CAMBRIDGE
International Education

# Cambridge International AS & A Level

**PHYSICS** **9702/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2025**

MARK SCHEME

Maximum Mark: 30

**Published**

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **11** printed pages.

## Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

## Annotations

| Annotation | Meaning |
|---|---|
| BOD | benefit of the doubt given |
| ✓ 1 | correct awarding one mark from additional detail 1.<br>similar numbered ticks are used for additional detail 2, 3, 4 etc. |
| ✓ | correct point or mark awarded |
| P | defining the problem mark |
| ECF | error carried forward applied |
| SF | error in number of significant figures |
| I | incorrect or insufficient point ignored while marking the rest of the response |
| ✗ | incorrect point or mark not awarded |
| U | incorrect unit |
| ^ | information missing or insufficient for credit |

| **Annotation** | **Meaning** |
|---|---|
| MO | methods of data collection mark |
| SEEN | point has been noted, but no credit has been given<br>or<br>blank page seen |
| R | repeat of point previously awarded mark |

| Question | Answer | Marks |
|---|---|---|
| 1 | **Defining the problem** | |
| | vary $v$ and measure $I$ **or** $v$ is the independent variable and $I$ is the dependent variable | **1** |
| | keep $A$ and $R$ constant | **1** |
| | **Methods of data collection** | |
| | labelled diagram of workable experiment including:<br>• fan positioned in line with the turbine so that blades of both fan and turbine overlap<br>• fan on bench<br>• fan labelled and one other label from bench, turbine, blade(s) (of turbine), terminals, $L$ | **1** |
| | workable circuit diagram showing resistor connected to an ammeter in series with the terminals of the turbine using correct circuit symbols | **1** |
| | method to vary $v$, e.g. change speed of fan / change distance between fan and blades / vary current in or p.d. across fan | **1** |
| | method to determine temperature $T$, e.g. use a thermometer | **1** |
| | **Method of Analysis** | |
| | plot a graph of $I^2$ against $v^3$ or equivalent (e.g. lg $I$ against lg $v$ or 2 ln $I$ against ln $v$) | **1** |
| | relationship valid if a straight line is produced passing through the origin<br>(For lg $I$ against lg $v$: relationship valid if a straight line with gradient = 1.5 is produced) | **1** |
| | $Q = \frac{2TR \times \text{gradient}}{AP}$<br>(For lg $I$ against lg $v$: $Q = \frac{2TR \times 10^{2 \times y\text{-intercept}}}{AP}$ ) | **1** |

| Question | Answer | Marks |
|---|---|---|
| 1 | **Additional detail including safety considerations** | **6** |
| | D1 precaution with reason linked to (moving) fan blades / turbine blades, e.g. keep away from the fan to avoid (moving) blades **or** use a screen around the fan / turbine to avoid (moving) blades<br>**or**<br>precaution with reason linked to prevent air / dust particles in eye, e.g. use goggles to avoid air stream (into eye) | |
| | D2 clamp turbine / fan to bench | |
| | D3 keep $P$ and $T$ constant | |
| | D4 $T = t + 273$ | |
| | D5 method to determine $A$: use a rule(r) / calipers to measure $L$ **and** $A = \pi L^2$ | |
| | D6 repeat measurements of $L$ in different positions / different blades **and** average | |
| | D7 method to measure $v$, e.g. use an anemometer or air speed meter<br>**or**<br>method to measure $P$, e.g. use a manometer or barometer or pressure gauge | |
| | D8 wait for steady / constant air flow / movement of blades / current | |
| | D9 method to determine $R$, e.g.:<br>separate circuit showing ohmmeter connected to $R$ only<br>**or**<br>terminals of turbine connected correctly to resistor and ammeter and voltmeter across resistor **and** $R = V / I$<br>**or**<br>separate workable circuit with power supply resistor, ammeter and voltmeter across $R$ **and** $R = V / I$ | |
| | D10 method to check temperature / pressure is constant, e.g. measure temperature / pressure several times / before and after | |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>gradient = $n$<br>$y$-intercept = $\lg\frac{2\pi}{k}$</td><td><b>1</b></td></tr>
<tr><td>2(b)</td><td>
<table>
<tr><th>lg ($r$ / $10^8$ m)</th><th>lg ($T$ / $10^3$ s)</th></tr>
<tr><td>0.152 or 0.1523</td><td>(1.72 or 1.716) ± 0.04</td></tr>
<tr><td>0.270 or 0.2695</td><td>(1.91 or 1.908) ± 0.03</td></tr>
<tr><td>0.377 or 0.3766</td><td>(2.08 or 2.079 or 2.0792) ± 0.04</td></tr>
<tr><td>0.470 or 0.4698</td><td>(2.23 or 2.230 or 2.2304) ± 0.03</td></tr>
<tr><td>0.576 or 0.5763</td><td>(2.38 or 2.380 or 2.3802) ± 0.04</td></tr>
<tr><td>0.723 or 0.7226</td><td>(2.59 or 2.591 or 2.5911) ± 0.03</td></tr>
</table>
Values of lg ($r$ / $10^8$ m) and lg ($T$ / $10^3$ s) correct as shown above.</td><td><b>1</b></td></tr>
<tr><td></td><td>Uncertainties in lg ($T$ / $10^3$ s) correct as shown above.</td><td><b>1</b></td></tr>
<tr><td>2(c)(i)</td><td>Six points from <b>(b)</b> plotted correctly.<br>Must be within half a small square. Diameter of points must be less than half a small square.</td><td><b>1</b></td></tr>
<tr><td></td><td>Error bars in lg ($T$ / $10^3$ s) plotted correctly.<br>All error bars must be plotted. Total length of bar must be accurate to less than half a small square and symmetrical.</td><td><b>1</b></td></tr>
</table>

