Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **October/November 2019**

MARK SCHEME

Maximum Mark: 40

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.

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Question	Answer	Marks
1(c)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5 points). There must be an even distribution of points either side of the line along the full length. One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least 5 points left after the anomalous point is disregarded. Line must not be kinked or thicker than half a small square.	**1**
1(c)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. Both read-offs must be accurate to half a small square in both the x and y directions. The method of calculation must be correct e.g. not $\Delta x / \Delta y$. The sign of the gradient on the answer line must match the graph.	**1**
	y-intercept: Correct read-off from a point on the line and substituted into $y = mx + c$. Read-off must be accurate to half a small square in both x and y directions. **or** Intercept read directly from the graph with read-off at $x = 0$ accurate to half a small square.	**1**
1(d)	Value of A = candidate's gradient **and** value of B = candidate's intercept. The values must not be fractions.	**1**
	A has no unit **and** unit for B correct (m, cm or mm).	**1**
1(e)	Correct calculation of M with a consistent unit.	**1**
	Answer on the answer line to 3 significant figures.	**1**

Question	Answer	Marks
2(a)(i)	Value of x in the range 6.5–7.5 cm to the nearest mm with unit.	**1**
2(a)(ii)	Percentage uncertainty in x based on absolute uncertainty in the range 2–4 mm. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(b)(i)	Value of T_1 in the range 0.4–1.0 s.	**1**
	At least two values of nT recorded where $n \geqslant 5$.	**1**
2(b)(ii)	Value of T_2 greater than T_1.	**1**
2(b)(iii)	Correct calculation of $T_2 - T_1$.	**1**
2(c)	Second value of x.	**1**
	Second values of T_1 and T_2.	**1**
	Quality: Second value of $\lvert T_2 - T_1 \rvert$ < first value of $\lvert T_2 - T_1 \rvert$.	**1**
2(d)(i)	Two values of k calculated correctly.	**1**
2(d)(ii)	Justification for s.f. in k linked to s.f. in x and $(T_2 - T_1)$.	**1**
2(d)(iii)	Valid comment consistent with calculated values of k, testing against a criterion stated by the candidate.	**1**

Question	Answer	Marks
2(e)(i)	A Too few readings/(only) two readings not enough to draw a (valid) conclusion (**not** 'not enough for accurate results', 'few readings'). B Problem with attaching spring to magnet e.g. tape not sticky enough, magnet falls from tape **or** Problems with additional modelling clay falling off magnet. C Difficult to line up magnets (because they repel). D Difficulty setting or measuring x with a reason e.g. holding metre rule by hand/metre rule or magnet moves/metre rule not vertical/parallax error/magnet is tilted so x varies across the width of the magnet/difficult to adjust boss so that x has the constant value. E ($T_2 - T_1$) is short **or** Percentage uncertainty in ($T_2 - T_1$) is large **or** Difficult to judge start of/end of/complete oscillation. F Others modes of oscillation e.g. magnet swinging **or** Magnets are attracted/stick to the stand (metal rod) and/or G-clamp/metal table. *1 mark for each point up to a maximum of 4.*	**4**

Question	Answer	Marks
2(e)(ii)	A Take more readings <u>and</u> plot a graph or take more readings <u>and</u> compare *k* values (**not** 'repeat readings' on its own). B Better method of attaching magnet to spring system e.g. glue spring to magnet/stickier tape/magnet with hook/attach string **or** Improved method of adding weight to magnet e.g. use adhesive putty/tape. C Put magnets in a (transparent) tube. D Improved method of measuring *x* e.g. place a mm grid behind magnets/clamp metre rule/use set square between ruler and bench/plumb-line to check ruler vertical/use a lab jack to raise magnet B/use travelling microscope. E Improved method of timing e.g. video/film/record with timer/view frame-by-frame, fiducial marker at centre of oscillation, force meter attached to springs. F Use wooden/plastic stand/longer wooden rod **or** Another named method of fixing magnet B to bench e.g. adhesive putty. *1 mark for each point up to a maximum of 4.*	**4**