically/turn off fans	
E	Oscillations die out quickly/ heavy damping	Use increased thickness of card	
F	*T* short/large uncertainty in *T*	Improved method of timing e.g. video and timer/frame-by-frame. Increase *l*/length of card	Use of computer/light gates/ camera/high speed camera/ too fast/time too fast/time more swings/time large no. of swings

[Total: 20]

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