
PHYSICS**9702/31**

Paper 3 Advanced Practical Skills 1

May/June 2019

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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This document consists of **7** printed pages.

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Question	Answer	Marks
1(a)	Value of <u>raw</u> v to nearest mm, with final value in the range 3.0–7.0 cm with a unit.	1
1(b)	Value of $x < y$.	1
1(c)	Six sets of readings of x and y (different values) with the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	5
	Range: Values include one (average) x value above 50.0 cm and one (average) x value below 50.0 cm.	1
	Column headings: Each column heading must contain a quantity, a unit and a separating mark where appropriate. The presentation of the quantity and unit must conform to accepted scientific convention e.g. x / cm .	1
	Consistency: All raw values of x and y must be given to the nearest mm only.	1
1(d)(i)	Axes: Sensible scales must be used, no awkward scales (e.g. 15 small squares for 10 units 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 in the table must be plotted on the grid. Diameter of plotted points must be $\leq$ half a small square (no “blobs”). Points must be plotted to an accuracy of half a small square.	1
	Quality: All points in the table must be plotted on the grid. Trend of points on graph must be correct. It must be possible to draw a straight line that is within ± 2.0 cm (to scale) on the y -axis (y / cm axis) of all plotted points.	1

Question	Answer	Marks
1(d)(ii)	Line of best fit: Judge by balance of all points on the grid about the candidate's line (at least 5 points). 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(d)(iii)	Gradient: The hypotenuse of the triangle used must be greater than half the length of the drawn line. The 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. Sign of gradient must match graph.	1
	y-intercept: Correct read-off from a point on the line and substituted into $y = mx + c$. Read-off must be 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.	1
1(e)	Value of P = candidate's gradient and value of Q = candidate's intercept. The values must not be fractions.	1
	No unit for P and unit for Q correct e.g. mm or cm or m.	1
1(f)	Correct calculation of R .	1
	Value of R on the answer line given to 3 significant figures.	1

Question	Answer	Marks
2(a)(i)	Value(s) of <u>raw</u> d and <u>raw</u> t to nearest mm with units.	1
2(a)(ii)	Percentage uncertainty in d based on an absolute uncertainty in the 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(b)(i)	Correct calculation of V .	1
2(b)(ii)	Justification for s.f. in V linked to s.f. in d and t .	1
2(c)	Value of n .	1
	Evidence of repeated n .	1
2(d)	Second values of d and t .	1
	Second value of n .	1
	Quality: Second value of n less than first value of n .	1
2(e)(i)	Two values of k calculated correctly. The final k values must not be fractions.	1
2(e)(ii)	Valid comment consistent with calculated values of k , testing against a criterion stated by the candidate.	1
2(f)	Correct unit and calculation of M using second k , and in the range 1.0–10.0 g.	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 Lid tilts/sinks more quickly with a reason e.g. cannot stack in one place/tendency to drop coins heavily/force added by hand. C Lid has a curved edge leading to inaccurate $d/t/V$. D Parallax error in t. E Large percentage uncertainty in t as t is small. F Mass of lid needs to be known/masses of two lids are different. G Coins have different mass or Coins or lid heavier when readings repeated because they are wet. <i>1 mark for each point up to a maximum of 4.</i>	4
2(g)(ii)	A Take more readings <u>and</u> plot a graph or take more readings <u>and</u> compare k values (not “repeat readings” on its own). B Improved method of loading coins e.g. tweezers/tongs/forceps/guide for coins mounted centrally. C Improved method of finding V e.g. displacement method/filling with liquid using syringe or pipette. DE Improved method of measuring t e.g. (vernier/digital) calipers/travelling microscope/two blocks/use many stacked lids of the same type. F Method to measure mass e.g. balance/scales. G Method to ensure coins or lid are dry e.g. allow water to evaporate/use hair dryer/use fresh coins or lid each time. <i>1 mark for each point up to a maximum of 4.</i>	4