CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9702 PHYSICS

9702/31 Paper 1 (Advanced Practical Skills 1), maximum raw mark 40

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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International Examinations

1 (a) (ii) Value of w with unit, in range 45.0 cm to 55.0 cm. [1]

(c) (iii) Value of I_B, with unit, to nearest 0.1 mA, in range $70.0 \leq I_B \leq 100.0$ mA. [1]

(d) Six sets of readings of w, I_A and I_B, different values, scores 5 marks, five sets scores 4 marks, etc. [5]
Incorrect trend –1.
Major help from Supervisor –2. Minor help from Supervisor –1.

Range: [1]
Range of $w \geq 60.0$ cm.

Column headings: [1]
Each column heading must contain a quantity and a unit.
The presentation of quantity and unit must conform to accepted scientific convention e.g. w/cm, w (cm), $(I_A+I_B)/(I_AI_B)/A^{-1}$, $(I_A+I_B)/(I_AI_B)/(1/A)$.
Do not allow $(I_A+I_B)/(I_AI_B)/(A/A^2)$.

Consistency: [1]
All values of w must be given to the nearest mm only.

Significant figures: [1]
Every value of $(I_A+I_B)/(I_AI_B)$ must be given to the same number of s.f. as (or one more than) the least s.f. in the corresponding values of I_A and I_B.

Calculated values: [1]
Values of $(I_A+I_B)/(I_AI_B)$ calculated correctly to the number of significant figures given by the candidate.

(e) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) are not allowed.
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.

Plotting of points: [1]
All observations in the table must be plotted.
Diameter of points must be ≤ half a small square (no "blobs").
Plotted points must be accurate to within half a small square.

Quality: [1]
All points in the table must be plotted on the grid (at least 5) for this mark to be awarded.
All points must be within ± 5 cm (± 0.05 m) on the w-axis from a straight line.

(ii) Line of best fit: [1]
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 by the candidate.
Lines must not be kinked or thicker than half a square.

(iii) Gradient: [1]
The hypotenuse of the triangle must be greater than half the length of the drawn line.
The method of calculation must be correct.
Both read-offs must be accurate to half a small square in both the x and y directions.

y-intercept: [1]
Either:
Correct read-offs 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:
Check read-off of the intercept directly from the graph (accurate to half a small square).

(f) M = value of the candidate's gradient and N = value of the candidate's y-intercept. [1]
Do not allow substitution methods. Do not allow fractions.

Unit for M correct (e.g. $A^{-1}\,m^{-1}$ or $A^{-1}\,cm^{-1}$ or $A^{-1}\,mm^{-1}$ or $mA^{-1}\,m^{-1}$ or $mA^{-1}\,cm^{-1}$ or $mA^{-1}\,mm^{-1}$)
and unit for N correct (e.g. mA^{-1} or A^{-1}). [1]

2 (a) (i) Value of L with unit, in range $55.0\,cm \leq L \leq 65.0\,cm$. [1]

(ii) Value of m to nearest gram or better, in range $10.0\,g \leq m \leq 100.0\,g$. [1]

(iv) Correct justification of significant figures in p linked to significant figures in L and m. [1]

(b) (i) Value of M to the nearest gram or better, in range $90.0\,g \leq M \leq 110.0\,g$. [1]

(iii) Correct calculation of C. [1]

(c) (ii) Value of x to the nearest mm, with unit, in range $5.0\,cm \leq x \leq 20.0\,cm$. [1]

(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]

(d) Second value of L. [1]

Second value of x. [1]

Correct trend for x with respect to L (x decreases as L decreases). [1]

(e) (i) Two values of k calculated correctly. [1]

(ii) Valid comment consistent with calculated values of k, testing against a criterion specified by the candidate. [1]

(f)	(i) Limitations (4 max.)	(ii) Improvements (4 max.)	Do not credit
A	Two readings not enough to draw a valid conclusion.	Take more readings (for different *L*) and plot a graph/ take more readings and compare *k* values.	"repeat readings"/ "too few readings"
B	Difficult to measure *x* with reason, e.g. parallax/ruler not in line with wood/strip moves as touched while taking measurement/mass obscures end of rule/strip oscillates/balance achieved for a short time	Improved method to measure *x* e.g. attach mass to bottom of strip/mark scale on strip/mark strip at balance point/measure (*L*–*x*)/clamp ruler horizontally	Travelling microscope Video
C	Difficult to balance with reason, e.g. wind/air conditioning or pivot moves	Method to remove wind, e.g. turn off fans/close windows or method of fixing pivot to bench i.e. tape/heavier pivot	Sliding rule Pivot size
D	Problem with Blu-Tack, e.g. mass of Blu-Tack not taken into account	Method to overcome problem with Blu-Tack, e.g. measure mass of Blu-Tack and add to value of *M* or fix mass with named adhesive, e.g. tape/glue because this has less mass	
E	Difficult to know where centre of mass is with reason, e.g. slot in mass or Difficult to place centre of mass at end of strip	Detailed method of finding centre of mass Method to attach mass on strip to ensure centre of mass is at the end of strip, e.g. hang mass from strip with thread	Mark centre of mass Measure diameter
F	Two strips have different density/*p*	Find mass or *p* of second strip	Different thickness/cross-sectional area