



# **Cambridge International AS & A Level**

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**PHYSICS**

**9702/33**

Paper 3 Advanced Practical Skills 1

**February/March 2022**

**MARK SCHEME**

Maximum Mark: 40

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**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 $F$ to nearest mm and in range 6.5 to 8.5cm	1
1(a)(ii)	$a$ and $b$ , with unit	1
	Correct calculation of $y$	1
1(b)	Six sets of readings of $h$ and $y$ with correct trend and without help scores 4 marks, five sets scores 3 marks etc.	4
	Range: $h_{\max} \geq 18.0$ 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. $h$ / cm.	1
	Consistency: All values of $h$ and $a$ and $b$ must be given to the nearest mm	1
1(c)(i)	Axes: Sensible scales are used, no awkward scales (e.g. 3:10) Scales are chosen so that the plotted points occupy at least half the graph grid in both $x$ and $y$ directions Axes are labelled with the quantity which is being plotted. Scale markings are no more than 2 cm (one large square) apart.	1
	Plotting of points: All observations in the table are plotted on the grid. Diameters of plotted points are less than half a small square (no blobs). Points are plotted to an accuracy of 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, and trend of points must have a negative gradient. It must be possible to draw a straight line that is within $\pm 0.5$ cm on the $y$ axis of all plotted points.	1

Question	Answer	Marks
1(c)(ii)	<p>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. There must be at least 5 points left after the anomalous point is discarded.            Lines must not be kinked or thicker than half a square.</p>	1
1(c)(iii)	<p>Gradient:            Sign of gradient matches graph.            The hypotenuse of the triangle used is greater than half the length of the drawn line.            Method of calculation is correct, not <math>\Delta x / \Delta y</math>.            Both read-offs must be accurate to half a small square in both the <math>x</math> and <math>y</math> directions.</p>	1
	<p><b>y</b>-intercept:  <b>Either</b>            Correct read-off from a point on the line substituted into <math>y = mx + c</math> or an equivalent expression, with read-off accurate to half a small square in both <math>x</math> and <math>y</math> directions.</p> <p><b>Or</b>            Intercept read directly from the graph, with read-off at <math>h =</math> zero accurate to half a small square in <math>y</math> direction.</p>	1
1(d)	<p><math>P</math> equal to candidate's gradient, and <math>Q</math> equal to candidate's intercept. Values must not be written as fractions.</p>	1
	Units for $P$ and $Q$ correct and consistent with value (e.g. no unit for $P$ , cm for $Q$ )	1
1(e)	<p>Correct calculation of <math>\rho</math>, with correct unit</p>	1
	Value of $\rho$ on answer line given to 2 or 3 s.f.	1

Question	Answer	Marks
2(a)(i)	All raw values of $d$ to nearest mm.	1
	Evidence of repeat readings for $d$ .	1
2(a)(ii)	Absolute uncertainty of 2 to 5 mm 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) provided the working is clearly shown.	1
2(b)	$n = 1$	1
	Value for $T$ in range 0.35 to 0.55 s, with unit.	1
	At least two measurements of at least $5T$ .	1
2(c)	$(\text{second } d) \div (\text{first } d)$ in range 0.85 to 0.95	1
	Second value for $T$ .	1
	Quality: second $T$ longer than first $T$ .	1
2(d)(i)	Two values of $k$ calculated correctly.	1
2(d)(ii)	Justification for sig. fig. in $k$ linked to sig. fig. in $d$ <u>and</u> $T$	1
2(e)	Calculation of percentage difference between candidate's two $k$ values. Comparison of percentage difference with 20% leading to a consistent conclusion	1
2(f)(i)	Two $k$ values are not enough to draw a valid conclusion Difficult to roll the clay into a sphere / diameter of sphere varies Parallax error when measuring $d$ Clay covers some coils as well as the joint Difficult to judge the start and/or end of an oscillation Time <u>period is short</u> so it is <u>difficult to count</u> the oscillations Some horizontal oscillation as well as vertical <b>4 max</b>	4

Question	Answer	Marks
2(f)(ii)	<p>Take more readings <u>and</u> plot a graph / calculate more <math>k</math> values and <u>compare</u> Improved method to make a perfect sphere Improved method of measuring <math>d</math>, e.g. use calipers / measure between blocks Method to prevent touching coils, e.g. denser material / improved shape / improved mounting method Put a fiducial mark at the centre of the oscillation Use video with timer in view / video and review frame by frame</p> <p><b>4 max</b></p>	<b>4</b>