Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/31**

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(d)(ii)	Line of best fit: Judge by the balance of all points on the grid (at least 5) about the candidate's line. There must be an even distribution of points either side of the line along its 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 square.	**1**
1(d)(iii)	Gradient: The hypotenuse of the triangle used should 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 sign of the gradient on the answer line must match the graph. Method of calculation must be correct, e.g. not $\Delta x / \Delta y$.	**1**
	y-intercept: Correct read-off from a point on the line substituted into $y = mx + c$ or an equivalent expression. 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 $R = 0$, accurate to half a small square in the *R* direction.	**1**
1(e)	Value of *A* = candidate's gradient **and** value of *B* = candidate's intercept. The values must not be fractions.	**1**
	Unit for *A* is correct (e.g. m^{-1} or cm^{-1} or mm^{-1}) **and** unit for *B* is correct (e.g. $\Omega\, m^{-1}$ or $\Omega\, cm^{-1}$ or $\Omega\, mm^{-1}$).	**1**

Question	Answer	Marks
2(a)(i)	Value of x to the nearest mm with unit in the range 9.0–11.0 cm.	**1**
2(a)(ii)	Percentage uncertainty in x based on absolute uncertainty of 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 raw L to the nearest mm with unit and in the range 20.0–30.0 cm.	**1**
2(b)(ii)	Correct calculation of $\sqrt{L}$.	**1**
2(b)(iii)	Justification for s.f. in $\sqrt{L}$ linked to s.f. in L.	**1**
2(c)	Second value of x.	**1**
	Second value of L.	**1**
	Quality: Second value of L > first value of L.	**1**
2(d)(i)	Two values of k calculated correctly.	**1**
2(d)(ii)	Valid comment consistent with calculated values of k, testing against a criterion stated by the candidate.	**1**
2(e)(i)	Value of T in the range 1.0–2.0 s.	**1**
2(e)(ii)	Correct calculation of g with correct consistent unit using second value of k.	**1**

Question	Answer	Marks
2(f)(i)	A Too few readings/(only) two readings not enough to draw a (valid) conclusion (**not** 'not enough for accurate results', 'few readings'). B Difficult to determine x or L_0 or L with reason e.g. parallax error/locating centre of bob/lower curved edge of wooden rod/holding ruler by hand. C Difficult to release two bobs at same instant/time. D Pendulums have different amplitudes/displacements **or** Two oscillations have different motions so difficult to compare. E Difficult to judge when the two pendulums are exactly in phase/difficult to adjust to the exact length so that the pendulums are in phase/trial and error process needed to identify when length gives same phase. F Difficult to judge start of/end of/complete oscillation. *1 mark for each point up to a maximum of 4.*	**4**
2(f)(ii)	A Take more readings and plot a graph or take more readings and compare k values (**not** 'repeat readings' on its own). B Measure to top and bottom of ball and take average **or** Take string off and measure on table **or** Clamp a ruler (vertically). C Improved method of release e.g. card gate release. E Use stop-watch and test for same period for each pendulum. F Video/record/film and view with timer/frame-by-frame. *1 mark for each point up to a maximum of 4. There is no marking point labelled D.*	**4**