CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 2003

GCE ADVANCED SUBSIDIARY LEVEL AND ADVANCED LEVEL

MARK SCHEME

MAXIMUM MARK: 25

SYLLABUS/COMPONENT: 9702/03

PHYSICS
Paper 3 (Practical (AS))

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

(c) (ii) Percentage uncertainty in first value of *d* **2/1/0**
Uncertainty = 1 mm or 2 mm scores 1 mark.
Ratio idea correct scores 1 mark.

(e) (i) Readings **3/2/1/0**
6 sets of values for *d*/*T* scores 1 mark.
Check a value for *T*. Underline checked value. Tick if correct and score 1 mark.
Ignore rounding errors. If incorrect, write in correct value and do not award the mark.
If there is no record of the number of oscillations then do not award this mark.
If there are no raw times do not award this mark.
If *t* for *T* then do not award this mark and ecf into the calculation for *d*/*T*.
Check a value for *d*/*T*. Underline this value. Tick if correct and score 1 mark.
Ignore rounding errors.
If incorrect, write in correct value and do not award the mark. ecf for *T*.
Help given by Supervisor, then -1. Excessive help then -2.
Misread stopwatch –1.

(e) (i) Repeated readings **1**
For each value of *d* there must be at least two values of *t*.
Do not award this mark if all of the repeats are identical.

(e) (i) Reasonable time used for oscillations **1**
At least half of the raw times must be greater than 20 s.
If there are no raw times do not award this mark.

(e) (i) Quality of results **2/1/0**
Judge by scatter of points about the line of best fit.
6 trend plots with little scatter scores 2 marks.
5 trend plots with little scatter scores 1 mark.
Wrong trend of plots cannot score these marks (i.e. *t* increases as *d* increases)

(e) (i) Column headings **1**
Apply to *d*/*T* only.

(e) (i) Consistency **1**
Apply to *d* only. All the values of *d* must be given to the nearest millimetre.

(e) (i) Significant figures **1**
Apply to *d*/*T* only.
d/*T* must be given to the same number, or one more than, the number of significant figures as the least accurate data. Check each value by row.

(e) (ii) Justification for sf in *d*/*T* **2/1/0**
Answer must relate sf in *d* (and *t*) to sf in *d*/*T*.
Do not allow answers in terms of decimal places.
'Raw data' ideas or reference to *T* instead of *t* can score 1/2 marks.

(f) (i) Axes **1**
Scales must be such that the plotted points occupy at least half the graph grid in both the *x* and *y* directions. Scales must be labelled with the quantities plotted.
Do not allow awkward scales (e.g. 3:10, 6:10, 7:10 etc.). Ignore unit.
Do not allow large gaps in the scale (i.e. 4 large squares or more).

(f) (i) Plotting of points **1**
Count the number of plots and write as a ringed number on the grid.
All observations must be plotted. There must be at least 5 plots on the grid.
Check a suspect plot. Circle and tick if correct. If incorrect, show correct position with arrow, and do not award the mark. Work to half a small square.

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(f) (i) Line of best fit **1**
There must be a reasonable balance of points about the line of best fit.
Only a straight line drawn through a linear trend is allowable.

(f) (ii) Determination of gradient **1**
Δ used must be greater than half the length of the drawn line.
$\Delta x/\Delta y$ scores zero. The value must be negative (if the line has a negative gradient).
Check the read-offs. Work to half a small square.

(f) (ii) *y*-intercept **1**
The value may be read directly or calculated using $y = mx + c$ and a point on the line.

(g_1) Gradient equated with $-\pi^2/g$ **1**

(g_2) Value of g **1**
Accept 9.3 m s^{-2} < g < 10.3 m s^{-2}.
This mark can only be scored if the gradient has been used.

(g_3) Unit of *g* **1**
Must be consistent with the working.

(g_4) Intercept equated with T_O **1**
A numerical value is expected. Allow ecf from candidate's value in **(f) (ii)**.

(g_5) Unit of T_O **1**

(h) Suggested improvement; e.g. **1**
Measure the time for a greater number of oscillations: Use a thinner rod/knife edge for the stop: Use a fiducial marker/projection on screen: Use an electronic timing method (e.g. light gates & timer/datalogger & motion sensor/laser & timer) Use larger values of *d*. Do not allow 'repeat readings', 'more sensitive stopwatch', 'do the experiment in a vacuum', switch the fans off', 'use heavier bob', 'avoid parallax error' or 'use a computer'.

25 marks in total.

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