CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 series

9702 PHYSICS

9702/33 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.

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Cambridge is publishing the mark schemes for the October/November 2012 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 h in range $0.085\,\text{m} \leqslant h \leqslant 0.095\,\text{m}$ consistent with unit. [1]

(c) Value of T in range $0.6\,\text{s} \leqslant T \leqslant 1.5\,\text{s}$ consistent with unit. [1]
Evidence of repeats. [1]

(d) Six sets of readings of h and T or raw times scores 4 marks, five sets scores 3 marks etc.
Help from Supervisor –1. [4]

Range: $h_{max} - h_{min} \geqslant 15.5\,\text{cm}$ [1]

Column headings:
Each column heading must contain a quantity and a unit where appropriate.
The unit must conform to accepted scientific convention e.g. T^2h / s^2m (or $\text{m}\,\text{s}^2$) and h^2/ m^2. [1]

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

Significant figures:
All values of h^2 must have the same number of significant figures as, or one more than, the number of significant figures in h. [1]

Calculation:
Values of T^2h calculated correctly. [1]

(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 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 ⩽ 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 5) for this mark to be scored. Judge by the scatter of all the points about a straight line.
All points must be within ± $0.0025\,\text{m}^2$ ($25\,\text{cm}^2$) in the h^2 direction 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 <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 should be greater than 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 substitution into $y = mx + c$.
Read-off must be accurate to half a small square in both the *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. [1]
Do not allow a value presented as a fraction.

Unit for *P* ($s^2\ m^{-1}$ or $s^2\ cm^{-1}$ or $s^2\ mm^{-1}$) and *Q* ($s^2\ m$ or $s^2\ cm$ or $s^2\ mm$) correct and consistent with value. [1]

[Total: 20]

2 (a) (ii) Value of *L* in range: 5.0 cm $\leqslant L \leqslant$ 15.0 cm with unit to nearest mm. [1]

(b) (ii) Value of *s* in range: 50.0 cm $\leqslant s \leqslant$ 70.0 cm with unit. [1]
Supervisor's help –1.
Evidence of repeat measurements. [1]

(iii) Absolute uncertainty in *s* is between 2 cm – 10 cm. [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) Correct calculation of *x.* [1]

(c) Raw value(s) of *t* greater than 1 s to a precision of 0.1 or 0.01 s with unit. [1]

(d) (i) Correct calculation of *v* using either value of *x* with consistent unit. [1]

(ii) Justification of significant figures in *v* linked to significant figures in *t* and *x* or (*s* – *L*) (not just "raw readings"). [1]

(e) (iii) Second value of *t.* [1]
Second value of *s.* [1]
Quality: correct trend; If *s* increases, *t* increases. [1]

(f) Sensible comment relating to the calculated values of *v*, 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 not enough (to draw a conclusion)	take many readings (for different masses) and plot a graph /calculate more *v* values and compare	'repeat readings' /few readings /take more readings and calculate average *v*
B	the car does not travel in a straight line	method of determining the distance e.g. video + scale/method of marking a path /method of guiding trolley in straight line	
C	times are short /large uncertainty in *t*	use a longer slope /use a steeper slope	trolley too fast
D	difficult to judge when trolley stopped/ difficult to start the stopwatch when all wheels on bench/when trolley at B/when trolley horizontal	improved method of timing eg video with timer or frame by frame/motion sensor placed at end of path/ticker tape timer	light gate(s) /reaction time /human error
E	there is a drop when the trolley reaches the end of the board/at B there is a loss of velocity/kinetic energy	method to smooth transition e.g. thinner board/bevelled edge/thin card placed at transition	
F	difficult to release without applying a force/ velocity /difficult to position head at B after releasing trolley A	method of releasing trolley e.g. card/barrier or electromagnet	air resistance
G	calculation of *x* doesn't take back of trolley into account	detailed method of measuring from wheel to the back of the trolley	measuring l

[Total: 20]

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