



Cambridge International AS & A Level

PHYSICS**9702/33**

Paper 3 Advanced Practical Skills 1

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.

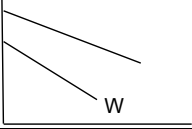
Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **9** printed pages.

Question	Answer	Marks
1(a)	Value of L to the nearest mm with unit and in the range 74.0–76.0 cm.	1
1(b)	Values of raw V_1 and V_2 to the nearest mV with unit.	1
	$V_2 > V_1$.	1
1(c)	Six sets of readings of d , V_1 and V_2 with correct trend (d increases as average V_1 increases and average V_2 decreases) and without help from the Supervisor scores 4 marks, five sets scores 3 marks, etc.	4
	Range: $d_{min} \leq 22.0$ cm and $d_{max} \geq 65.0$ 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. $(\frac{V_2}{V_1})d / \text{m}$, d^2 / m^2 .	1
	Significant figures: All values of $(\frac{V_2}{V_1})d$ must be given to the same number of s.f. as (or one more than) the least number of s.f. in d , V_1 and V_2 .	1
	Calculation: Correct calculation of $(\frac{V_2}{V_1})d$.	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 $\leq$ 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) on the grid for this mark to be awarded. Trend of points must be negative. It must be possible to draw a straight line that is within ± 2.5 cm (to scale) on the $(\frac{V_2}{V_1})d$ 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 and substituted 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 $d^2 = 0$, accurate to half a small square.	1

Question	Answer	Marks
1(e)	Value of P = candidate's gradient and value of Q = candidate's intercept. The values must not be fractions.	1
	Unit for P : m^{-1} , cm^{-1} or mm^{-1} and unit for Q : m, cm or mm.	1
1(f)	Line labelled W with steeper gradient and smaller intercept. 	1

Question	Answer	Marks
2(a)(i)	Raw value(s) of A to the nearest mm with unit and $A \geq 5.0$ cm.	1
	Evidence of repeat readings.	1
2(a)(ii)	Percentage uncertainty in A based on absolute uncertainty ≥ 3 mm. If several readings have been taken, then the absolute uncertainty can be half the range (but not zero) provided the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	1
2(b)(i)	Value of θ to the nearest degree in the range 60° – 70° .	1
	Value of H with unit.	1
2(b)(ii)	Correct calculation of $\cos^2 \theta$.	1
2(c)	Second value of θ .	1
	Second value of H .	1
	Second value of $H >$ first value of H .	1
2(d)(i)	Two values of k calculated correctly. The final k values must not be written as fractions.	1
2(d)(ii)	Justification for significant figures in k linked to significant figures in H , A and either θ or $\cos \theta$.	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

Question	Answer	Marks
2(f)(i)	A Two readings are not enough to draw a (valid) conclusion (not “not enough for accurate results”, “few readings”). B Difficult to measure θ or angle with reason e.g. hand moves during measurement/holding protractor in hand/parallax error/string too thick. C Difficult to judge the horizontal or vertical. D Masses or strings collide/hit stand/string wraps around boss/string slips off rod of clamp/trajectory of motion out of alignment/masses not in the right plane. E Difficult to measure H or A with reason e.g. uncertain where the top measurement is/measured distance not the same as the height the mass falls/mass moves when touched or measured. <i>1 mark for each point up to a maximum of 4.</i>	4
2(f)(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 Method to improve measurement of θ e.g. clamp the 10g mass or clamp protractor/thinner string/put a board behind with marked angle(s)/take a photo and measure angle/project angle onto a screen/use a stop at the correct angle. C Method to determine the vertical or horizontal e.g. use a plumb-line/spirit level/set square with detail. D Method to improve alignment e.g. use longer rod/notched rod/larger diameter on end of rod/place plasticine on the end of the rod/use guide. E Improved method to measure H or A e.g. use a clamped pointer/take a photo with a scale/use large dividers or calipers. <i>1 mark for each point up to a maximum of 4.</i>	4



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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **9** printed pages.

