**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

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

# MARK SCHEME for the October/November 2012 series

## 9702 PHYSICS

**9702/36** 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 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 October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE
International Examinations

**1 (b) (ii)** Value of raw $x$ in range $2\,\text{mm} \leq x \leq 15\,\text{mm}$. Consistent with unit. [1]

**(c) (iv)** Value of $R$ in range $1\,\text{k}\Omega$ to $200\,\text{k}\Omega$ [1]

**(d)** Six sets of readings of $p$ and $R$ scores 5 marks, five sets scores 4 marks etc. [5]
Minor help from supervisor –1, major help –2.
Incorrect trend / no $p$ values / no $R$ values then –1.

Range of $p$: $p_{max} - p_{min} \geq 15\,\text{cm}$ [1]

Column headings: [1]
Each column heading must contain a quantity and a unit.
The unit must conform to accepted scientific convention e.g. $d$ / cm, $d^{1.5}$ / $\text{m}^{1.5}$, $d^{1.5}$ ($\text{m}^{1.5}$) or $d^{1.5}$ in $\text{m}^{1.5}$, $\sqrt{d^3}$ / $\sqrt{\text{m}^3}$, $R$ / $\text{k}\Omega$

Consistency of presentation of raw readings: [1]
All raw values of $p$ must be given to the nearest mm.

Significant figures: [1]
All values of $d^{1.5}$ must be given to the same s.f. as (or one more than) the s.f. in $d$.

Calculation: [1]
Values of $d^{1.5}$ calculated correctly.

**(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 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 on the graph grid.
Diameter of plots must be ≤ half a small square (no "blobs").
Points must be plotted correctly to an accuracy of half a small square in both $x$ 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 points about a straight line.
All points must be within $0.005\,\text{m}^{1.5} = 5\,\text{cm}^{1.5} = 160\,\text{mm}^{1.5}$ of a straight line, in the $d^{1.5}$ direction.

**(ii)** Line of best fit: [1]
Judged by balance of all points on the grid (at least 5 points) about the candidate's line. 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.

**(e) (iii)** Gradient:

© Cambridge International Examinations 2012

Sign of gradient must match graph. [1]
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 $x$ and $y$ directions.
The method of calculation must be correct.

$y$-intercept: [1]
Either:
Check correct read-offs 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.

**(f)** Value of $a$ = candidate's gradient. Value of $b$ = candidate's intercept. [1]
Do not allow a value presented as a fraction.

Unit for $a$ (e.g. $\text{k}\Omega\,\text{cm}^{-1.5}$). [1]

**[Total: 20]**

**2 (a) (i)** Value of raw $d$ to nearest mm only, with unit. [1]

**(ii)** Absolute uncertainty between 2 mm and 5 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(s) of raw $h$ in range $13.0\,\text{cm} \leq h \leq 17.0\,\text{cm}$, with unit. [1]

**(b) (i)** Value(s) of raw $t$ in range 1.0 s to 10.0 s, with unit, to at least 0.1 s. [1]

Evidence of repeat readings of $t$. [1]

**(ii)** Correct calculation of $v$, with consistent unit. [1]

**(iii)** Valid justification for s.f. in $v$ based on s.f. in $t$ and $h$. [1]
Not just 'raw readings'.

**(c) (i)** Second value of $d$. [1]

**(ii)** Second value of $t$. [1]

Quality: Correct trend. When $d$ decreases (i.e. second $d$ value is less than first $d$ value) $t$ also decreases (i.e. second $t$ value is less than first $t$ value) or vice versa. [1]

© Cambridge International Examinations 2012

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

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

**(e)**

| | **(i)** Limitations **4 max.** | **(ii)** Improvements **4 max.** | Do not credit |
|---|---|---|---|
| **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** | difficult to form a perfect cylinder / diameter of cylinder varied | method to make uniform cylinder e.g. moulds / pastry cutter idea<br>placing all plasticine inside | pre-sized cylinders /<br>pastry cutter idea<br>removing off-cuts (mass must stay constant) /<br>repeat diameter and average /<br>no change of material |
| **C** | cylinder does not rise steadily / oscillates as rises/hits sides / problem linked to sticking pulley | method to overcome sticking pulley e.g. lubricant | use wider tube |
| **D** | difficult to start/stop the watch at the instant when cylinder passes mark(s) / reaction time error linked to start/stop of stopwatch | method to improve time measurement e.g. light gates with timer / video with timer or frame by frame / motion sensor below X | video to take reading /<br>parallax linked to marks or *h* / reaction time error on its own / timer gates / video and playback<br><br>knowing / judging when to start/stop stopwatch |
| **E** | difficult to time as the time is small / large uncertainty in time / cylinder moves too fast linked to time | method to increase time e.g. increase *h* / longer tube / more plasticine / decrease mass of X | larger tube |
| **F** | difficult to measure diameter of cylinder due to curved shape of sides | improved method for measurement e.g. (vernier) calipers / set squares with detail | parallax error in *d* /<br>calipers linked to *h* |

Do not allow: repeated readings / human error using stopwatch / helpers / use a computer /use of micrometer screw gauge

**[Total: 20]**

© Cambridge International Examinations 2012