CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 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 2014 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_0 in range 0.045 m–0.070 m (4.5 to 7.0 cm). [1]
If out of range, compare to Supervisor's value ± 20%.

(b) (iii) Value of $L > L_0$. [1]

(c) Six sets of readings of m and L scores 5 marks, five sets scores 4 marks, etc. [5]
Incorrect trend then –1. Correct trend is L decreases as m increases for all m values.
Major help from Supervisor –2. Minor help from Supervisor –1.

Range: at least one value of m less than 200 g and one value more than 200 g. [1]

Column headings: [1]
Each column heading must contain a quantity and an appropriate unit. The presentation of quantity and unit must conform to accepted scientific convention, e.g. θ/°, L/m, m^2/kg^2, e/m, e^2(m^2).

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

Significant figures:
Significant figures for every row of m^2 same as (or one greater than) the s.f. in m as recorded in table. [1]

Calculation: [1]
Values of e^2 calculated correctly to the number of significant figures given by the candidate.

(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 plots 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 ± 0.0005 m^2 of e^2 from a straight line.

(ii) Line of best fit: [1]
Judge by balance of all points on the grid about the candidates' 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.

(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.

(e) *P* = – value of the gradient and *Q* = value of the *y*-intercept. [1]
Do not allow fractions**.** Do not allow substitution methods.

(f) Check substitution and value of *M* in range 0.100–0.500 kg with unit. [1]

[Total: 20]

2 (b) (ii) Value of *x* in the range 25.0–35.0 cm with unit. [1]

x to the nearest mm [1]

(iii) Absolute uncertainty in *x* in range 2 mm–5 mm. [1]
If repeated readings have been taken, then the uncertainty can be half the range (not zero) only if working shown.
Correct method of calculation to obtain percentage uncertainty.

(c) (ii) Value of *T* with unit. [1]
Evidence of repeats. [1]

(iii) Correct calculation of *f.* [1]

(d) (ii) Second value of *x*. [1]
Second value of *T*. [1]
Second value of *T* < first value of *T*. [1]

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

(ii) Justification of significant figures in *k* linked to significant figures in *x* and *T* / time. (Do not allow "raw readings".) [1]

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

(f)	(i) Limitations (4 max)	(ii) Improvements (4 max)	Do not credit
A	Two readings not enough to draw a conclusion.	Take more readings for different lengths and plot a graph or take more readings and compare *k* values.	Not enough repeat readings. Few readings. Idea of repeats. "Too few readings / two readings" on its own.
B	Difficulty linked to timing with reason, e.g. time small / short / vibrates fast / high frequency / oscillates fast / swings fast. **or** Large uncertainty in time with reason. **or** Human reaction time with reason, e.g. short time.	Improved method of timing, e.g. video with timer / video and view frame by frame / light gate placed at the centre / motion sensor at side of blade (to timer / datalogger display).	"Human errors / reaction time" on their own. "Light gate" on its own. Moves fast. Video and playback. Fans. Longer blade. Simultaneous release of blade and start timer. Amplitude. High speed camera or slow motion cameras.
C	Unevenness of oscillation or G-clamp moving.	Improved method of smoother oscillation, e.g. use of wooden block either side of hacksaw blade. Method of fixing G-clamp, e.g. clamp G-clamp (to table).	
D	Difficulty judging centre of masses (due to slots).	Use masses without slots / measure to the top and bottom and average.	Blu Tack. Masses different heights.
E	Difficult to measure *x* with reason, e.g. difficult to know where to start *x* as jaws of clamp are rounded / blade may not be vertical (due to clamp).	Improved method to measure *x*, e.g. description of use of set square	Uncertainty in metre rule. Parallax error.
F	Small range for *x* for measurable times		

[Total: 20]