Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **May/June 2022**

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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[Turn over

Question	Answer	Marks
1(a)	Value of V in range 5.00–7.00 V with unit and to the nearest 0.01 V.	**1**
1(b)	Value for t with unit in the range 2.0–20.0 s.	**1**
	Evidence of repeat readings for t.	**1**
1(c)	Six sets of readings of R and t with correct trend (as R increases, t increases) and without help from the Supervisor scores 4 marks, five sets scores 3 marks etc.	**4**
	Range: $R_{min} \leqslant 22\ k\Omega$ **and** $R_{max} \geqslant 470\ k\Omega$.	**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. $1 / R\ (k\Omega^{-1})$.	**1**
	Consistency: Values of t must all be given to the nearest 0.1 s or all to the nearest 0.01 s.	**1**
	Significant figures: All values of $1 / t$ must be given be to the same number of s.f. as (or one more than) the s.f. in the corresponding value of t.	**1**
	Calculation: Values of $1 / t$ 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 the *x* and *y* directions. Axes must be labelled with the quantity that is being plotted. Scale markings are no more than 2 cm (one large square) apart.	**1**
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points must be ⩽ half a small square. Points must be plotted to an accuracy of half a small square in both *x* and *y* directions.	**1**
	Quality: All points in the table must be plotted (at least 5) for this mark to be awarded. Trend of points must be positive It must be possible to draw a straight line that is within $\pm$ 0.0025 $k\Omega^{-1}$ on the 1 / *R* axis of all plotted points.	**1**
1(d)(ii)	Line of best fit: Judge by the 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 5 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. Both read-offs must be accurate to half a small square in both the *x* and *y* directions. Method of calculation must be correct (not $\Delta x / \Delta y$). Gradient sign on answer line matches graph drawn.	**1**
	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 1 / *R* = 0, accurate to half a small square.	**1**

Question	Answer	Marks
1(e)	Value of a = candidate's gradient **and** value of b = candidate's intercept. The values must not be fractions.	**1**
	Units for a and b correct (e.g. $\Omega\,s^{-1}$ for a and s^{-1} for b).	**1**

Question	Answer	Marks
2(a)	Value for *W* to at least nearest 0.1 N.	**1**
2(b)(i)	Raw values of *F* to at least nearest 0.1 N. Repeated readings, if present, have the same precision.	**1**
	Repeated readings for *F*.	**1**
2(b)(ii)	Percentage uncertainty in *F* based on an absolute uncertainty of 0.20–0.50 N. If several readings have been taken, then the absolute uncertainty can be half the range (but not zero) provided working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(b)(iii)	Correct calculation of *E*.	**1**
2(c)	Value for *T* in range 2.0–30.0 s.	**1**
	Repeated readings for *T*.	**1**
2(d)	Second values of *F* and *T*.	**1**
	Second *F* > first *F*.	**1**
2(e)(i)	Two values of *k* calculated correctly. The final *k* values must not be written as fractions.	**1**
2(e)(ii)	Justification based on significant figures in *E* (or *F* and *W*) and *T*.	**1**
2(f)	Calculation of percentage difference between candidate's two *k* values. Comparison of percentage difference with 40% leading to a consistent conclusion.	**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 Difficult to measure *W* with reason e.g. newton meter scale not precise enough/newton meter doesn't move off zero. C Block tends to slide towards edge of plate/newton meter not vertical. D Difficult to measure *F* with reason e.g. block detaches suddenly/difficult to judge or predict when block will leave the surface/reading is only at the value for a short time. E Difficulty with *F* or *W* or *E* since value is very small so large uncertainty/large percentage uncertainty. F Difficult to measure *T* with reason e.g. difficult to judge/determine moment when water level passes mark on syringe. *1 mark for each point up to a maximum of 4.*	**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 Measure *W* using an electronic scale. C Workable method of ensuring the newton meter operates vertically e.g. attach string to newton meter and have string guide fixed above centre of plate/use of plumb-line to help judgement of vertical. D Video/film/record <u>newton meter</u> or use data logger/force sensor **and** find *F*/<u>maximum</u> reading/<u>maximum</u> force **or** use newton meter with maximum hold indication. E Use a block that is larger/heavier/denser/wider. F Video/film/record <u>syringe</u> with <u>timer</u> in view. *1 mark for each point up to a maximum of 4.*	**4**