**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

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

# MARK SCHEME for the May/June 2012 question paper

# for the guidance of teachers

## 9702 PHYSICS

**9702/34** Paper 3 (Advanced Practical Skills 2), 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 must be read in conjunction with the question papers and the report on the examination.

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**1 (a) (iii)** Value for $I_0$ in range 2.0 to 4.0 mA, with unit. [1]

**(b) (ii)** First value of $I$ (greater than $I_0$). [1]

**(c)** Six sets of readings of $R$ and $I$ scores 5 marks, five sets scores 4 marks etc. [5]
Major help from Supervisor –2. Minor help from Supervisor –1. Incorrect trend then –1.

Range: [1]
Values of $R$ must include 0.22 kΩ or 0.33 kΩ **and** 3.3 kΩ or 4.7 kΩ.

Column headings: [1]
Each column heading must contain a quantity and a unit.
There must be some distinguishing mark between the quantity and the unit.

Consistency: [1]
Values of $I$ must be given either all to the nearest 0.1 mA or all to the nearest 0.01 mA.

Significant figures: [1]
Every value of 1/$R$ must be given to either 2 or 3 significant figures.

Calculated values: [1]
1/$R$ calculated correctly.

**(d) (i)** Axes: [1]
Sensible scales must be used (no awkward scales such as 3:10).
Scales must be chosen so that the plotted points must 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 3 large squares apart.

Plotting of points: [1]
All observations in the table must be plotted.
Diameter of plots must be ‹ half a small square (no blobs). Plotting must be accurate to half a small square.

Quality: [1]
Range of $I$ must be at least 2 mA, and all points must be within 0.5 mA of a straight line.
All points in the table must be plotted (at least 5) for this mark to be scored.

**(ii)** Line of best fit: [1]
Judge by balance of all points on the grid about the candidate's line (at least 5 points).There must be an even distribution of points either side of the line along the full length.
One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate.
Line must not be kinked or thicker than half a small square.

**(d) (iii)** Gradient: [1]
The hypotenuse 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.
Do not allow $\Delta x / \Delta y$.

*y*-intercept: [1]
Either:
Correct read off from a point on the line is substituted into $y = mx + c$.
Or:
Check read-off of the intercept directly from the graph.

**(e)** Calculation of *b* is correct, [1]
i.e. *b* = (candidate's gradient value)/(candidate's intercept value).

Value for *b* in range 0.8 kΩ to 1.2 kΩ, with unit. [1]

**[Total: 20]**

**2 (b)** Value of *d* in range 0.80 to 0.99 mm, to nearest 0.01 mm, with unit. [1]
Evidence of repeated measurements for *d*. [1]

**(c)** Percentage uncertainty in *d* based on absolute uncertainty of 0.01 mm. [1]
Correct calculation to get percentage uncertainty.

**(d) (iv)** Value of $\theta$ in range 91° to 180° to nearest degree, with unit. [1]
Evidence of repeated measurements for $\theta$. [1]

**(v)** Correct calculation of $\sin(180° - \theta)$. [1]
$\sin(180° - \theta)$ given to 2 or 3 s.f. [1]

**(e)** Second value of *d*. [1]
Second value of $\theta$. [1]
Quality: $\theta$ larger for smaller *d*. [1]

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

**(ii)** Valid conclusion based on the calculated values of *k*. Candidate must test correctly against a stated criterion. [1]

**(g)**

| | **(i)** Limitations **4 max.** | **(ii)** Improvements **4 max.** | No credit/not enough |
|---|---|---|---|
| **A** | two results not enough | take more readings and plot a graph/<br>calculate more *k* values and compare | 'repeat readings' on its own/<br>few readings/<br>take more readings and (calculate) average *k*/<br>only one reading |
| **B** | $\theta$ (or angle, or scale reading, or protractor reading, or pointer reading) is difficult to measure, with reason linked to rapid motion or short time | video and view playback/<br>slow motion camera/<br>video to read angle/<br>add a 'max hold' pointer/<br>angle sensor with data logger (or computer) | just 'use a computer'/<br>'reading' difficult to measure |
| **C** | parallax error in $\theta$ measurement | use mirror scale/<br>description of method to reduce error | view at right angles/<br>trial and improvement |
| **D** | $\theta$ (or reading) is difficult (or inaccurate, or imprecise) because pointer is thick | – | use thinner pointer/<br>use larger scale |
| **E** | pointer attachment moves | description of secure method of attachment | |
| **F** | – | description of method of fixing block to bench | |

**[Total: 20]**