CAMBRIDGE
INTERNATIONAL EXAMINATIONS

JUNE 2002

GCE Advanced Subsidiary Level

MARK SCHEME

MAXIMUM MARK : 25

SYLLABUS/COMPONENT :9702 /3

PHYSICS
(PRACTICAL (AS))

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Question 1

Measurements and observations

M1 Readings **6**

Write the number of readings as a ringed total by the results table.
Check a value for d^2. Tick if correct. If incorrect, write in correct value & -1.
Check a value for T^2. Tick if correct. If incorrect, write in correct value & -1.
Ignore small rounding errors. Ignore POTE errors (A2 = 0)
6 sets of readings scores 6/6, 5 sets 5/6 etc..
If help given by supervisor then -1, excessive help then -2.
If help is given from the Supervisor then write 'SR' in a ring at the top of the front page of the candidate's script. Also, please indicate the type of help given in a written comment by the table of results.

M2 More than half measured times > 20 s **1**

M3 Repeated readings of time, averaged correctly **1**

For each value of d there must be at least two values of t.
If t_{av} not shown, but T (or T^2) calculated from correct t_{av}, then allow.
If neither shown, or all raw times are the same, then zero.

M4 Quality of results **2**

Judged by scatter of plotted points about the line (accept examiner corrections). This mark is only given for 5 or more plots on the grid.
Look at trend of plots. Allow five trend plots and one outlier for two marks.
Shallow curve gets one mark.

M5 Justification of sf in d^2 **1**

Candidate's answer must relate the number of sf in d to the number of sf in d^2.
Do not accept answers in terms of decimal places.

Presentation of results

R1 Column headings **1**

Every column must be headed with a quantity and a correct unit.
Allow d/cm, d in cm, d(cm) or a solidus notation occupying two lines.
Do not allow d cm, d_{cm} cm (d) or just cm (with no d).

R2 Consistency of raw readings. **1**

All raw readings of a particular quantity must be given to the same degree of precision (e.g. if one value of t is measured to 2 d.p. then all values of t should be given to 2 d.p.).
All the d values should be given to the nearest millimetre.
All the t values should be given to the nearest 0.1 s or 0.01 s.
Write $\checkmark_c$ at the foot of each correct column of raw readings.
Ignore columns of average values.
Ring any inconsistency noted, write X_c at the foot of the column, and -1.
Apply to raw values of t and d only.

R3 Significant figures in d^2 (from raw values of d) **1**

If d measured to 2 SF then allow d^2 to 2 SF or 3 SF but not 1 SF or 4 SF.
If d measured to 3 SF then allow d^2 to 3 SF or 4 SF but not 2 SF or 5 SF.

Graphical work

G1 Axes. **1**

Each axis must be labelled with a correct symbol (or description). Ignore units.
Scales must be such that the plotted points occupy at least half the graph grid in both the x and y directions (i.e. at least 4 x 6 large squares).
Do not allow more than 3 large squares between scale markings on an axis.
Do not allow an axis with an awkward scale (n/a 3:10, 7:10, 8:10 etc.)

G2 Plotting of points. **1**

Count the number of plots on the grid and write this as a ringed total on the grid.
Do not allow plots which are in the margin area.
All observations must be plotted.
Check one suspect plot. Circle this plot. Tick if correct.
If incorrect, mark the correct position with a small cross and use an arrow to indicate where the plot should have been, and -1.
Allow errors up to and including half a small square.

G3 Line of best fit. **1**

Only expect to see a straight line through a linear trend.
A smooth curve drawn through a curved trend is allowable for this mark.
This mark can only be awarded for 5 or more plots on the grid.
There must be a reasonable balance of points about the line which has been drawn.
Do not allow a line which is greater than half a small square thickness.

G4 Measurement of gradient. **1**
Ignore any units given with the value. Ignore POTE errors.
Hypotenuse of Δ must be at least half the length of the drawn line.
Check the read-offs on the x and y axes. These must be within half a small square.
If the calculated or quoted lengths for Δx or Δy are inaccurate by more than one small square then zero.
$\Delta x/\Delta y$ gets zero.
Values taken for the table which are <u>on the line</u> within half a small square are acceptable.
A drawn curve will lose this mark.

G5 y-intercept **1**
Check the read-off. Must be accurate to half a small square.
Allow the value to be calculated using $y = mx + c$ and a <u>point on the line</u>.
A drawn curve will lose this mark.

<u>Analysis</u>

A1 Gradient equated with $8\pi^2 m/k$ (may be implied from working) **1**

A2 Value of k (= 1580/gradient value, or 1.58/gradient (using kg)) **1**
Circle mass value when checking. POTE errors will lose this mark.

A3 Intercept equated with $4\pi^2 I_o/k$ (may be implied from working) **1**

A4 Value of I_o **1**
Correct substitution and method of working.

A5 Valid unit of k (N m, kg m^2 s^{-2} or g cm^2 s^{-2}) **OR** valid unit of I_o (kg m^2 or g cm^2) **1**
The unit must be consistent with the values which are used.

A6 No balls, $T = \sqrt{}$Intercept or by calculation using I_o and k **1**
Ignore sf. Ignore unit.

25 marks in total

Special cases

S1 No raw times t, no record of number of osc;
M1, -1; M2 = M3 = 0; R2 = 0.

S2 Frequency used instead of period (i.e. has calculated n/t);
M1, -1; M4 = 0.
If drawn curve then **G4 = G5 = 0.**

S3 Raw times t used instead of period T (i.e. has calculated t^2 not T^2);
M1, -1 and ecf.

S4 Has reversed axes (i.e. plotted d^2 vs T^2);
A2 = A4 = 0 (unless correct algebraic rearrangement of eqn)

S5 Has plotted the wrong graph (e.g. T^2 vs d, T vs d^2 or T vs d etc.);
G4 = G5 = 0 (if drawn curve). **A2 = A4 = 0.**

S6 Something obviously wrong (e.g. all times more or less the same, no trend etc.)
M1, -2.

N.B. POTE error will result in A2 = 0 only
Allow A2 and A4 if calculated by substitution provided two points on the line have been used.