Cambridge International AS & A Level

PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **February/March 2023**

MARK SCHEME

Maximum Mark: 40

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This document consists of **8** printed pages.

Question	Answer	Marks
1(a)(i)	Value of L in range 43.0 to 47.0 cm, with unit.	1
1(a)(ii)	Value of h less than H and θ to nearest degree and in range 5° to 40°.	1
1(b)	Six sets of readings of h and θ with correct trend and without help scores 4 marks, five sets scores 3 marks etc.	4
1(b)	Range: $\theta_{min} \leqslant 10°$ and $\theta_{max} \geqslant 30°$	1
1(b)	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. $\theta / °$ $\sin\theta$ must not have a unit.	1
1(b)	Consistency: All raw values of h must be given to the nearest mm	1
1(b)	Significant figures: Values of $\sin\theta$ given to 3 s.f.	1
1(b)	Calculation: Values of $\sin\theta$ calculated correctly	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 Scales are labelled with the quantity which is being plotted. Scale markings are no more than 2 cm apart.	1
1(c)(i)	Plotting of points: All observations from the table are plotted on the grid. Diameters of plotted points are < half a small square (no blobs). Plots are accurate to within half a small square in both x and y directions.	1

Question	Answer	Marks
1(c)(i)	Quality: All points in the table must be plotted (at least 5) for this mark to be awarded. It must be possible to draw a straight line that is within $\pm\,0.02$ on the $\sin\theta$ axis of all plotted points. The trend must be negative.	**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 If all points lie on trend candidates do not need to indicate an anomalous point. However, a single off-trend point is allowed as anomalous if it is circled or labelled **and** there are at least five other plotted points. 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. Not $\Delta x\,/\,\Delta y$. Both read-offs must be accurate to half a small square in both the x and y directions.	**1**
1(c)(iii)	y-intercept: 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 $h =$ zero accurate to half a small square in y direction.	**1**
1(d)	a equal to candidate's gradient **and** b equal to candidate's intercept. Values must not be written as fractions or to only 1 significant figure.	**1**
1(d)	Units for a and b correct and consistent with value (e.g. cm^{-1} for a and no unit for b)	**1**
1(e)	Correct calculation of M	**1**

Question	Answer	Marks
2(a)	Raw values for v to nearest mm **and** final value in range 39.0 to 41.0 cm.	1
2(a)	Final value for u_0 in range 4.0 to 6.0 cm.	1
2(b)(i)	Raw values for u to nearest mm.	1
2(b)(ii)	Absolute uncertainty of 0.5 to 1.0 cm and correct method of calculation to obtain percentage uncertainty in u. If several readings have been taken, then the absolute uncertainty can be half the range, but not zero if values are equal.	1
2(b)(iii)	Correct calculation of f	1
2(b)(iii)	Correct calculation of n	1
2(b)(iv)	Justification correctly linked to the significant figures in v **and** u	1
2(c)	Second value of v	1
2(c)	Second value of u	1
2(c)	Quality: second u greater than first u	1
2(d)	Two values of k calculated correctly Final values of k are not written as fractions	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)	A Two k values are not enough to draw a valid conclusion B Difficult to judge when image is sharpest / difficult to produce a sharp image C Difficult to hold torch in line with lens (axis) D Difficult to measure u (or v) due to parallax error / deciding lens position E Second solution may be diluted by traces of first solution / some of first solution remains on the lens F LEDs not at front of torch *1 mark for each point up to a maximum of 4.*	4

Question	Answer	Marks
2(f)(ii)	A Take more readings **and** plot a graph / calculate more *k* values and **compare** B Method to reduce unwanted light e.g. use screens around the area of the image / use darkroom C Mount **torch** on block (or stand) OR use an optical bench D Use set square next to rule (as pointer) / mark lens position on container E Clean the lens / clean the container / use a new container for second test F Remove glass from front of torch *1 mark for each point up to a maximum of 4.*	**4**