UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 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

1 Manipulation, measurement and observation

Successful collection of data

(a) (i) Measurement of e.m.f. of power supply [1]

(b) Measurements [5]
Five marks for six sets of readings for I and R_3, four for five sets, etc.

(b) Circuit set up without help from Supervisor [1]

Range and distribution of values

(b) R_3 = 33 or 47Ω and R_3 = 560 or 680Ω must be included [1]

Quality of data

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

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, I (A)).

Table: raw data

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

Table: calculated quantities

(b) Significant figures [1]
Apply to $1/I$ only.
If I is given to 2 sf, then accept $1/I$ to 2 or 3 sf.
If I is given to 3 sf, then accept $1/I$ to 3 or 4 sf.
If I is given to 4 sf, then accept $1/I$ to 4 or 5 sf.

(b) Values of $1/I$ correct. [1]
Check a value. If incorrect, write in the correct value.

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. Ignore units.

Do not penalise reversed axes or 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.

Graph: trend line

(Graph) Line of best fit (must be 5 or more plots) [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

Interpretation of graph

(c) (iii) Gradient [1]
The hypotenuse 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 $\Delta x/\Delta y$).

(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 a false origin has been used then label FO.

Drawing conclusions

(d) Must be in range 40.0 to 55.0 Ω. [1]
Value for R_1 obtained from *y*-intercept x *E*.
2 or 3 sf. Unit required

(d) Value for R_2 [1]
Should be 220 Ω ± 50 Ω unless Supervisor has used different resistors to those specified.
Method of working must be correct.
2 or 3 sf. Unit required.

[Total for Question 1: 20]

2 Manipulation, measurement and observation

Successful collection of data

(a) (ii) First value of d (less than 40 cm) no more precise than 1 mm. [1]

(a) (ii) First value of h (less than d) [1]

(a) (iii) Method of measuring h accurately [1]
e.g. Use of set squares to indicate height / repeat to refine position.
Do not accept repeated readings for this mark
Do not accept just 'use a set square'

(b) Second value of d (less than 40 cm) [1]

(b) Second value of h (less than d) [1]

(b) Evidence of repeated measurements for h (first or second reading) [1]

Quality of data

(b) Values of e within 10% of each other [1]

Presentation of data and observations

Display of calculation and reasoning

(b) Values of e calculated correctly [2]
One mark each
Calculations must be checked

(c) Consideration of the percentage uncertainty in h from **(a)(iv)** is expected. [1]
Knowledge of error propagation methods is not required.

Analysis, conclusions and evaluation

Drawing conclusions

(c) Conclusion [1]
Sensible comments relating to values of *e*.
Incorrect ideas score zero.

Estimating uncertainties

(a) (iv) Percentage uncertainty in *h* [1]
If repeated readings have been done then the uncertainty must be half the range.
Absolute uncertainty must be 2 to 10 mm.
Correct ratio idea required.

Identifying limitations

(d) (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 Hard to judge rebound height, with reason
C Parallax (error in measuring *h*)
D Difficult to release without applying a force
E Rule may not be vertical / perpendicular
F Only cm divisions on rule (if borne out by readings)
G Inconsistent bounce

Suggesting improvements

(d) (ii) Relevant points must be underlined and ticked. [4]
Some of these might be:
A Take several *d* values **and** plot graph/compare *e* values
B Use video and play back slowly/position sensor
C **Method** of reducing parallax problem (adjustable marker/drop many times to refine value of *h*/assistant **to drop** ball/ensure measurement taken at eye level)
D Mechanical **method** of release/hold ball against stop
E **Method** of making rule vertical

G Use flat surface/turn off fans

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

[Total for Question 2: 20]