
PHYSICS**9702/32**

Paper 3 Advanced Practical Skills 2

May/June 2019

MARK SCHEME

Maximum Mark: 40

Published

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This document consists of 7 printed pages.

Question	Answer	Marks
1(a)	Value of x in range 45.0–55.0 cm.	1
1(b)	Value of $y < x$.	1
1(c)	Six sets of readings of x and y with the correct trend and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	5
	Range: $x_{\min} \leq 20.0 \text{ cm}$ and $x_{\max} \geq 80.0 \text{ cm}$.	1
	Column headings: Each column heading must contain a quantity, a unit and a separating mark where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. $1/x/\text{cm}^{-1}$.	1
	Consistency: All values of x and y must be given to the nearest mm.	1
	Significant figures: The number of significant figures for every value of $1/y$ should be the same as, or one greater than, the number of s.f. of y as recorded in the table.	1
	Calculation: Values of $1/y$ calculated correctly.	1

Question	Answer	Marks
1(d)(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 in the table must be plotted on the grid. Diameter of plotted points must be $\leq$ half a small square (no blobs). Plots must be accurate to within half a small square in both x and y directions.	1
	Quality: All observations in the table (at least 5) 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 $\pm 0.005 \text{ cm}^{-1}$ ($\pm 0.5 \text{ m}^{-1}$) in the $1/x$ direction of all plotted points.	1
1(d)(ii)	Line of best fit: Judge 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. Allow one anomalous point only if clearly indicated (i.e. circled or labelled) by the candidate. Lines must not be kinked or thicker than half a 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

Question	Answer	Marks
1(e)	a equal to candidate's gradient and b equal to candidate's intercept. The values must not be fractions.	1
	No unit for a and unit for b is correct (e.g. m^{-1}).	1

Question	Answer	Marks
2(a)	Value for θ recorded to nearest degree and $\theta < 90^\circ$.	1
2(b)	Value for F recorded to nearest 0.1 N with unit.	1
	Evidence of repeat readings of F .	1
2(c)	Percentage uncertainty in F based on an absolute uncertainty of 0.2–0.5 N. 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(d)(i)	Second value for θ .	1
2(d)(ii)	Second value for F .	1
	Quality: Second $F <$ first F .	1
2(e)	Value of W in range 1.0–5.0 N with unit.	1
2(f)(i)	Two values of μ calculated correctly.	1
2(f)(ii)	Valid comment consistent with the calculated values of μ , testing against a criterion specified by the candidate.	1
2(g)	Correct calculation of F .	1
	F given to 2 or 3 significant figures.	1

Question	Answer	Marks
2(h)(i)	A Two readings are not enough to draw a (valid) conclusion (not “not enough for accurate results”, “few readings”). B Difficult to clamp board <u>so that it is stable</u>. C Difficult to pull (block) at steady speed. D Difficulty with F/force/newton-meter reading with reason (e.g. fluctuates / friction varies in different places). E F is small so percentage uncertainty in F is large. <i>1 mark for each point up to a maximum of 4.</i>	4
2(h)(ii)	A Take more readings <u>and</u> plot a graph or take more readings <u>and</u> compare μ values (not “repeat readings” on its own). B Improved clamping method e.g. use two clamps/fix base to bench with adhesive putty. C Detail of constant speed pulling arrangement (e.g. use motor/pulley with mass adjusted to give terminal velocity). D Video/film/record linked to <u>measurement of force</u>. E Use force sensor with data logger/use more precise newton-meter/add masses on top of block. <i>1 mark for each point up to a maximum of 4.</i>	4