CAMBRIDGE
INTERNATIONAL EXAMINATIONS

JUNE 2002

GCE Advanced Level

MARK SCHEME

MAXIMUM MARK : 30

SYLLABUS/COMPONENT :9702 /5

PHYSICS
(PRACTICAL)

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Question 1

Measurements and observations

M1 Readings (for one bulb, 1st table only) **5**

Write the number of readings as a ringed total by the results table.
Check a value for log I. Tick if correct.
If incorrect, write in correct value and -1.
Check a value for log V. Tick if correct.
If incorrect, write in correct value and -1.
Ignore small rounding errors. Allow values of I outside the stated range.
Allow ln values to be used.
6 sets of readings scores 5 marks.
5 sets of readings scores 4 marks.
4 sets of readings scores 3 marks 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 Quality of results **1**

Judge by scatter of points about both lines of best fit
5 trend plots needed on both lines for this mark to be awarded.

Presentation of results

R1 Column headings **1**

Apply to V and I in both tables.
Do not apply to log quantities.
Allow V/V, V in V, V(V) or a dividing line.
Do not allow V V, V_V or just V (with no unit).

R2 Consistency of raw readings given in both tables of results. **1**

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

R3 SF in calculated quantities **1**

Apply to values of n. If no values of n, apply to gradient values.
Accept two or three sf only.

Graphical Work

Apply G1, G2 & G3 to both lines
Apply G4 & G5 to the parallel combination (i.e. the top line)

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 (4 x 6 large squares).
Do not allow > 3 large squares between scale markings on an axis.
Do not allow awkward scales (e.g. 3:10, 7:10, 8:10 etc.)

G2 Plotting of points. **1**
Count the number of plots on the grid and write this value by the lines and ring it. Do not allow plots 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.
Allow errors up to and including half a small square.

G3 Line of best fit. **1**
Apply to both lines.
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.
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**
Apply to parallel arrangement only (i.e. the top line)
Ignore units.
Hypotenuse of Δ must be > half the length of the drawn line.
Check the read-offs. Work to half a small square.
Do not allow $\Delta x/\Delta y$.

G5 y-intercept **1**
Apply to parallel arrangement only (i.e. the top line)
Tick origin, or label FO if the line $x = 0$ is not shown.
Allow read-off of y-intercept to half a small square.
If $y = mx + c$ used, then check the substitution from a point on the line.
Can be implied from $\log k$ = candidate's y-intercept.

Analysis

A1 $\log I = n \log V + \log k$, **1**
Can be implied from candidate's working (i.e. n = gradient and $\log k = y$-intercept)
Allow $\ln I = n \ln V + \ln k$.

A2 Value of n (0.45 to 0.60) from second graph **1**
A POTE will not score this mark.

A3 Value of k from second graph **1**
Method of working must be correct (i.e. $k = 10^{\text{cand. } y\text{-intercept}}$ or $e^{\text{cand. } y\text{-intercept}}$)

A4 Sensible comment **1**
(e.g. (current doubled since lamps in parallel so) k doubled (with V constant);
(lamps still heat up so law is 'same' so) n unchanged)

A5 k increased by factor of 3 and n unchanged. **1**

A6 $I = mkV^n$ **1**

20 marks in total

Special cases

S1 Voltmeter misread (but not POTE);
M1, -1.
Ammeter misread (but not POTE);
M1, -1.
Both meters misread;
M1, -2.

S2 Plotted wrong graph (e.g. I vs V)
A2 = A4 = A5 = A6 = 0.
Reversed axes (unless algebra correct); for **A2** allow n in range 1.6 to 2.2.

S3 No trend (or wrong trend)
M1, -2.

S4 Drawn curve
M2 = G3 = G4 = G5 = 0

Question 2

A1 Use a Hall probe/search coil/current balance/magnetic field sensor with datalogger or meter to measure magnetic field **1**

A2 Hall probe connected to a galvanometer/microammeter/voltmeter/calibrated Hall probe/datalogger. **1**
Search coil connected to ballistic galvanometer/datalogger.
Current balance and measure force or current (n/a Newton meter)
If magnetic field sensor used then the meter must be specified. Allow datalogger

A3 Insert/remove search coil from field **1**
Arrange plane of Hall probe to be perpendicular to field.
Current balance with some detail (e.g. wire perpendicular to field or adjust current until balance)

B1 Use an appropriate thermometer to measure temperature in the range 0 – 200°C **1**
e.g. thermocouple thermometer/digital thermometer/thermistor thermometer resistance thermometer/electric thermometer
Do not allow vague 'thermometer'.
If mercury-in-glass thermometer employed, then the range must be specified.

B2 Method of heating the magnet uniformly **1**
e.g. oven/constant temperature enclosure/heat in oil
Do not allow the magnet to be heated in boiling water/use of Bunsen flame
Do not allow vague answers such as 'heat source'.
Do not allow magnet to be heated in coil.

B3 Leave magnet for a 'long time' in order to achieve uniform temperature **1**

C1 Vary temperature of magnet and measure B and θ **1**
Only apply to workable arrangements such as Hall probe/search coil/induced e.m.f./ induced current/current balance/force on current-carrying wire.
Do not allow iron filings methods/paper clips/force on a nearby magnet

C2 Keep the distance of the Hall probe to the magnet constant **1**
Allow 'distance from magnet to 'detector' is the same'. Allow 'move magnet at same speed' (if magnet has been inserted into coil).
Unworkable methods cannot score this mark.

D Any good further design features. Some of these might be: **3**
Perform the experiment away from other magnetic materials
Use datalogger to record/display results (possible three marks for good description)
Awareness that Hall probe must not become hot during the experiment
Allow magnet to reach thermal equilibrium and then quickly place Hall probe next to magnet; record B and then quickly remove the probe.
Attach thermocouple to magnet/thermocouple detail.
Detail relating to calibration of Hall probe.
Use fridge/freezer/ice bath to achieve 0 ^{O}C.
Any good safety point.

Allow other valid points.

11 marking points, but only **10 marks maximum can be scored.**