CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 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.

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1 (b) (ii) Values of raw L in range 2.0 cm $\leqslant L \leqslant$ 8.0 cm consistent with unit. [1]

(iii) Value of $\theta < 90°$ with unit. No raw value greater than 0.5° precision. [1]

(c) Five sets of readings of L, m and θ scores 5 marks, four sets scores 4 marks etc. [5]
Incorrect trend then –1.
Major help from Supervisor –2. Minor help from Supervisor –1.

Range: $m_{min} \leqslant 0.100$ kg, $m_{max} \geqslant 0.350$ kg. [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. m / kg, $m \sin\theta$ / kg, θ / °.

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

Significant figures: [1]
All values of $m \sin\theta$ must have the same number of significant figures as, or one more than, the least number of significant figures in m and θ.

Calculation: [1]
Values of $m \sin\theta$ calculated correctly.

(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 that 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 on the graph grid.
Diameter of plots must be $\leqslant$ half a small square (no blobs).
Check that the points are plotted correctly. Work to an accuracy of half a small square in both the x and y directions.

Quality: [1]
All points in the table must be plotted (at least 4) for this mark to be scored.
Judge by the scatter of all the points about a straight line.
All points must be within ± 0.01 kg in the $m \sin\theta$ direction of a straight line.

(ii) Line of best fit: [1]
Judge by balance of all the points on the grid (at least 4) about the candidate's line.
There must be an even distribution of points either side of the line along the full length.
Allow <u>one</u> 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 sign of the gradient must match the graph. 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 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 substitution into $y = mx + c$.
Read-off must be accurate to half a small square in both the *x* and *y* directions.
Or:
Check the read-off of the intercept directly from the graph.

(e) Value of *P* = candidate's gradient. Value of *Q* = candidate's intercept. [1]
Do not allow a value presented as a fraction.

Unit for *P* ($m\,kg^{-1}$ or $cm\,kg^{-1}$ or $mm\,kg^{-1}$ or $m\,g^{-1}$ or $cm\,g^{-1}$ or $mm\,g^{-1}$) and *Q* (m or cm or mm) correct and consistent with value. [1]

[Total: 20]

2 (a) (ii) Value of circumference in range 30.0 – 50.0 cm to the nearest mm with unit. [1]

(iii) Absolute uncertainty in circumference is between 2 mm – 6 mm. [1]
If repeated readings have been taken, then the absolute uncertainty can be half the range. Correct method used to calculate the percentage uncertainty.

(iv) Value of circumference within 2 cm of first value. [1]

(b) (ii) Raw time values to at least 0.1 s or 0.01 s, value of 0.5 s < *T* < 2.0 s. [1]
Evidence of repeats. [1]

(c) (i) Second value of *T*. [1]
Second value of *T* > first value of *T*. [1]

(ii) Third value of *T*. [1]

(d) (ii) Correct calculation of two values of *k*. [1]
Correct calculation of third value of *k*. [1]

(iii) Justification of significant figures in *k* linked to significant figures in time and *m* (not just "raw readings") [1]

(iv) 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 **4 max.**	**(ii)** Improvements **4 max.**	Do not credit
A	three results not enough /not enough results	take more readings and plot a graph	two results not enough /repeat readings /few readings
B	string too wide for markings on rule	use thinner string	
C	rules have different thicknesses so effective length of loop changes/ /different lengths so not a fair test	use rulers of similar thicknesses/ readings/method to take thickness into account /use rulers of the same length	
D	times are small /large uncertainty in time	use longer strings/improved method of timing	
E	difficult to judge start/ end of/complete oscillation	Position/motion sensor facing the rule /video with timer	position sensor at end or in middle
F	swings of 30 cm ruler highly damped		
G	difficult to make two loops of the same circumference	method by which this can be achieved	
H	large uncertainty in mass	method of measuring mass more precisely	accurate balance

[Total: 20]

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