Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/03**

Paper 3 Advanced Practical Skills **For Examination from 2016**

SPECIMEN MARK SCHEME

2 hours

MAXIMUM MARK: 40

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[Turn over

1 **(a)** Value of I recorded with consistent unit. [1]

(b) Six sets of readings of I and R scores 5 marks; five sets scores 4 marks etc. [5]
Major help from Supervisor –2 (setting up apparatus). Minor help from Supervisor –1.

Range of R includes 2.5 Ω and 40 Ω. [1]

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. $1/I$ /A^{-1}. Do not allow $1/I$ (A).

Consistency: [1]
All values of I must be given to the same number of decimal places.

Significant figures: [1]
Significant figures for every row of values of $1/I$ same as or one greater than I as recorded in table. Accept three or four s.f. only.

Calculation: [1]
All values of $1/I$ calculated correctly.

(c) **(i)** Axes: [1]
Sensible scales must be used, no awkward scales (e.g. 3:10).
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").
Work to an accuracy of half a small square.

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be awarded.
Scatter of points must be less than 0.1 m^{-1} from a straight line on the $1/I$ axis.

(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 (i.e. circled or labelled) by the candidate.
Line must not be kinked or thicker than half a small square.

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(iii) Gradient: [1]
The hypotenuse of the triangle must be at least 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.
The method of calculation must be correct.

y-intercept: [1]
Either:
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:
Correct read-off of the intercept directly from the graph.

(d) Value of $E = 1/$(candidate's gradient). [1]
Value of $r = E \times$ (candidate's intercept) or
Value of r = (candidate's intercept) / (candidate's gradient) [1]

(e) Line Z drawn with smaller gradient and same *y*-intercept. [1]

[Total: 20]

2 **(a)** Measurement of mass of salt and container A. [1]
Measurement of mass of salt and container B. [1]
Measurement of mass of empty container. [1]
Correct calculation of m_A and m_B by subtraction of mass of container. [1]

(b) **(i)** Measurement of t_A. [1]

(ii) Measurement of t_B. [1]

Repeated measurements taken (here or in **(i)**). [1]
Quality: $t_B = 2t_A \pm 10\%$. [1]
(Do not allow this mark if the stopwatch has been misread.)

(c) Absolute uncertainty in t_A in the range 0.1–0.4 s. If repeated readings have been taken, then the absolute uncertainty can be half the range provided this is not zero. Correct method of calculation to get percentage uncertainty. [1]

(d) **(i)** One mass flow rate calculated correctly. [1]

Second mass flow rate calculated correctly and a correct unit (g s^{-1} or kg s^{-1}), consistent with candidate's working. [1]

(ii) Sensible comment relating to the calculated mass flow rates, testing against a criterion specified by the candidate. [1]

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(e) (i) Relevant points might include: [4]

Two readings are not enough to draw a valid conclusion.
Difficulty with removing finger and starting the stopwatch at the same time.
Length of pipe at bottom of funnel may affect results.
Salt may contain 'lumps' which affect the flow rate.
Moisture content of salt may affect flow rate.
Hard to see the point at which all the salt has passed out of the container.
Human error in starting/stopping the stopwatch.
Salt sticks to the sides of the funnel.

(ii) Relevant points might include: [4]

Take many readings and plot a graph of the results.
Use greater masses of salt to increase *t*.
Greater masses reduce uncertainty in *t*.
Use mechanical method (joined to timer) to start the flow.
Use light gates to determine when salt ceases to pass out of the hole.
Use of a second person fully explained.

Do not allow "repeated readings".
Do not allow "use a computer to improve the experiment".

[Total: 20]

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