
PHYSICS

9702/51

Paper 5 Planning, Analysis and Evaluation

October/November 2019

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 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **8** printed pages.



Cambridge Assessment
International Education

Question	Answer	Marks
1	Additional detail including safety considerations	
D1	use large box/tray to collect ball (to prevent ball rolling on floor/bouncing) or reasoned method to avoid draughts, e.g. switch off fans, close windows, use a screen	6
D2	method to determine P from correct circuit, e.g. $P = I \times V$ or use wattmeter to measure P	
D3	stand on bench with <u>clamped</u> rule <u>vertically</u> to measure vertical distance	
D4	method to ensure <u>clamped rule to measure h</u> is vertical, e.g. correctly positioned set square indicated at right angles between the rule <u>and</u> the horizontal surface or plumb line shown in appropriate position	
D5	$r = d / 2$ when diameter measured	
D6	repeat diameter measurement in <u>different</u> directions <u>and</u> find average	
D7	repeat experiment for each value of r <u>and</u> determine average h	
D8	method to determine h , e.g. $h = \text{reading top of ball} - r - \text{top of blower}$ or $h = \text{reading bottom of ball} + r - \text{top of blower}$ or $h = (\text{distance from top of ball to top of blower} + \text{distance from bottom of ball to top of blower}) / 2$	
D9	wait for the ball to become stationary (vertically)	
D10	video (camera) shown level with elevated ball and description of playback frame-by-frame or slow motion	

Question	Answer	Marks														
2(a)	gradient = q and $y\text{-intercept} = \lg\left(\frac{2\pi}{\sqrt{k}}\right) = \lg 2\pi - \frac{1}{2}\lg k$	1														
2(b)	<table><tr><th>T / s</th><th>$\lg (T / \text{s})$</th></tr><tr><td>1.56</td><td>0.193 or 0.1931</td></tr><tr><td>1.79</td><td>0.253 or 0.2529</td></tr><tr><td>1.97</td><td>0.294 or 0.2945</td></tr><tr><td>2.14</td><td>0.330 or 0.3304</td></tr><tr><td>2.31</td><td>0.364 or 0.3636</td></tr><tr><td>2.45</td><td>0.389 or 0.3892</td></tr></table>	T / s	$\lg (T / \text{s})$	1.56	0.193 or 0.1931	1.79	0.253 or 0.2529	1.97	0.294 or 0.2945	2.14	0.330 or 0.3304	2.31	0.364 or 0.3636	2.45	0.389 or 0.3892	
T / s	$\lg (T / \text{s})$															
1.56	0.193 or 0.1931															
1.79	0.253 or 0.2529															
1.97	0.294 or 0.2945															
2.14	0.330 or 0.3304															
2.31	0.364 or 0.3636															
2.45	0.389 or 0.3892															
	Values of T as above.	1														
	Values of $\lg T$ as above.	1														
	Uncertainties in T all ± 0.04 .	1														
	Uncertainties in $\lg (T/\text{s})$ consistent with uncertainties in T e.g. from ± 0.011 to ± 0.007 .	1														

Question	Answer	Marks
2(c)(i)	Six points plotted correctly. Must be accurate to the nearest half a small square. Diameter of points must be less than half a small square.	1
	Error bars in $\lg T$ plotted correctly. All error bars must be plotted. Length of bar must be accurate to less than half a small square and symmetrical.	1
2(c)(ii)	Line of best fit drawn. Lower end of line should pass between (2.22, 0.22) and (2.25, 0.22) and upper end of line should pass between (2.49, 0.34) and (2.51, 0.34). Do not accept line from first to last plot.	1
	Worst acceptable line drawn (steepest or shallowest possible line that passes through all the error bars). All error bars must be plotted.	1
2(c)(iii)	Gradient determined with clear substitution of data points from the line of best fit into $\Delta y / \Delta x$. Distance between data points must be greater than half the length of the drawn line.	1
	uncertainty = gradient of line of best fit – gradient of worst acceptable line or uncertainty = $\frac{1}{2}$ (steepest worst line gradient – shallowest worst line gradient)	1
2(c)(iv)	y-intercept determined by substitution of correct point from the line of best fit into $y = mx + c$.	1
2(d)	k determined from y-intercept. $k \left(= \left(\frac{2\pi}{10^{y\text{-intercept}}} \right)^2 \right) = \left(\frac{2\pi}{10^{(c)(iv)}} \right)^2$	1
	q = answer to (c)(iii) and given to 2 or 3 significant figures.	1

Question	Answer	Marks
2(e)	M determined from (d) or (c)(iii) and (c)(iv) with correct substitution shown. $M = \sqrt[q]{\frac{T\sqrt{k}}{2\pi}} = \sqrt[q]{\frac{\sqrt{k}}{2\pi}} = \sqrt[2q]{\frac{k}{4\pi^2}}$ or $\lg M = \frac{(\lg 1) - \lg\left(\frac{2\pi}{\sqrt{k}}\right)}{q}$ $\lg M = -\frac{\text{y-intercept}}{\text{gradient}} = -\frac{\mathbf{(c)(iv)}}{\mathbf{(c)(iii)}}$ $M = 10^{\left(\frac{\mathbf{(c)(iv)}}{\mathbf{(c)(iii)}}\right)}$	1