CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/35**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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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Question	Answer	Marks
1(a)	Value of T_0 in the range 0.45 –0.65 s with unit.	**1**
	Evidence of repeats of nT_0 where $n \geqslant 5$.	**1**
1(b)	Value of $T > T_0$.	**1**
1(c)	Six sets of readings of x (different values) and time with correct trend (T decreases as x increases) and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $x_{min} \leqslant 10.0$ cm **and** $x_{max} = 40.0$ cm.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit should conform to scientific convention e.g. $(T - T_0)^2 / s^2$.	**1**
	Consistency: All raw values of x given to the nearest mm.	**1**
	Calculation: Correct calculation of $(T - T_0)^2$.	**1**
1(d)(i)	Axes: Axes must be labelled with the required quantities. Scales must be chosen so that the plotted points occupy at least half the graph grid in both the x and y directions. Scale markings are no more than 2 cm (one large square) apart. Sensible scales must be used. Scales must not be awkward (e.g. 3:10 or fractions).	**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 the x and y directions.	**1**
	Quality: All points in the table (at least 5) must be plotted on the grid. Trend must be correct. It must be possible to draw a straight line that is within $\pm$ 2 cm (to scale) on the x-axis of all plotted points.	**1**

Question	Answer	Marks
1(d)(ii)	Line of best fit: 'Best fit' is judged by balance of all points on the grid (at least 5 points) about the candidate's line. There must be an even distribution of points either side of the line along the full length. Line must not be kinked or thicker than half a small square. Some candidates may choose to identify an anomalous point. If they identify **one** point as anomalous (e.g. by circling or labelling) then this point is to be disregarded when judging the line of best fit. There must be at least 5 points left after the anomalous point is disregarded.	**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 method of calculation must be correct, not $\Delta x / \Delta y$. The gradient sign on the answer line must be consistent with the graph drawn.	**1**
	y-intercept: Correct read-off from a point on the line and substituted correctly into $y = mx + c$ or an equivalent expression. Read-off accurate to half a small square in both the x and y directions. **or** Intercept read directly from the graph, with read-off at $x = 0$, accurate to half a small square in y direction.	**1**
1(e)	Value of P = – candidate's gradient **and** value of Q = candidate's intercept. The values must not be written as fractions or given to only one significant figure.	**1**
	Units for P: $s^2\,m^{-1}$ or $s^2\,cm^{-1}$ consistent with x measurement **and** units for Q: s^2.	**1**

Question	Answer	Marks
2(a)	Value(s) of raw D to the nearest mm with unit.	**1**
2(b)(i)	Raw value(s) of y to the nearest mm with unit.	**1**
	Evidence of repeats of y.	**1**
2(b)(ii)	Percentage uncertainty in y based on absolute uncertainty in the range 2–10 mm. Correct method of calculation to obtain percentage uncertainty e.g. (absolute uncertainty / value from **(b)(i)**) $\times$ 100. If several readings have been taken, then the absolute uncertainty can be half the range (but not zero) provided the working is shown clearly.	**1**
2(b)(iii)	Correct calculation of $(r + y)$.	**1**
2(c)	Second value of D.	**1**
	Second value of y.	**1**
	Second value of $y >$ first value of y.	**1**
2(d)(i)	Two values of k calculated correctly. The final k values must not be written as fractions or given to only one significant figure.	**1**
2(d)(ii)	Justification for significant figures in k linked to significant figures in D and $(r + y)$.	**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)	Value of y **and** correct calculation of r with unit using candidate's second value of k.	**1**

Question	Answer	Marks
2(g)(i)	A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to measure <u>*D*</u> with a reason e.g. lid in the way / bevelled edges at top or bottom / diameter at top different to rest of jar / parallax error. C Difficult to judge/determine when nail disappears. D Difficult to measure jar <u>*y*</u> with a reason e.g. parallax error / holding the nail in place / moving nail in correct line. E Difficult to measure lens <u>*y*</u> because the lens has to be held by hand. F *k* for glass jar with water may not be suitable to apply for a glass lens (or words to that effect). *1 mark for each point up to a maximum of 4.*	**4**
2(g)(ii)	A Take more readings (for different values of *D*) <u>and</u> plot a graph **or** take more readings <u>and</u> compare *k* values (**not** "repeat readings" on its own). B Use calipers (to measure *D*). C Use a white screen behind nail. D Method to hold nail in position e.g. clamp/adhesive putty/base for nail **or** put jar and nail on strip with scale markings **or** guide for nail. E Clamp lens / use lens holder. F Measure *k* using a solid glass cylinder. *1 mark for each point up to a maximum of 4.*	**4**