CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/54**

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.

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 standard isation 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. 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 or blank page seen
R	repeat of point previously awarded mark

Question	Answer	Marks
1	**Defining the problem**	
	vary m and measure f **or** m is the independent variable and f is the dependent variable	**1**
	keep f_0 constant	**1**
	Methods of data collection	
	labelled diagram of workable experiment including: • turntable base and motor on bench • two labels from turntable, motor, belt, C, putty, bench, release mechanism	**1**
	workable circuit showing terminals of motor connected to (d.c.) supply	**1**
	method to measure time to determine f and f_0, e.g. use a stopwatch to measure (n)t **and** method to measure m, e.g. use a (top-pan) balance	**1**
	measure the time t for n revolutions **and** $T = t / n$ **and** $f = 1 / T$ **or** $f = n / t$	**1**
	Method of Analysis	
	plots a graph of $\frac{1}{f}$ against m or equivalent Do not accept logarithms.	**1**

Question	Answer	Marks
1	$\frac{1}{f}$ against m | m against $\frac{1}{f}$ $K = \frac{r^2}{f_0 \times \text{gradient}}$ | $K = \frac{r^2 \times \text{gradient}}{f_0}$	**1**
	$\frac{1}{f}$ against m | m against $\frac{1}{f}$ $\beta = f_0 \times y\text{-intercept}$ | $\beta = -\frac{f_0 \times y\text{-intercept}}{\text{gradient}}$ **or** $\beta = -\frac{r^2 \times y\text{-intercept}}{K}$	**1**

Question	Answer	Marks
1	**Additional detail including safety considerations**	**6**
	D1 precaution linked to <u>putty</u> leaving turntable, e.g. screens around apparatus / cushions to prevent putty from leaving bench	
	D2 keep *r* <u>constant</u>	
	D3 use rule(r) to measure *r*	
	D4 stand and fixed point located above P (to ensure *r* is constant)	
	D5 method to ensure putty is dropped at (constant) distance *r*, e.g.; fixed location above the turntable to drop putty to keep *r* constant **or** draw a circle of radius *r* on the turntable	
	D6 method to keep f_0 constant, e.g. adjust the rheostat to keep the current in the motor constant / check ammeter	
	D7 clamp motor and/or turntable (base) <u>to bench</u>	
	D8 lubricate the turntable to reduce friction	
	D9 repeat experiment for the same value of *m* **and** determine the average *f*	
	D10 relationship valid <u>if</u> a straight line is produced (with *y*-intercept = $\frac{\beta}{f_0}$) Do not accept line through the origin.	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>gradient = $D\lambda$</td><td>1</td></tr>
<tr><td rowspan="2">2(b)</td><td>
<table>
<tr><th>$\frac{1}{s}$ / mm^{-1}</th><th>y / mm</th></tr>
<tr><td>5.6 or 5.56</td><td>3.30</td></tr>
<tr><td>4.8 or 4.76</td><td>2.89</td></tr>
<tr><td>4.2 or 4.17</td><td>2.51</td></tr>
<tr><td>3.7 or 3.70</td><td>2.26</td></tr>
<tr><td>3.2 or 3.23</td><td>1.96</td></tr>
<tr><td>2.6 or 2.63</td><td>1.59</td></tr>
</table>
Values of $\frac{1}{s}$ and y correct as shown above.</td><td>1</td></tr>
<tr><td>Uncertainties in $\frac{1}{s}$ from $\pm$ 0.3 to $\pm$ 0.07.</td><td>1</td></tr>
<tr><td rowspan="2">2(c)(i)</td><td>Six points from (b) plotted correctly.
Must be within half a small square. Diameter of points must be less than half a small square.</td><td>1</td></tr>
<tr><td>Error bars in $\frac{1}{s}$ plotted correctly.
All error bars must be plotted. Total length of bar must be accurate to less than half a small square and symmetrical.</td><td>1</td></tr>
</table>

Question	Answer	Marks
2(c)(ii)	Straight line of best fit drawn. Thickness of the line must be less than half a small square. Do not accept line from top point to bottom point. Line must pass between (2.90, 1.80) and (3.00, 1.80) **and** between (5.30, 3.20) and (5.40, 3.20).	**1**
	Worst acceptable line drawn (steepest or shallowest possible line that passes through all the error bars). Thickness of the line must be less than half a small square. All error bars must be plotted.	**1**
2(c)(iii)	Gradient determined with clear substitution of data points into $\Delta y / \Delta x$. 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 $\Delta y / \Delta x$. uncertainty = (gradient of line of best fit – gradient of worst acceptable line) **or** uncertainty = ½ (steepest worst line gradient – shallowest worst line gradient)	**1**
2(d)	(0.921 ± 0.008) (m)	**1**
2(e)(i)	λ determined using gradient **and** λ given to 2 or 3 significant figures. $\lambda = \frac{\text{gradient}}{D}$	**1**
	λ determined using gradient **and** λ given with SI units with appropriate power of ten. $\lambda = \frac{\text{gradient}}{D}$ Unit of λ: m or mm.	**1**

Question	Answer	Marks
2(e)(ii)	Percentage uncertainty in λ determined with clear method shown. $\%\text{uncertainty} = \left(\frac{\Delta\text{gradient}}{\text{gradient}} + \frac{\Delta D}{D}\right) \times 100$ **or** correct substitution for max/min methods.	**1**
2(f)	s determined to a minimum of 2 significant figures from **(c)(iii)** or **(d)** and **(e)(i)** with correct substitution **and** correct power of ten. $s = \frac{\text{gradient}}{0.005\ (\text{m})}$ **or** $s = \frac{D \times \lambda}{0.005\ (\text{m})} = \frac{\textbf{(d)} \times \textbf{(e)(i)}}{0.005\ (\text{m})}$	**1**
	Absolute uncertainty determined with correct substitution. For use of gradient from **(c)(iii)**: $\Delta s = \left(\frac{\Delta\text{gradient}}{\text{gradient}} + \frac{0.005}{0.500}\right) \times s$ **or** correct substitution for max/min methods. For use of D and λ from **(d)** and **(e)(i)**: $\Delta s = \left(\frac{\Delta D}{D} + \frac{\Delta\lambda}{\lambda} + \frac{0.005}{0.500}\right) \times s$ **or** correct substitution for max/min methods: $\Delta s = \left(\frac{\max D \times \max\lambda}{\min y}\right) - s$ **or** $\Delta s = s - \left(\frac{\min D \times \min\lambda}{\max y}\right)$	**1**