Specimen Paper

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9702/31

PHYSICS
Paper 31 (Advanced Practical Skills)

Question 1

Manipulation, measurement and observation (9 marks)

Successful collection of data (7 marks)

(c) Measurements **6**
One mark for each set of readings for I and R.

(c) Repeats **1**

Range and distribution of values (1 mark)

(c) Range of resistance values **1**
Should cover the whole range from $2.5\,\Omega$ to $40\,\Omega$.

Quality of data (1 mark)

Graph Quality of results **1**
Judge by scatter of points about the best fit line.
At least 5 plots are needed for this mark to be scored.

Presentation of data and observations (7 marks)

Table of results: layout (1 mark)

(c) Layout: Column headings **1**
Each column heading must contain a quantity and a unit.
Ignore units in the body of the table.
There must be some distinguishing mark between the quantity and the unit (i.e. solidus is expected, but accept, for example, I (A)).

Table of results: raw data (1 mark)

(c) Consistency of presentation of raw readings **1**
All values of I must be given to the same number of decimal places.

Table of results: calculated quantities (2 marks)

(c) Significant figures in calculated quantities **1**
Apply to $1/I$. Accept two or three significant figures only.

(c) Correct values of total resistance and $1/I$ calculated **1**
All values should be correct for this mark.

Graph: layout (1 mark)

Graph 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 which is being plotted.

Graph: plotting of points (1 mark)

Graph Plotting of points **1**
All observations must be plotted.
Ring and check a suspect plot. Tick if correct. Re-plot if incorrect.
Work to an accuracy of half a small square.

Graph: trend line (1 mark)

Graph Line of best fit **1**
Judge by scatter of points about the candidate's line.
There must be a fair scatter of points either side of the line.
Indicate best line if candidate's line is not the best line.

Analysis, conclusions and evaluation (4 marks)

Interpretation of graph (2 marks)

(d)(iii) Gradient **1**
The hypotenuse of the Δ must be greater than half the length of the drawn line.
Read-offs must be accurate to half a small square.
Check for $\Delta y/\Delta x$ (i.e. do not allow $\Delta x/\Delta y$).

(d)(iii) y-intercept **1**
Values must be read to the nearest half square.
If a false origin has been used, then label FO.
The value can be calculated using ratios or $y = mx + c$.

Drawing conclusions (2 marks)

(e) Value for E **1**
Unit required.

(e) Value for r **1**
Unit required.

Question 2

Manipulation, measurement and observation (7 marks)
Successful collection of data (6 marks)

(a) Measurements of m_A and m_B with mass of beaker included **2**
One mark each.

(a) Measurement of mass of empty beaker measured **1**

(c)(ii) Measurement of t_A **1**

(c)(iii) Measurement of t_B **1**

(c)(iii) Repeated measurements for both t_A and t_B **1**

Quality of data (1 mark)

(c)(iii) Quality of results ($t_B = 2t_A \pm 10\%$) **1**
Do not allow this mark if the stopwatch has been misread.

Presentation of data and observations (3 marks)
Display of calculation and reasoning (3 marks)

(a) Correct calculation of m_A and m_B (i.e. subtraction of mass of beaker) **1**

(e)(i) Calculation of mass flow rates **2**
One mark each.
Correct unit (g s^{-1} or kg s^{-1}), consistent with candidate's working, required for both marks to be awarded.

Analysis, conclusions and evaluation (10 marks)
Drawing conclusions (1 mark)

(e)(ii) Sensible comment relating to constant mass flow rate **1**
e.g. rate not affected by mass.

Estimating uncertainties (1 mark)

(d) Percentage uncertainty in t **1**
If repeated readings have been done, then the uncertainty must be half the range.
Accept Δt = 0.1 s to 0.4 s. Correct ratio idea required.

Identifying limitations (4 marks)

(f)(i) Sources of error or limitations of procedure **4**

Relevant points might include:
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

(f)(i) Improvements **4**

Relevant points might include:
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
Do not allow 'repeated readings'.
Do not allow 'use a computer to improve the experiment'.