Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

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PHYSICS	**9702/52**
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

[Turn over

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1	**Defining the problem**	
	x is the independent variable and h is the dependent variable **or** vary x and measure/determine h	**1**
	keep r and/or k constant	**1**
	Methods of data collection	
	labelled diagram of workable experiment including: • labelled spring • upper ball vertically (by eye) above the spring and at least one of the balls labelled • vertical (by eye) rule at least from top of spring to position of upper ball	**1**
	method to determine x, e.g. use a rule/calipers to measure original and final length of spring and find the difference	**1**
	use of micrometer/calipers/rule to measure diameter of ball	**1**
	method to determine h described, e.g. measure the distance between the top of the ball at maximum height and the top of the ball on the spring **or** measure the distance between the bottom of the ball at maximum height and the bottom of the ball on the spring	**1**
	Method of analysis	
	plot a graph of h against x^2 (or lg h against lg x)	**1**
	relationship valid if a straight line through (0,0) (for lg h against lg x straight line with gradient = 2)	**1**
	$\rho = \dfrac{3k}{8\pi r^3 g \times \text{gradient}}$ $\left(\text{for } \lg h \text{ against } \lg x, \quad \rho = \dfrac{3k}{8\pi g r^3 \times 10^{y\text{-intercept}}}\right)$	**1**

Question	Answer		Marks
1	**Additional detail including safety considerations**		
	D1	use large box/cage 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	expression to determine *k* from relevant experiment, e.g. $k = mg / x$ or gradient of *F*–*x* graph	
	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 *x* <u>and</u> determine average *h*	
	D8	method to securely fix spring to the bench e.g. tape/G-clamp	
	D9	experiment to determine *k*, e.g. place mass *m* on the spring and measure compression *x*	
	D10	video (camera) shown level (by eye) with elevated ball and description of play back frame by frame or slow motion	

Question	Answer	Marks
2(a)	gradient = *q* **and** *y*-intercept = lg *p*	1
2(b)	R / 10^3 Ω — lg (R / 10^3 Ω): 9.4 or 9.40 — 0.97 or 0.973 5.9 or 5.88 — 0.77 or 0.771 or 0.769 3.9 or 3.92 — 0.59 or 0.591 or 0.593 2.5 or 2.54 — 0.40 or 0.398 or 0.405 1.7 or 1.71 — 0.23 or 0.230 or 0.233 1.1 or 1.08 — 0.04 or 0.041 or 0.033	
	Values of *R* as above.	1
	Values of lg *R* as above.	1
	Uncertainties in *R* from (±0.9 to ±1.2) to (±0.02 to ±0.03) **and** row 2 between ±0.40 and ±0.50 **and** row 4 between ±0.09 and ±0.10.	1
	Uncertainties in lg *R* consistent with uncertainties in *R* e.g. from ±0.05 to ±0.01.	1
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 *R* plotted correctly. All error bars must be plotted. Length of bar must be accurate to less than half a small square and symmetrical.	1

Table in 2(b):

R / 10^3 Ω	lg (R / 10^3 Ω)
9.4 or 9.40	0.97 or 0.973
5.9 or 5.88	0.77 or 0.771 or 0.769
3.9 or 3.92	0.59 or 0.591 or 0.593
2.5 or 2.54	0.40 or 0.398 or 0.405
1.7 or 1.71	0.23 or 0.230 or 0.233
1.1 or 1.08	0.04 or 0.041 or 0.033

Question	Answer	Marks
2(c)(ii)	Line of best fit drawn. Upper end of line should pass between (2.500, 0.70) and (2.502, 0.70) **and** lower end of line should pass between (2.528, 0.30) and (2.532, 0.30). Do not accept line from first to last point.	**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. Gradient must be negative.	**1**
	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(c)(iv)	y-intercept determined by substitution of correct point from the line of best fit into $y = mx + c$.	**1**
2(d)	p determined from y-intercept. p (= $10^{y\text{-intercept}}$) = $10^{\textbf{(c)(iv)}}$	**1**
	q = answer to **(c)(iii) and** given to 2 or 3 significant figures.	**1**

Question	Answer	Marks
2(e)	*T* determined from **(d) or (c)(iii) and (c)(iv)** with correct substitution shown. $T = \sqrt[q]{\dfrac{R}{p}} = \sqrt[q]{\dfrac{15}{p}}$ **or** $\lg T = \dfrac{\lg 15 - \lg p}{q} = \dfrac{1.176 - \lg p}{q}$ $\lg T = \dfrac{\lg 15 - y\text{-intercept}}{\text{gradient}} = \dfrac{1.176 - \textbf{(c)(iv)}}{\textbf{(c)(iii)}}$ $T = 10^{\left(\frac{1.176 - \textbf{(c)(iv)}}{\textbf{(c)(iii)}}\right)}$	**1**