**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the October/November 2012 series

## 9702 PHYSICS

**9702/35** 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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**1 (a) (iv)** Value for $I_1$ < 200 mA, with consistent unit. [1]

**(v)** Value for $I_2$ with unit of current. [1]
$I_2 > I_1$ [1]

**(b)** Six sets of readings of $I_1$, $I_2$ and $x$ scores 4 marks, five sets scores 3 marks etc. [4]
Incorrect trend –1.
Major help from Supervisor –2. Minor help from Supervisor –1.

Range: $x_{max} - x_{min} \geqslant 0.500$ m. [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. $I$ / A or $I$(A), 1/$x$ (m$^{-1}$), $I_1/I_2$

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

Significant figures: [1]
All values of $I_2 / I_1$ must have the same significant figures as, or one more than, the least number of significant figures in raw $I_1$ and $I_2$

Calculation: [1]
Values of $I_2 / I_1$ calculated correctly.

**(c) (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.
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 ± 0.25 m$^{-1}$ in the 1/$x$ 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 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 sign of the gradient must match the graph.
The hypotenuse of the triangle used must 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.

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

Unit for *P* (m or cm or mm, consistent with value) and *Q* (no unit) correct. [1]

**[Total: 20]**

**2 (a) (i)** Value for *D* in range 10 to 20 mm to the nearest mm, with unit. [1]

**(ii)** Percentage uncertainty in *D* based on an absolute uncertainty of 0.5, 1, 2 or 3 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.

**(b) (ii)** Value of *x* to the nearest mm, in range 1.3 – 1.7 cm, with unit. [1]

**(iii)** Correct calculation of *V* with consistent unit. [1]

**(c) (iv)** Raw time values to 0.1 s or 0.01 s. Value of *T* in range 0.1 – 1.0 s. [1]

Evidence of repeat measurements. [1]

**(d) (iv)** Second value of *x.* [1]

**(e)** Second value of *T.* [1]

Second value of *T* < first value of *T.* [1]

**(f) (i)** Correct calculation of two values of *k.* [1]

**(ii)** Justification of significant figures in *k* linked to significant figures in *D, x* and time (not just "raw readings"). [1]

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

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**(g)**

| | **(i)** Limitations **4 max.** | **(ii)** Improvements **4 max.** | Do not credit |
|---|---|---|---|
| **A** | two results not enough | take more readings<br>and plot a graph/<br>calculate more *k* values and<br>compare | "repeat readings" on its own<br><br>few readings/<br>only one reading<br><br>take more readings and (calculate) average *k* |
| **B** | parallax error in *D*/<br>difficult to measure *D* because loop is in the way | use Vernier<br>calipers/micrometer/travelling microscope to measure *D** | use string |
| **C** | *V* not accurate because<br>*D* not internal diameter | measure thickness/diameter of wire using micrometer<br><br>use travelling microscope/Vernier calipers to measure *D** | |
| **D** | mass swings side-to-side/<br>horizontal movement/ moves in more than one plane/non-uniform oscillation | | |
| **E** | times are small/large<br>uncertainty in *T* | use bigger mass<br><br>improved timing method e.g. motion/position sensor below weight/video with timer/video and view frame-by-frame** | light gates/<br>human error/reaction time/<br>time more cycles/<br>high frequency oscillations |
| **F** | difficult to judge<br>start of/end of/complete oscillation | fixed/fiducial marker<br><br>improved timing method e.g.<br>motion/position sensor below weight/video with timer/video and view frame-by-frame** | marker fixed to spring/<br>marker placed at extreme(s) of oscillation<br><br>light gates |
| **G** | metal strip bends/<br>not horizontal | use stiffer strip/<br>thicker strip/support strip at both ends. | strip not straight/<br>move spring/use stronger strip |

* Credit in $B_s$ or $C_s$, but not both.
** Credit in $E_s$ or $F_s$, but not both.

**[Total: 20]**

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