UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced/Advanced Subsidiary Level

MARK SCHEME for the November 2005 question paper

PHYSICS

9702/05 Paper 5

maximum raw mark 30

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

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1 (b) (i) Repeated readings of raw times **[1]**

(ii) Absolute uncertainty in t (one mark) **[2]**
Working to get the number of oscillations for 1% uncertainty (one mark).

(c) Readings **[3]**
6 sets scores one mark.
Allow more than 6 sets without penalty.
lg (T/s) and lg n correct; one mark each. Values must be checked.
Minor help from the Supervisor, -1. Major help, then -2.
If help has been given then write SR at the top of the front page of the script, and give a brief explanation of the type of help that has been given by the table of results.

Most raw times > 10 s **[1]**

Quality of results **[1]**
Judge by scatter of points about the line of best fit.

Column headings **[1]**
Each column heading must contain a quantity and a unit.
There must be some distinguishing feature between the quantity and the unit.

Consistency of raw readings **[1]**
All the raw readings of t should be given to the same number of d.p.

(d) (i) Axes **[1]**
The axes must be labelled with the quantities plotted.
Ignore units on the axes.
The plotted points must occupy at least half the graph grid in both the x and y. directions (i.e. 4 large squares in the x-direction and 6 large squares in the y-direction).
Do not allow more than 3 large squares between the labels on an axis.
Do not allow awkward scales (e.g. 3:10, 6:10 etc.).

Plotting of points **[1]**
All the observations must be plotted.
Count the number of plots and ring this total on the grid.
Do not allow plots in the margin area.
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.

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(ii) Line of best fit **[1]**
Only a drawn straight line through a linear 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 drawn line.
Do not allow a line of thickness greater than half a small square.

(iii) Gradient **[1]**
Ignore any units given with the value.
Hypotenuse of Δ must be > half the length of line drawn.
Check the read-offs. Work to half a small square. $\Delta x/\Delta y$ gets zero.
Values taken from the table that lie on the line to within half a small square are acceptable.

(iii) *y*-intercept **[1]**

(e) q = gradient **[1]**

(e) $p = 10^{y\text{-intercept}}$ **[1]**

(f) Value of k **[1]**
Must be in range 20 to 30 N m^{-1}

(f) Unit of k (e.g. N m^{-1} or kg s^{-2}) **[1]**

(f) sf in k (accept 2 or 3 sf only) **[1]**

20 marks in total

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2 **A1** Procedure OK (i.e. measure pressure and electrical power; change pressure and measure new power and repeat). **[1]**
This mark can be scored even if the method is unworkable.

A2 Diagram of workable arrangement **[2]**
e.g. wire connected to joulemeter and power supply. A stopwatch must be used if this method is employed. Allow alternative circuit using ammeter and voltmeter.
The wire must be shown inside a closed container with some means of changing and measuring the pressure.
One mark for the electrical arrangement; one mark for the mechanical arrangement.

A3 Measurement of pressure **[1]**
(e.g. Bourdon gauge/pressure gauge/manometer)

B1 Change setting on the power supply to keep the wire at the same temperature when the pressure is changed. **[1]**

B2 Power supplied to wire = V x I (or reading on joulemeter ÷ time) **[1]**

B3 Use of thermocouple thermometer to monitor temperature whilst pressure is changed or adjust V or I to keep R (and hence T) constant **[1]**

C Any one safety precaution **[1]**
e.g. safety screens/goggles/wire mesh surrounding vacuum chamber

D1/2 Any further good design features **[2]**
Some of these might be:
Thermocouple thermometer shown attached to the wire to monitor temperature.
Light spot galvanometer connected to thermocouple.
Use of a needle valve to control pressure.
Vacuum grease the connecting wires to the heater wire.
Allow time between readings for experiment to stabilise.
Do not allow the wire to become too hot or the thermocouple may melt.

10 marks in total

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