CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 2003

GCE ADVANCED SUBSIDIARY LEVEL AND ADVANCED LEVEL

MARK SCHEME

MAXIMUM MARK: 30

SYLLABUS/COMPONENT: 9702/05

PHYSICS
Paper 5 (Practical (A2))

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Question 1

(b) Temperature of ice/water mixture (-1 to +2°C; ignore unit and sf) **1**

(d_1) Readings **3/2/1/0**
6 values of ln *I* scores one mark.
Allow more than 6 sets without penalty.
Write the number of readings as a ringed total by the table.
Choose a row in the table.
Check a value for ln(*I*/A). Tick if correct and score one mark.
If incorrect, write in correct value and do not award the mark.
Ignore small rounding errors.
No help from Supervisor scores one mark. Minor help zero. Major help –1.
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.

(d_2) Quality of results **2**
Judge by scatter of points about the line of best fit.
6 trend scores 2 marks; 5 trend scores one mark; no trend scores zero.
Allow very shallow curve.
If an incorrect graph has been plotted these marks cannot be awarded.
Allow quality marks if the negative signs of ln *I* have been omitted.

(d_3) 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.
Ignore unit with column heading for ln *I*.

(d_4) Consistency of raw readings **2**
All the raw readings of *V* should be given to the same number of d.p.
All the raw readings of *I* should be given to the same number of d.p.
One mark each. Do not allow 'added zeros'.

(e_1) Axes **1**
The axes must be labelled with ln *I* and *V*.
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.).

(e_2) 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 do not award the mark. Allow errors up to and including half a small square.

(e_3) 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.
Allow this mark if the trend of plots is a very shallow curve.

(e_4) 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.

(e_5) *y*-intercept **1**
The value may be read from the *y*-axis or calculated from a point on the line using $y = mx + c$.

(f_1) e/kT = gradient **1**
Can be implied in the working.

(f_2) Value for *e* **1**
A numerical value is expected. Method of working must be correct.
1.6×10^{-19} C with no working scores zero.
Gradient and kelvin must be used and the value of *e* must be … x 10^{-19} or … x 10^{-20}.

(f_3) Value for I_O **1**
Working must be checked (i.e. $I_o = e^{y\text{-intercept}}$)

(f_4) Units of both correct *e* and I_o **1**
(i.e. a unit of charge and a unit of current)

(f_5) SF in *e* **1**
Allow 2 of 3 sf only

(g) Correct working to give *I* when *V* = 1.0 V and *T* = 373 K **1**
Method of working must be correct. Ignore unit and sf.
Do not allow gradient value to be substituted.

20 marks in total.

Question 2

A1 Procedure OK (i.e. find m_B and acc^n of A or B; change m_B and repeat). **1**
An experiment must have been described for this mark to be awarded.
This mark can be scored even if the method is unworkable.

A2 Diagram of workable arrangement to find acceleration **1**
(e.g. object falls between two markers/light gates/smart pulley at top)
If the diagram is not very detailed refer to text.

A3 Measurement of mass m_B (e.g. using balance/Newton meter/calibrations on masses) **1**

B1 Valid method of measuring time **1**
Accept stopwatch; ticker-tape; light gates; motion sensors and dataloggers; smart pulley etc..
Unworkable methods will not score this mark.

B2 Correct measurements taken to find acceleration **1**
(e.g. measure a distance and $u = 0$ (if distance/time method used)
spacing of successive dots on ticker-tape
some detail of sampling rate if motion sensor/datalogger used)

B3 Use of results to calculate acceleration **1**
(e.g. substitute into $s = ut + \frac{1}{2}at^2$; $a = 25(x_2 - x_1)$ etc..)
If motion sensor used then acceleration obtained from monitor.

C1 Any one safety precaution **1**
(e.g. Catch falling mass in bucket of sand
Care needed to prevent mass B from coming over the top of the pulley
Whiplash from breaking wires etc.
Clamp retort stand to prevent it from falling over.
Do not allow vague 'safety goggles'. Insist on a reason being given.

D1/2/3 Any further good design features **3**
Some of these might be:
Method of supporting the pulley
Mention of friction in the pulley/oil pulley/smooth pulley
Use large distance (to reduce percentage uncertainty)
Limitations of stopwatch methods
Vary s and measure t; use graph to find a
Repeat the experiment to find values of a for each value of m_B
Some detail about the timing circuit (e.g. stop terminals on timer connected to double pole switch and electromagnet).

10 marks in total.