Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **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.

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[Turn over

Question	Answer	Marks
1(a)(i)	Value of L with unit and in the range 20.0–25.0 cm.	**1**
1(a)(ii)	Value of T in range 0.80–1.20 s.	**1**
	Repeats: at least two measurements of at least 5T.	**1**
1(b)	Six sets of readings of L and T with correct trend and without help from the Supervisor scores 4 marks, five sets scores 3 marks, etc.	**4**
	Range: $L_{min} \leqslant 12.0$ cm **and** $L_{max} \geqslant 40.0$ 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. L^2 / cm^2.	**1**
	Consistency: All values of raw L must be given to the nearest mm.	**1**
	Significant figures: Values of L^2 should be to the same number of s.f. as (or one more than) the number of s.f. in the corresponding value of L.	**1**
	Calculation: Values of L^2 calculated correctly.	**1**

Question	Answer	Marks
1(c)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions). Scales must be chosen so that the plotted points occupy at least half the graph grid in both the *x* and *y* directions. 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 $\pm$ 0.02 m^2 on the L^2 axis (*x*-axis) of <u>all</u> plotted points.	**1**
1(c)(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(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. Method of calculation must be correct, e.g. $\Delta y / \Delta x$. Gradient sign on answer line matches graph drawn.	**1**
	y-intercept: Correct read-off from a point on the line and substituted into $y = mx + c$ or an equivalent expression. Read-off accurate to half a small square in both *x* and *y* directions. **or** Intercept read directly from the graph, with read-off at $L^2 = 0$, accurate to half a small square.	**1**

Question	Answer	Marks
1(d)	*a* equal to candidate's gradient **and** *b* equal to candidate's intercept. Values must not be written as fractions.	**1**
	Units for *a* (e.g. $s^2 cm^{-2}$) and *b* (e.g. s^2) are correct.	**1**

Question	Answer	Marks
2(a)(i)	Evidence of measuring a multiple of t and then dividing.	**1**
2(a)(ii)	Values of d_1 and d_2 to nearest 0.1 cm.	**1**
2(a)(iii)	Correct calculation of V_R.	**1**
2(a)(iv)	Justification based on significant figures in t, d_1 and d_2.	**1**
2(b)(i)	Value of x_1 to nearest 1 cm^3 and in range 45–55 cm^3.	**1**
2(b)(ii)	Value of x_2 less than x_1.	**1**
	Correct calculation of V_A.	**1**
2(b)(iii)	Percentage uncertainty based on an absolute uncertainty in the range 2–4 cm^3. 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(c)	Second values for x_1 and x_2.	**1**
	Second V_A > first V_A.	**1**
2(d)(i)	Two values of k calculated correctly. The final values must not be written as fractions.	**1**
2(d)(ii)	Valid comment consistent with the calculated values of k, testing against a criterion specified by the candidate.	**1**

Question	Answer	Marks
2(e)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Large percentage uncertainty in $t/d_1/d_2/V_R$. C Difficult to remove all air from cup at start/air leaks out of cup when operating syringe. D Difficult to judge when cup starts to rise **or** difficult to operate plunger smoothly **or** difficult to stop plunger when cup starts to rise. E Cup sticks to wall of container. F Volume (or mass) of cup/paper clip/string not taken into account. G x (or V_A) values affected by water getting into tube. *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 Use vernier calipers/digital calipers/micrometer/travelling microscope. C Description of workable method of removing air. D Video/film/record with <u>syringe</u> in view **or** mark cup starting position on container. E Use wider container. F Method of finding volume of cup/string/paper clip **or** method of measuring mass of cup/string/paper clip e.g. top pan balance. G Method of removing water from tube **or** use new tube. *1 mark for each point up to a maximum of 4.*	**4**