Cambridge International AS & A Level

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **March 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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This document consists of **8** printed pages.

Question	Answer	Marks
1(a)(i)	Value of C_o to the nearest mm and in range 1.5 cm to 3.0 cm	**1**
1(a)(ii)	Value of $C > C_o$	**1**
1(a)(iii)	Value of x in range 14.0 to 33.0 cm	**1**
1(b)	Six sets of readings of C and x with correct trend and without help scores 4 marks, five sets scores 3 marks etc.	**4**
	Range: $x_{max} - x_{min} \geqslant 14.0$ 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. $1 / E^4 / \text{cm}^{-4}$	**1**
	Consistency: All values of raw x must be given to the nearest mm	**1**
	Significant figures: Values of $1 / E^4$ should be to the same s.f. (or one more than) the s.f. in the corresponding value of E.	**1**
	Calculation: Values of $1 / E^4$ calculated correctly	**1**

Question	Answer	Marks
1(c)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10) Scales must be chosen so that the plotted points occupy at least half the graph grid in both *x* and *y* directions Scales must be labelled with the quantity which is being plotted. Scale markings should be no more than 3 large squares apart.	1
	Plotting of points: All observations must be plotted on the grid. Diameter of plotted points must be $\leqslant$ half a small square (no blobs). Plots must be accurate to within half a small square in both *x* and *y* directions.	1
	Quality: All points in the table must be plotted (at least 5) for this mark to be awarded. Scatter of plots must be no more than $\pm$ 2.0 cm (to scale) from a straight line in the *x* direction.	1
1(c)(ii)	Line of best fit: Judged by 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 the full length One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. Lines must not be kinked or thicker than half a square.	1
1(c)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. Method of calculation must be correct. Both read-offs must be accurate to half a small square in both the *x* and *y* directions.	1
	y-intercept: **Either** Correct read-off from a point on the line substituted into *y* = *mx* + *c* or an equivalent expression, with 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 *x* = zero accurate to half a small square in *y* direction.	1

Question	Answer	Marks
1(d)	*a* equal to candidate's gradient, and *b* equal to candidate's intercept. Values are not written as fractions.	1
	Unit for *a* is dimensionally correct, e.g. cm^{-5} and unit for *b* is dimensionally correct, e.g. cm^{-4}	1

Question	Answer	Marks
2(a)	Value of *L* in range 2.5 cm to 3.5 cm and given to nearest mm or better	1
	Value of *D* in range 6.0 to 9.0 cm and given to nearest mm or better	1
2(b)(i)	Value of raw *d* to nearest 0.001 cm and final value in range 0.040 cm to 0.090 cm	1
2(b)(ii)	Absolute uncertainty of 0.001 cm and correct method of calculation to obtain percentage uncertainty in *d*. If several readings have been taken, then the absolute uncertainty can be half the range, but not zero if values are equal.	1
2(c)	Value for *t* in s, with unit	1
	Evidence of repeat readings for *t*	1
2(d)	Second values for *d* and *t*	1
	Quality: second *t* shorter than first *t*	1
2(e)(i)	Two values of *k* calculated correctly.	1
2(e)(ii)	Justification based on sig. fig. in *t* and *d*	1
2(e)(iii)	Sensible comment relating to the calculated values of *k*, testing against a criterion specified by the candidate.	1
2(f)	Correct calculation of *S*	1

Question	Answer	Marks
2(g)(i)	Two *k* values are not enough to draw a valid conclusion Hole may not be same size as pin Difficult to measure *D* as bottle distorts Difficulty with 1 cm depth with reason, e.g. holding bottle steady (when timing) / seeing what the depth is Difficulty with measuring time with reason, e.g. lines are thick / difficult to judge when level passes line / difficult to see water level 4 max	4
2(g)(ii)	Take more readings <u>and</u> plot a graph / calculate more *k* values and <u>compare</u> Measure hole itself, with detail of method Stand bottle on graph grid / use a more rigid <u>named</u> material for bottle / measure with bottle between blocks Place bottle on a support in the bowl / clamp <u>bottle</u> (after filling) / mark line 1 cm from bottom of bottle Video with timer in view (or frame by frame) / use coloured water 4 max	4