MARK SCHEME for the October/November 2014 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 2014 series for
most Cambridge IGCSE®, Cambridge International A and AS Level components and some
Cambridge O Level components.
1 (a) (ii) Value of voltmeter reading with unit in range $0.30 \, \text{V} \leq V \leq 0.70 \, \text{V}$. 

(b) (ii) Value of $l$ with unit in range $20 \, \text{cm} \leq l \leq 80 \, \text{cm}$. 

(c) Six sets of readings of $R$ and $l$ scores 5 marks, five sets (or use of $R = 0$) scores 4 marks etc.


Range:
Values of $R$ must include $0.22 \, \text{k}\Omega$ or $0.33 \, \text{k}\Omega$, and $4.7 \, \text{k}\Omega$ or $3.3 \, \text{k}\Omega$.

Column headings:
Each column heading must contain a quantity and a unit. The presentation of quantity and unit must conform to accepted scientific convention e.g. $1/R/k\Omega^{-1}$ or $1/R/(k\Omega)^{-1}$, $1/l/(m^{-1})$ or $1/l/(1/m)$ but not $1/R/k\Omega^{-1}$, $1/R/(k\Omega)$ or $1/l/(m)$.

Consistency:
All values of raw $l$ must be given to the nearest mm only.

Significant figures:
Every value of $1/l$ must given to the same s.f. as (or one greater than) the s.f. in raw $l$.

Calculation:
Values of $1/R$ calculated correctly to the number of significant figures given by the candidate.

(d) (i) Axes:
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 should be no more than three large squares apart.

Plotting:
All observations in the table must be plotted. Diameter of points must be ≤ half a small square (no “blobs”). Plotted points must be accurate to within half a small square.

Quality:
All points in the table must be plotted (at least 5) for this mark to be awarded. Scatter of points must be less than $\pm 0.001 \, \text{cm}^{-1}$ of $1/l$ from a straight line.

(ii) Line of best fit:
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. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. Lines must not be kinked or thicker than half a small square.
(iii) Gradient: 
The hypotenuse of the triangle 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.

y-intercept: 
Either: 
correct read-off from a point on the line substituted into \( y = mx + c \).
Read-off must be accurate to half a small square in both x and y directions. 
Or: 
correct read-off of the intercept directly from the graph.

(e) \( a = \) the value of the gradient and \( b = \) the value of the y-intercept. 

Unit for \( a \) and unit for \( b \) consistent with values given. 
e.g. kΩm\(^{-1}\) for \( a \) and m\(^{-1}\) for \( b \).

[Total: 20]
<table>
<thead>
<tr>
<th>(g)</th>
<th>(i) Limitations (4 max.)</th>
<th>(ii) Improvements (4 max.)</th>
<th>Do not credit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>Two readings not enough to draw a conclusion</td>
<td>Take more readings (for different (d)) and plot a graph / take more readings and compare (k) values</td>
<td>Not enough readings / repeat readings / few readings / too few readings / ‘two readings’ (on its own)</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Difficult to measure (L) or (d) with reason e.g. parallax / transparent liquid / hanging above bench / bottle not vertical / bottle not uniform</td>
<td>Improved method to measure (L) or (d) e.g. detailed use of set square on bench / colour water / add scale to bottle / place bottle on bench and use rule</td>
<td>Marks on bottle / finding centre of nail / meniscus problem</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Difficult to judge the end of oscillation</td>
<td>Improved method of timing e.g. video with timer / video and view frame by frame / put marker at the centre of oscillation / motion sensor with correct position i.e. placed so the bottle moves towards and away from it.</td>
<td>Release height / amplitude varies / human reaction time / video and play back / high speed camera / slow motion camera / use of motion sensor / use of light gates /</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>(d) varies as bottle swings</td>
<td>Use sand (or named material that can be poured)</td>
<td></td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>Difference in (t) values is small</td>
<td>Use larger change in depths</td>
<td>Use longer bottle / (t) is small</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>Stand (or nail) moves while bottle oscillates</td>
<td>Method to stabilise clamp (or nail) e.g. G-clamp / add weight to stand / clamp nail between wooden blocks</td>
<td>Glue stand to bench</td>
</tr>
</tbody>
</table>

Do not credit: damping / release force / friction / hitting stand / fans / problems with counting / use computer / just “use data logger” on its own.

[Total: 20]