Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **October/November 2021**

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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[Turn over

Question	Answer	Marks
1(a)	Value of H with unit and in the range 20.0–40.0 cm.	**1**
1(b)	Final value of T in the range 2.0–10.0 s.	**1**
	At least two measurements of nT where $n \geqslant 5$.	**1**
1(c)	Six (or more) sets of readings of w (different values) and time with the correct trend and without help from the Supervisor scores 4 marks, five sets scores 3 marks, etc.	**4**
	Range: $w_{min} \leqslant 6.0$ cm **and** $w_{max} \geqslant 18.0$ cm.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention, e.g. T / s and $1/w$ / cm^{-1} or $1/w$ (1 / cm).	**1**
	Consistency: All values of w must be given to the nearest 0.1 cm.	**1**
	Significant figures: All values of $1/w$ must be given to the same number of s.f. as (or one more than) the number of s.f. of raw w.	**1**
	Calculation: Values of $1/w$ are correct.	**1**

Question	Answer	Marks
1(d)(i)	Axes: Scales must be chosen so that the plotted points occupy at least half the graph grid in both *x* and *y* directions. Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions). Axes must be labelled with the quantity that is being plotted. Scale markings should be no more than three large squares apart.	**1**
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points must be $\leqslant$ half a small square. Points must be plotted to an accuracy of half a small square in both *x* and *y* directions.	**1**
	Quality: All points in the table (at least 5) must be plotted on the grid. Trend of points on graph must be correct. It must be possible to draw a straight line that is within $\pm$ 0.01 cm^{-1} (or $\pm$ 1 m^{-1}) on the 1 / w axis of all plotted points.	**1**
1(d)(ii)	Line of best fit: Judge by the 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. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least five points left after the anomalous point is disregarded. Line must not be kinked or thicker than half a small square.	**1**
1(d)(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. Method of calculation must be correct, e.g. $\Delta y / \Delta x$. Gradient sign on answer line matches graph drawn.	**1**
1(e)(i)	*B* = candidate's gradient value. Value must not be written as a fraction.	**1**
	Unit for *B* correct (e.g. cm s or m s).	**1**
1(e)(ii)	Correct calculation of *g* consistent with the unit.	**1**

Question	Answer	Marks
2(a)(i)	L_0 in the range 3.0–8.0 cm.	**1**
2(a)(ii)	Percentage uncertainty based on an absolute uncertainty ΔL_0 in the range 2–5 mm. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if working is clearly shown. Correct method of calculation to find percentage uncertainty.	**1**
2(b)(i)	Value of $L_1 > L_0$.	**1**
2(b)(ii)	Correct calculation of $(L_1 – L_0)$.	**1**
2(b)(iii)	Correct calculation of k.	**1**
2(b)(iv)	Justification of the number of significant figures linked to the number of significant figures in F and $(L_1 – L_0)$.	**1**
2(c)(i)	Raw value(s) of d and L recorded to the nearest millimetre.	**1**
2(c)(ii)	Second values of d and L.	**1**
	Second value of $(L_1 – L_0)$ is larger than the first value of $(L_1 – L_0)$.	**1**
2(d)(i)	Two values of C calculated correctly. The final values must not be written as fractions.	**1**
2(d)(ii)	Valid comment consistent with the calculated values of C, testing against a criterion stated by the candidate.	**1**
2(e)	Correct calculation of W.	**1**

Question	Answer	Marks
2(f)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to measure *d* with reason, e.g. rule falls/rule slips off/end point near mass hanger difficult to identify. C Values of $(L - L_0)$ or $(L_1 - L_0)$ are small giving large uncertainty (error) **or** large <u>percentage</u> uncertainty (error) in $(L - L_0)$ or $(L_1 - L_0)$. D Problem with mass of putty, e.g. mass of putty not included/putty changes force on spring. E Difficulty to judge whether spring is vertical/to make spring vertical. F Difficult to measure L_0, L, L_1 or length of spring with reason, e.g. holding rule to measure length nudges spring/coils slanted/rule not vertical/parallax/hands unsteady. G <u>*k*</u> determined using only <u>one</u> result. *1 mark for each point up to a maximum of 4.*	**4**

Question	Answer	Marks
2(f)(ii)	A Take more readings and plot a graph or take more readings and compare *C* values (**not** "repeat readings" on its own). B Method to improve measurement of *d*, e.g. string loop under mass hanger to hold rule. C Use of named device for more precise length measurements, e.g. calipers/travelling microscope. D Improved method to account for mass of putty, e.g. use a balance to measure mass of putty/use glue/use tape (instead of putty). E Method to provide a vertical reference, e.g. use a plumb-line behind spring/set square on bench large enough to be viewed behind spring/method to ensure metre rule is vertical with set square on bench. F Improved method to measure L_0, L, L_1 or length of spring, e.g. pointers on rule/clamped ruler/mark points on spring coils for reference. G Method to improve determination of *k*, e.g. take many readings and plot graph/use a range of masses/many readings and calculate average. *1 mark for each point up to a maximum of 4.*	**4**