UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 question paper

9702 PHYSICS

9702/05 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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.

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1 Planning (15 marks)

Defining the problem (3 marks)

P1 *A* is the independent variable or vary *A*. [1]

P2 *R* is the dependent variable or determine *R* for different *A*. [1]

P3 Keep the temperature (of glass) constant. Do not allow "controlled variable". [1]

Methods of data collection (5 marks)

M1 Basic circuit diagram. [1]
Ammeter and voltmeter with power supply, or
ohmmeter without power supply, or
bridge methods.

M2 Correct orientation of glass between electrodes – largest cross-sectional area. [1]

M3 A distance (thickness) measured using a micrometer/vernier scale/vernier callipers. [1]

M4 Method of determining area perpendicular to current flow. [1]
Distances measured and multiplied together.
This mark may only be scored if it is clear that the correct dimensions are being used.

M5 Method of determining resistance. [1]
Ohmmeter.
$R = V/I$ justified.
Description of balancing bridge with correct equation.

Method of analysis (2 marks)

A1	A2
R against $1/A$	ρ = gradient/l
R against l/A	ρ = gradient
$1/A$ against R or $1/R$ against A	$\rho = 1/(\text{gradient} \times l)$
l/A against R or l/R against A	ρ = 1/gradient
lg R against lg A	$\rho = 10^{l \times \text{y-intercept}}$

[2]

Safety considerations (1 mark)

S1 Relevant safety precaution related to: [1]
EHT power supply (>100 V) – switch off before changing circuit/use of rubber gloves;
or handling glass – wear (thick) gloves.

Additional detail (4 marks)

D1/2/3/4 Relevant points might include [4]
Calculation of typical resistance of glass using value of resistivity given.
Range of ammeter or ohmmeter with reasoning.
Use of EHT or power supply >1000 V or microammeter/galvanometer.
Take many readings of thickness and average.
Good contact between circuit and glass e.g. metal plates, foil, conducting putty.
Metal plates/foil/conducting putty to cover all of the cross-sectional area in use.
Method of securing good contact between circuit and glass, e.g. g clamps, weights.
Clean/dry the glass.

[Total: 15]

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2 Analysis, conclusions and evaluation (15 marks)

(a) gradient = $-\rho\eta$
y-intercept = ln R_0 or $\log_e R_0$ [1]

(b)

ln (R/s^{-1})	Errors in ln R
6.620 or 6.62	± 0.02 – 0.03
6.363 or 6.36	± 0.03
6.064 or 6.06	± 0.05
5.799 or 5.80	± 0.06
5.521 or 5.52	± 0.08
5.247 or 5.25	± 0.10 – 0.11

Column heading for ln (R); ln R calculated. All correct for one mark. [1]
2 or 3 dp scores one mark as shown. [1]
Errors in ln R: Ignore no. of sf in errors. [1]

(c) (i) Points plotted correctly. All six within half a small square required for this mark. [1]
Error bars in ln R plotted correctly. Check x = 0.0300 m. Allow ecf. [1]

(ii) Line of best fit. Must be within tolerances. [1]
Worst acceptable straight line. Line should be clearly labelled. [1]

(iii) Gradient of best-fit line. Must be negative. [1]
Award this mark if in range –54.0 to –56.0.
If out of range, check the read offs. Work to half a small square.
The triangle used should be greater than half the length of the drawn line.

Error in gradient [1]
Method of determining absolute error. Expect to see difference between gradient from best-fit line and the worst acceptable line correctly evaluated.

(d) Value of η [1]
Award mark for method η = candidate's gradient/11300 evaluated.
Error in η [1]
Method of determining absolute error.
Unit of η: **m^2 kg^{-1}**. [1]

(e) Value of x in the range **0.0410 m to 0.0425 m** [1]

If x in the range **0.0410 m to 0.0425 m**, then method of determining error in x. [1]

[Total: 15]

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