Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/05**

Paper 5 Planning, Analysis and Evaluation **For Examination from 2016**

SPECIMEN MARK SCHEME

1 hour 15 minutes

MAXIMUM MARK: 30

This document consists of **3** printed pages and **1** blank page.

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CAMBRIDGE International Examinations

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Question 1 Planning

Defining the problem

P Vary pressure.

P For different values of pressure, measure frequency.

D Keep frequency of sound wave generated constant.

D Keep temperature of the air constant.

Methods of data collection

M Labelled diagram of apparatus: container with source of sound.

M Method of varying *p*: e.g. use of pump to remove air/valve to allow air in.

M Method of measuring *p*: e.g. Bourdon gauge/pressure gauge/manometer.

M Use microphone connected to oscilloscope to measure frequency.

D Method to determine the period of the wave including the use of the timebase.

D $f = 1/\text{period}$.

Method of analysis

A Plot f against p^2; allow lg f against lg p.

A Relationship is correct if graph is a straight line through the origin.

A k = gradient.

Safety considerations and additional detail

D Use a safety screen/goggles to prevent glass entering eyes if glass container shatters.

D Use of *y*-axis on c.r.o. to check that initial sound has constant amplitude.

D Need to seal points where wires pass through bell jar.

D Use loud sound to obtain measurable readings at low pressures.

D Check temperature with a thermometer.

Award P, M and A marks where seen. Award a maximum of 6 D marks. **[Total: 15]**

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Question 2 Analysis, conclusions and evaluation

<table>
<tr><td></td><td>Mark</td><td>Expected Answer</td><td>Additional Guidance</td><td></td></tr>
<tr><td>(a)</td><td>A</td><td>Gradient = c^2</td><td></td><td>[1]</td></tr>
<tr><td>(b)</td><td>T1</td><td>R^2/ 10^{-4} m^2 and E^3 / MeV^3</td><td>Allow R^2 (10^{-4} m^2) and E^3 (MeV^3)</td><td></td></tr>
<tr><td></td><td>T2</td><td><table><tr><td>16.0 or 16.00</td><td>156 or 155.7</td></tr><tr><td>18.9 or 18.92</td><td>183 or 183.3</td></tr><tr><td>23.0 or 23.04</td><td>221 or 221.4</td></tr><tr><td>25.5 or 25.50</td><td>248 or 247.7</td></tr><tr><td>32.5 or 32.49</td><td>310 or 310.3</td></tr></table></td><td>Values must correspond to table.</td><td></td></tr>
<tr><td></td><td>U1</td><td>From $\pm$ 0.4 to $\pm$ 0.6</td><td>Allow more than one significant figure.</td><td>[3]</td></tr>
<tr><td>(c)(i)</td><td>G1</td><td>Five points plotted correctly</td><td>Must be within half a small square. Penalise ‘blobs’. Ecf allowed from table.</td><td></td></tr>
<tr><td></td><td>U2</td><td>All error bars in R^2 plotted correctly</td><td>Must be accurate within half a small square.</td><td>[2]</td></tr>
<tr><td>(c)(ii)</td><td>G2</td><td>Line of best fit</td><td>Allow ecf from points plotted incorrectly – examiner judgement.</td><td></td></tr>
<tr><td></td><td>G3</td><td>Worst acceptable straight line. Steepest or shallowest possible line that passes through <u>all</u> the error bars.</td><td>Line should be clearly labelled or dashed. Should pass from top of top error bar to bottom of bottom error bar or bottom of top error bar to top of bottom error bar. Mark scored only if all error bars are plotted.</td><td>[2]</td></tr>
<tr><td>(c)(iii)</td><td>C1</td><td>Gradient of best fit line</td><td>The triangle used should be at least half the length of the drawn line. Check the read-offs. Work to half a small square. Do not penalise POT. (Should be about 1.1×10^{-5})</td><td></td></tr>
<tr><td></td><td>U3</td><td>Uncertainty in gradient</td><td>Method of determining absolute uncertainty Difference in worst gradient and gradient.</td><td>[2]</td></tr>
<tr><td>(d)</td><td>C2</td><td>$c = \sqrt{\text{gradient}}$</td><td>Gradient must be used. Should be about 0.0033.
Do not penalise POT.</td><td></td></tr>
<tr><td></td><td>C3</td><td>m MeV$^{-3/2}$</td><td></td><td></td></tr>
<tr><td></td><td>U4</td><td>Absolute uncertainty in c</td><td>Check working.</td><td>[3]</td></tr>
<tr><td>(e)(i)</td><td>C4</td><td>E given to 2 or 3 s.f.</td><td></td><td>[1]</td></tr>
<tr><td>(e)(ii)</td><td>U5</td><td>Percentage uncertainty in E</td><td>$\frac{2}{3}\left(\frac{\Delta R}{R}+\frac{\Delta c}{c}\right)\times 100 = \frac{1}{3}\left(2\frac{\Delta R}{R}+\frac{\Delta m}{m}\right)\times 100$</td><td>[1]</td></tr>
</table>

[Total: 15]

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