| Question | Answer | Marks |
|---|---|---|
| 2(c)(ii) | Straight line of best fit drawn.<br>Thickness of the line must be less than half a small square.<br>Do not accept line from top point to bottom point.<br>Line must pass between (0.19, 1.80) and (0.21, 1.80) **and** between (0.645, 2.50) and (0.66, 2.50). | **1** |
| | Worst acceptable line drawn (steepest or shallowest possible line that passes through all the error bars).<br>Thickness of the line must be less than half a small square.<br>All error bars must be plotted. | **1** |
| 2(c)(iii) | Gradient determined with clear substitution of data points into $\Delta y / \Delta x$.<br>Distance between data points must be greater than half the length of the drawn line. | **1** |
| | Gradient determined of worst acceptable line with clear substitution of data points into $\Delta y / \Delta x$.<br><br>uncertainty = (gradient of line of best fit – gradient of worst acceptable line)<br>**or**<br>uncertainty = ½ (steepest worst line gradient – shallowest worst line gradient) | **1** |
| 2(c)(iv) | *y*-intercept determined by substitution of correct point with consistent powers of ten into $y = mx + c$. | **1** |
| | *y*-intercept of worst acceptable line determined by substitution into $y = mx + c$.<br><br>uncertainty = *y*-intercept of line of best fit – *y*-intercept of worst acceptable line<br>**or**<br>uncertainty = ½ (steepest worst line *y*-intercept – shallowest worst line *y*-intercept)<br><br>Do not accept ECF from false origin method. | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(d) | Value of *n* determined using gradient **and** *n* **and** *k* given to 2 or 3 significant figures.<br>$n = \text{gradient} = \textbf{(c)(iii)}$ | **1** |
| | Value of *k* determined using *y*-intercept.<br>Correct method must be seen.<br>$k = \dfrac{2\pi}{10^{y\text{-intercept}}} = \dfrac{2\pi}{10^{\textbf{(c)(iv)}}}$ | **1** |
| | Absolute uncertainties in *n* **and** *k* determined.<br>Absolute uncertainty in *n* = absolute uncertainty in gradient<br>**and**<br>$\Delta k = \dfrac{2\pi}{10^{y\text{-intercept}}} - \dfrac{2\pi}{10^{\text{WAL } y\text{-intercept}}}$<br>Correct method must be seen. | **1** |
| 2(e) | *r* determined to a minimum of 2 significant figures from **(c)(iii)** and **(c)(iv)** or **(d)** with correct substitution **and** correct power of ten.<br>$r = 10^{\frac{\lg 1380 - y\text{-intercept}}{\text{gradient}}} \times 10^{8}$<br>**or**<br>$r = \sqrt[n]{\dfrac{k \times 1380}{2\pi}} \times 10^{8}$ | **1** |