CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9702/53  Paper 5 (Planning, Analysis and Evaluation),
maximum raw mark 30

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the examination. It shows the basis on which Examiners were instructed to award marks. It does not
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1 Planning (15 marks)

Defining the problem (3 marks)

P V is the independent variable, or vary V and f is the dependent variable, or measure f.
Or f is the independent variable, or vary f and V is the dependent variable, or measure V. [1]

P Change f (allow V) until the mass leaves/gap between plate. [1]

P Keep the position of the mass constant. (Do not allow keep mass constant.) [1]

Methods of data collection (5 marks)

M Labelled diagram showing signal generator/a.c. supply connected to vibrator with two wires with mass on plate. At least two labels needed. [1]

M Voltmeter/c.r.o. connected in parallel with vibrator in a workable circuit. [1]

M Measure f or T from signal generator/c.r.o. (Allow detailed use of motion sensor/stroboscope.) [1]

M Detail regarding mass leaving the plate: listen to noise, look for gap. [1]

M Repeat each experiment for the same value of V (allow f if consistent with above) and average. [1]

Method of analysis (2 marks)

Plot a graph of:

<table>
<thead>
<tr>
<th>A</th>
<th>$f^2$ against $1/V$</th>
<th>$1/V$ against $1/f^2$</th>
<th>$f$ against $1/\sqrt{V}$</th>
<th>$1/\sqrt{V}$ against $f$</th>
<th>$\lg V$ against $\lg f$</th>
<th>$\lg f$ against $\lg V$</th>
</tr>
</thead>
</table>

or

<table>
<thead>
<tr>
<th>V</th>
<th>$1/f^2$ against $1/V$</th>
<th>$\sqrt{V}$ against $1/f$</th>
<th>$1/f$ against $\sqrt{V}$</th>
</tr>
</thead>
</table>

or

$A \quad k = \frac{\text{gradient} \times \pi^2}{2} \quad k = \frac{\pi^2}{\text{gradient}^2} \quad k = \frac{\pi^2}{\text{gradient}^2} \quad k = \frac{\pi^2}{2} \quad k = \pi^2 \times 10^c \quad k = \pi^2 \times 10^{2c}$ [1]

Safety considerations (1 mark)

S Precaution linked to mass leaving vibrating plate, e.g. use safety screen/goggles/sand tray. [1]
Additional detail (4 marks)

D Relevant points might include
1 Wait for vibrator to oscillate evenly
2 Method to determine period of oscillation from c.r.o., i.e. one time period \times time-base
3 Method to determine \( f \) from c.r.o. having determined \( T \), i.e. \( f = \frac{1}{T} \)
4 Method to determine \( V \) from c.r.o, i.e. amplitude (height) \times y\text{-}gain
5 Relationship is valid if the graph is a straight line passing through the origin
   [For lg – lg graph the gradient must be correct (–2 or –0.5)]
6 Determine \( f \) (allow \( V \) if consistent with above) by increasing and decreasing \( V \) or \( f \)
7 Clean surfaces of metal plate/small mass
8 Spirit level to keep plate horizontal/eye level to look for gap

Do not allow vague computer methods.
### Analysis, conclusions and evaluation (15 marks)

<table>
<thead>
<tr>
<th>Mark</th>
<th>Expected Answer</th>
<th>Additional Guidance</th>
</tr>
</thead>
</table>
| (a)  | A1 gradient = \( m \)  
y-intercept = \( \log k \) | Allow a mixture of significant figures. T1 (first column) and T2 (second column) must be values in table. |
| (b)  | T1  
T2 |
| 1.70 or 1.699 | 1.312 or 1.3118 |
| 1.79 or 1.785 | 1.204 or 1.2041 |
| 1.85 or 1.851 | 1.114 or 1.1139 |
| 1.90 or 1.903 | 1.041 or 1.0414 |
| 1.95 or 1.954 | 0.98 or 0.978 |
| 2.00 or 1.996 | 0.90 or 0.903 |
| U1   | From ±0.01 to ±0.03 | Allow more than one significant figure. |
| (c)  | G1 Six points plotted correctly |
|      | G2 Line of best fit |
|      | G3 Worst acceptable straight line. Steepest or shallowest possible line that passes through all the error bars. |
| (iii)| C1 Gradient of line of best fit |
|      | U3 Uncertainty in gradient |
| (iv) | C2 y-intercept |

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Uncertainties in Question 2

(c) (iii) Gradient [U3]

uncertainty = gradient of line of best fit – gradient of worst acceptable line

uncertainty = \( \frac{1}{2} \) (steepest worst line gradient – shallowest worst line gradient)

(iv) [U4]

uncertainty = y-intercept of line of best fit – y-intercept of worst acceptable line

uncertainty = \( \frac{1}{2} \) (steepest worst line y-intercept – shallowest worst line y-intercept)

(d) (ii) [U5]

\( \text{max } k = 10^{\text{max } y\text{-intercept}} \) and \( \text{min } k = 10^{\text{min } y\text{-intercept}} \)

\[
\text{percentage uncertainty} = \frac{\text{max } k - \text{min } k}{k} \times 100 = \frac{k - \text{min } k}{k} \times 100 = \frac{1}{2} \left( \text{max } k - \text{min } k \right) \times 100
\]