CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

Question	Answer	Marks
1(a)	Value of θ in range 50°–75°.	**1**
1(b)	Six sets of readings of x (different values) and θ with correct trend (as x increases, average θ increases) and without help from the Supervisor scores 5 marks, five sets scores 4 marks, etc.	**5**
	Range: $x_{min} \leqslant 20$ g **and** $x_{max} \geqslant 200$ g.	**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. θ/°. 1 / cos θ must have no unit.	**1**
	Consistency: All values of θ must be given to the nearest degree.	**1**
	Significant figures: Values of 1 / cos θ given to same number of s.f. as (or one more than) the number of s.f. in θ.	**1**
	Calculation: Values of 1 / cos θ calculated correctly	**1**
1(c)(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 $\pm$ 0.20 on the 1 / cos θ axis of <u>all</u> plotted points.	**1**

Question	Answer	Marks
1(c)(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(c)(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 substituted 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(d)	Value of *a* = candidate's gradient **and** value of *b* = candidate's intercept. The values must not be written as fractions or given to only one significant figure.	**1**
	Unit for *a* correct and consistent with *x* readings (e.g. g^{-1}) **and** no unit for *b*.	**1**
1(e)	Correct calculation of *Q*.	**1**

Question	Answer	Marks
2(a)(i)	Value for T_0 in range 0.20–2.00 s with unit.	**1**
	Evidence of repeat measurements of T_0.	**1**
2(a)(ii)	Absolute uncertainty in T_0 in range 0.2–0.5 s. Correct method of calculation to find percentage uncertainty e.g. (absolute uncertainty/value from **(a)(i)**) × 100. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.	**1**
2(b)(i)	Values for L and W to the nearest mm with unit **and** $L > W$.	**1**
2(b)(ii)	All raw value(s) for T to the nearest 0.1 s or all raw value(s) to nearest 0.01 s with unit.	**1**
	Value of $T > T_0$.	**1**
2(c)	Second values of L and W.	**1**
	Second value of T.	**1**
	Value of second T greater than first T.	**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 based on the significant figures in $(T - T_0)$, W and L.	**1**
2(e)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 15% leading to a consistent conclusion.	**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 T_0 is short so large uncertainty / large percentage uncertainty in T_0. C Difficult to judge/determine/decide whether P has just touched the pulley **or** difficulty maintaining the same release point. D Difficult to judge/determine/decide when mass just reaches the end of its fall. E Difficulties with card with reason e.g. judging if central in slot / ensuring card is horizontal. *1 mark for each point up to a maximum of 4.*	**4**
2(f)(ii)	A Take more readings and plot a graph **or** take more readings and compare *k* values (**not** "repeat readings" on its own). B Increase the fall distance. C Use pointer at the starting point / use a stop. D Record/film/video with timer **or** record/film/video and view frame-by-frame **or** use a position/distance sensor placed below or above mass **and** a data logger. E Measure to find position of centre of the card and mark it **or** use spirit level (to check the card is horizontal) or other workable method to check card is horizontal. *1 mark for each point up to a maximum of 4.*	**4**