Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **May/June 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Mark
1(b)(iii)	Value(s) of I_1 with unit in the range 30–200 mA.	**1**
1(c)(iii)	$I_2 > I_1$ (ECF unit from **1(b)(iii)**).	**1**
1(d)	Six sets of readings of x (different values), I_1, I_2 with correct trend and without help from Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: $x_{max} \geqslant 90$ 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. x / m, I_2 / mA, I_2 / I_1 no unit.	**1**
	Consistency: All values of x must be given to the nearest mm.	**1**
	Significant figures: All values of I_2 / I_1 must be given to the same number of s.f. as (or one more than) the s.f. in raw I_1 and I_2 (using the s.f. of the I value with the lowest number of s.f.).	**1**
	Calculation: Values of I_2 / I_1 are correct.	**1**
1(e)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions). 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 that is being plotted. Scale markings should be no more than three 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”). Points must be plotted to an accuracy of half a small square.	**1**

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Question	Answer	Mark
	Quality: All values of I_2 / I_1 must be greater than 1. All points in the table must be plotted for this mark to be awarded. It must be possible to draw a straight line that is within ± 0.05 on the I_2 / I_1 axis (normally *y* axis) of all plotted points.	**1**
1(e)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5). There must be an even distribution of points either side of the line along the full length. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least five points left after the anomalous point is disregarded. Lines must not be kinked or thicker than half a small square.	**1**
1(e)(iii)	Gradient: Gradient sign on answer line matches graph drawn. The hypotenuse of the triangle used must be greater than half the length of the drawn line. Method of calculation must be correct. Do not allow $\Delta x / \Delta y$. Both read-offs must be accurate to half a small square in both the *x* and *y* directions.	**1**
	y-intercept: Correct read-off from a point on the line substituted correctly into $y = mx + c$ or an equivalent expression. 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 $x = 0$, accurate to half a small square in *y* direction.	**1**
1(f)	Value of *P* = candidate's gradient **and** value of *Q* = candidate's intercept. The values must not be fractions.	**1**
	Unit for *P* is correct (e.g. m^{-1}) **and** *Q* stated without a unit.	**1**

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Question	Answer	Mark
2(b)(ii)	Values of time in the range 3–7 s and within 0.4 s of each other. All raw readings stated to same precision **and** to at least 0.1 s.	**1**
2(c)(ii)	x on the answer line in the range 35.0–40.0 cm **and** all value(s) of raw x to nearest mm with unit.	**1**
2(c)(iii)	Absolute uncertainty in x in range 2–5 mm. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(e)(i)	Value of n on answer line in the range 10 to 20. No unit.	**1**
	Evidence of repeat readings.	**1**
2(e)(ii)	Correct calculation of $(n + 1)^2 / n^2$.	**1**
2(f)	Second value of x.	**1**
	Second value of n.	**1**
	Quality: second value of n < first value of n (if $x_2 < x_1$ allow $n_2 > n_1$).	**1**
2(g)(i)	Two values of k calculated correctly.	**1**
2(g)(ii)	Valid comment consistent with calculated values of k, testing against a criterion specified by the candidate.	**1**
2(h)	Correct calculation of L written to 3 s.f. and correctly rounded to 3 s.f.	**1**

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Question	Answer	Mark
2(i)(i)	A Two readings are not enough to draw a valid conclusion (**not** "not enough for accurate results", "few readings"). B Difficult to judge when the balls are back in phase. C Balls hit each other/blown by moving air/balls move sideways/irregular movement. D Difficult to ensure both lengths 35 cm or difficult to measure *x* with a reason e.g. string kinked/parallax error. E Damping/oscillations die out quickly. F Difficulty linked to fixing block/wood with reason e.g. longer block requires more tape (therefore an unfair test)/block comes unstuck/blocks attached at an angle (*x* not constant). G For two/both balls the release point is different or release instant is different. *1 mark for each point up to a maximum of 4.*	**4**
2(i)(ii)	A Take more readings and plot a graph/take more readings and compare *k* values (**not** "repeat readings" on its own). B Video/film/record **and** perpendicular to plane of oscillation/from the side. C Turn off air conditioning/close windows/use windshield/use a longer rod. D Improved method of measuring 35 cm or *x* e.g. use clamps to fix loop and ball. F Improved method of attachment e.g. Blu-Tack/glue/Velcro/stickier tape/stronger adhesive on the tape. G Improved method of release e.g. bar to hold both balls then drop away like a gate. *1 mark for each point up to a maximum of 4.*	**4**

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