UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 question paper

9702 PHYSICS

9702/32 Paper 32 (Advanced Practical Skills 2), maximum raw mark 40

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UNIVERSITY of CAMBRIDGE
International Examinations

Question 1

Manipulation, measurement and observation

Successful collection of data

(b) Measurements [5]
Five marks for six sets of readings for l and R_2,
four for five sets, etc.
(–1 for unreasonable values of R_2, e.g. R_2>40 or R_2<2.5, e.g. impossible R_2)

(b) Circuit set up without help from Supervisor (minor help –1, major help –2) [2]

Range and distribution of values

(b) R_2 values must include 40 Ω and one value $\leqslant$ 5 Ω [1]

Presentation of data and observations

Table: layout

(b) Column headings [1]
Each column heading must contain a quantity and a unit where appropriate.
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, l (cm)).

Table: raw data

(b) Consistency of presentation of raw readings [1]
All values of l must be given to the same number of decimal places.
(l can be to nearest 1 mm or 1 cm).

Table: calculated quantities

(b) Significant figures [1]
Apply to $1/l$ only.
If l is given to 2 sf, then accept $1/l$ to 2 or 3 sf.
If l is given to 3 sf, then accept $1/l$ to 3 or 4 sf.
Values of $1/l$ given as fractions lose this mark.

(b) Values of $1/l$ correct. [1]
Check a value. If incorrect, write in the correct value.
Allow values of 1/l given as fractions for this mark.

Graph: layout

(Graph) Axes [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) are not allowed.
There should not be more than three large squares between axis labels.
Scales must be chosen so that the plotted points must occupy at least half the graph grid in both *x* and *y* directions.
Scales must be labelled with the quantity which is being plotted (do not accept *R* instead of R_2). Ignore units.
Do not penalise reversed axes but penalise if the wrong graph has been plotted.

Graph: plotting of points

(Graph) All observations must be plotted. [1]
Ring and check a suspect plot, tick if correct. Re-plot if incorrect (and re-check quality mark).
Work to an accuracy of half a small square.
Penalise blobs ⩾ half a small square diameter.

Graph: trend line

(Graph) Line of best fit (must be 5 or more plots, do not allow if scatter is large). [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.

Quality of data

(Graph) Judge by scatter of points about the best fit line (all points ±1 Ω) [1]
Trend must be correct. At least 5 plots are needed for this mark to be scored.

Analysis, conclusions and evaluation

Interpretation of graph

(c) (iii) Gradient [1]
The hypotenuse must be at least half the length of the drawn line.
Read-offs must be accurate to half a small square (if incorrect, write in correct value).
Check for $\Delta y/\Delta x$ (i.e. do not allow $\Delta x/\Delta y$). Ignore POTE.

(c) (iii) *y*-intercept [1]
The value must be read to the nearest half square.
The value can be calculated using ratios or $y = mx + c$ (if algebra is not obviously wrong).
If a false origin has been used then label FO.

Drawing conclusions

(d) Value for R_1 [1]
There should be evidence that it is obtained from 1/(100cm x gradient).
Must be in range 5 to 15 Ω.
2 or 3 sf. Unit required.

(d) Value for *k* [1]
Should be candidate's intercept. 2 or 3 sf.
Unit required.
Should be in range 0.0050 to 0.0150 cm^{-1}.

[Total for Question 1: 20]

Question 2

Manipulation, measurement and observation

Successful collection of data

(b) (ii) First value of *d* to nearest cm or mm. [1]

(c) (ii) First value of *t* (must be between 0.1 and 10 s). [1]

(f) (ii) Second value of *d* (must be less than first value) [1]

(f) (ii) Second value of *t*. [1]

(f) (ii) Two values of *h* in range 0 to 130 cm. (both values could be the same) [1]

(f) (ii) Repeated measurements for *t* (first or second reading) [1]

Quality of data

(f) (ii) Smaller *d* gives greater *v* (use corrected values of *v*). [1]

Presentation of data and observations

Display of calculation and reasoning

(e) First value of *v* calculated correctly. Calculations must be checked (if wrong, write in correct value). [1]

(f) (ii) Second value of *v* calculated correctly. Calculations must be checked (if wrong, write in correct value). [1]

(g) Correct calculation to check proportionality [1]
Possibilities include: Two calculations of *vd*.
Ratio of *v* values and inverse ratio of *d* values both calculated.

Analysis, conclusions and evaluation

Drawing conclusions

(g) Conclusion [1]
Sensible comments relating to proportionality calculations and to the suggested relation.
Incorrect ideas score zero.

Estimating uncertainties

(d) Percentage uncertainty in *t*. [1]
Absolute uncertainty must be 0.1 to 0.5 s, or if repeated readings have been done then the uncertainty could be half the range.
Correct ratio idea and x100 required.

Identifying limitations

(h) (i) Relevant points must be underlined and ticked. [4]
Some of these might be:

A Two sets of readings not enough (to draw valid conclusion).
B Cone may have not reached terminal velocity.
C Hard to see when cone strikes floor.
D Cone falls at an angle (due to draughts/imbalance of cone).
E Human error in timing/reaction time.
F Difficult to measure diameter because cone flexible.
G Parallax error (at reading positions).

X Other source of error

Suggesting improvements

(h) (ii) Relevant points must be underlined and ticked. [4]
Some of these might be:

A Take more readings and plot a graph/calculate ratios.
B Ensure terminal velocity by increasing release height/measure velocity at two intervals to check terminal velocity reached.
C Use pressure/other sensor (on floor) to stop timer/use assistant to judge when it reaches the floor.
D Turn off fans/balance the cone e.g. extra strip of tape.
E1 Use light gate to trigger stopwatch/use video camera with slow motion replay/use multiflash photography/use high speed camera with known time intervals.
E2 Time over greater distance.
F Measure diameter of cone in two directions and average.
G Drop in front of rule/read at eye level.

Y Another improvement, well explained.

Do not allow 'repeated readings' (unless qualified by 'plot a graph').
Do not allow 'use a computer to improve the experiment'

[Total for Question 2: 20]