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: $R_{\min} \leq 22 \text{ k}\Omega$ and $R_{\max} \geq 470 \text{ k}\Omega$.	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. $1/R \text{ (k}\Omega^{-1}\text{)}$.	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 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 $\leq$ 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 $\pm 0.0025 \text{ k}\Omega^{-1}$ 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. $\Omega\text{ s}^{-1}$ 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. <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 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. <i>1 mark for each point up to a maximum of 4.</i>	4



Cambridge International AS & A Level

PHYSICS**9702/35**

Paper 3 Advanced Practical Skills 1

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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **9** printed pages.

Question	Answer	Marks
1(a)	Value of T with unit and in the range 1.0–1.5 s.	1
	nT measured at least twice with $n \geq 5$.	1
1(b)	Six sets of readings of m and time with correct trend (T increases as m increases) and without help from the Supervisor scores 5 marks, five sets scores 4 marks etc.	5
	Range: Values of m include $m \geq 400$ g and $m \leq 150$ g.	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. T/m s kg ⁻¹ and $1/m$ kg ⁻¹ .	1
	Consistency: All raw values of time given to the nearest 0.1 s or all given to the nearest 0.01 s.	1
	Significant figures: All values of T/m must be given to the same number of significant figures as (or one more than) the least number of s.f. in the raw time and m .	1
	Calculation: Correct calculation of T/m .	1

Question	Answer	Marks
1(c)(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 $\leq$ 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 (at least 5) must be plotted on the grid for this mark to be awarded. Trend of the points must be positive. It must be possible to draw a straight line that is within $\pm 0.2 \text{ kg}^{-1}$ on the $1/m$ axis of all plotted points.	1
1(c)(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(c)(iii)	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 and substituted 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 $1/m = 0$, accurate to half a small square.	1

Question	Answer	Marks
1(d)	Value of P = candidate's gradient and value of Q = candidate's intercept. The values must not be fractions.	1
	Unit for P : s and unit for Q : s kg ⁻¹ .	1

Question	Answer	Marks
2(a)(i)	Value(s) of raw d to the nearest 0.01 mm or 0.001 mm with unit and final value in the range 0.43–0.49 mm.	1
2(a)(ii)	Value of raw L to the nearest mm and final value in the range 43.0–49.0 cm.	1
2(a)(iii)	Percentage uncertainty in L based on absolute uncertainty of 2–6 mm. If several readings have been taken, then the absolute uncertainty can be half the range (but not zero) provided the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	1
2(a)(iv)	Correct calculation of C .	1
2(a)(v)	Justification for significant figures in C linked to significant figures in d and L .	1
2(b)	Value of θ to the nearest 1° or 0.5° and $80^\circ\text{C} \geq \theta \geq 70^\circ\text{C}$.	1
	Correct calculation of $\Delta\theta$.	1
2(c)(i)	Second value of $d <$ first value of d .	1
	Second value of L .	1
2(c)(ii)	Second value of I with unit.	1
2(d)	Two values of k calculated correctly. The final k values must not be written as fractions.	1
2(e)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 30% leading to a consistent conclusion.	1

Question	Answer	Marks
2(f)(i)	A Two readings are not enough to draw a (valid) conclusion (not “not enough for accurate results”, “few readings”). B Difficult to measure L with a reason e.g. unclear where the junction starts/wire not straight. C Difficulty in reading θ or temperature with a reason e.g. temperature not the same throughout/time lag of thermometer/reading thermometer and ammeter simultaneously. D Difficulty in reading I with reason e.g. readings fluctuate/(variable contact) resistance of wires and clips. E Problem identified with setup e.g. wires came apart at the junctions/wires short-circuiting/keeping second junction away from hot beaker. <i>1 mark for each point up to a maximum of 4.</i>	4
2(f)(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 Method to improve measurement of L e.g. tape/glue wire onto ruler. C Use a stirrer to ensure the water temperature is constant throughout/use water bath to control temperature or use a digital thermometer (with a lower response time) or use video with thermometer and ammeter in view. D Improved method of joining wires e.g. solder. E Method to limit movement of wires e.g. clamp the wires or use insulated wire to prevent short circuit. <i>1 mark for each point up to a maximum of 4.</i>	4