UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level and GCE Advanced Subsidiary Level

MARK SCHEME for the May/June 2006 question paper

9702 PHYSICS

9702/05 Paper 5

Maximum 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.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2006 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

1 (b) (ii) Expect to see *x* read to nearest mm **and** then:
Use connector with sharp edge **[1]**
Position the wire on top of the scale on the rule to reduce parallax error

(c) Readings **[3]**
Write the number of readings as a ringed total by the results table.
6 sets of readings scores 1 mark.
Check a value for lg(*x*/m) and a value for lg(*I*A). Underline checked values.
Ignore small rounding errors. Tick if correct; 1 mark each.
If incorrect then write in correct value.
Excessive alterations in the table then –1.
If minor help is given with the circuit, then –1. If excessive help is given then –2.
Please indicate when help has been given to a candidate by writing **SR** at the top of the front page of the candidate's script. Also, please indicate the type of help that has been given by writing a brief comment by the table of results.

Column headings. Allow lg(*x*/m) and lg(*I*/A). Allow POT errors. **[1]**
There must be some distinguishing mark between the quantity and its unit.
Please ✓ or underline each correct column heading to show that it has been seen.

Consistency of raw readings in the table of results **[1]**
Apply to *x* and *I* only.
Expect to see *I* to either 0.01 A or 0.1 A.
Expect to see all the values of *x* given to the nearest millimetre.
Indicate using a vertical line down each column of raw readings to show it has been seen and a ✓C if correct.

(d) (i) Axes **[1]**
Each axis must be labelled with a quantity. Allow lg(*x*), lg*x*, lg(*x*/m) but not lg*x*/m.
Scales must be such that the plotted points occupy more than half the graph grid in both the *x* and *y* directions. Do not allow more than 3 large squares between scale markings. Do not allow awkward scales (e.g. 3:10, 6:10, 7:10, etc.).

Plotting of points **[1]**
Count the number of plots on the grid and write this value by the line and ring it.
Do not allow plots in the margin area.
The number of plots must correspond to the number of observations (at least 6).
Do not award this mark if the number of plots is less than the number of observations.
Check one suspect plot. Circle this plot. Tick if correct. If incorrect then mark the correct position with a small cross and use an arrow to indicate where the plot should have been. Allow errors less than half a small square.

© University of Cambridge International Examinations 2006

(ii) Line of best fit **[1]**
There must be a reasonable balance of points about the line of best fit.
If one of the plots is a long way from the trend of the other plots then allow this plot to be ignored when the line is drawn.
One mark can be awarded if the line of best fit is 'reasonable', but not quite right.

(iii) Measurement of gradient **[1]**
The hypotenuse of the triangle must be greater than half the length of the drawn line.
If read-offs are inaccurate by half a small square, or more, then zero.
Please indicate the vertices of the triangle used by labelling with Δ.
One mark for the read-offs. The value **must** be negative. Value should be around -1.0.
Δ*x*/Δ*y* scores zero. Ignore units.

y-intercept. Expect –0.8. Ignore units. **[1]**
Check the read-off. Value must be within half a square.
Accept correct substitution from a point on the line into $y = mx + c$. Allow ecf from **(d)(iii)** gradient for *m*.

(e) lg *x* = *n* lg *I* + lg *k* **[1]**
This can be implied from the working.

Value for *n* (from gradient). Allow ecf from **(d)(iii)** gradient. n = –1.0. Ignore unit. **[1]**

Value for *k* (from $10^{y\text{-intercept}}$). Allow ecf from **(d)(iii)** *y*-intercept. k = 0.158. Ignore unit. **[1]**
Working must be checked.

(f) **(i)** Value of diameter of wire (± 0.02 mm of SV). (36 swg, diameter = 0.18 mm) **[1]**

(ii) Cross-sectional area correct. (36 swg, Area = $2.5 \times 10^{-8}\ m^2$) **[1]**

(iii) Percentage uncertainty in area **[2]**
One mark for percentage uncertainty in *r*. One mark for % uncertainty x 2.

(g) Correct value of *ρ*. No POT error allowed. Expect to see $\rho = 4.7 \times 10^{-7}\ \Omega m$ **[1]**
Check the substitution and consistency of units.

(h) *k* = 4 x previous value. Allow ecf **(g)**. Expect to see $k = 1.9 \times 10^{-6}\ \Omega m$ **[1]**

[Total: 20 marks]

© University of Cambridge International Examinations 2006

Question 2

A1 Diagram of arrangement (light source/mesh/screen or collimator/mesh/telescope) **[1]**

A2 Fringes or dots shown on screen. May be shown on diagram. **[1]**

A3 Some sensible discussion of coherence **[1]**

A4 Use of laser or single slit (and lens) in collimator **[1]**

B1 Measurements: distance from mesh to screen and separation between fringes **[1]**
OR measure an angle from the spectrometer table

B2 n = 1; find separation between central fringe and first bright fringe **[1]**
OR measure angle between central bright beam and first order beam using scale on table

B3 Use of $n\lambda = \sin\theta$ to find d. n must be clearly identified **[1]**

C Any safety precaution **[1]**
e.g. use goggles/do not look directly into laser beam/cover over sodium lamp
do not touch the bulb

D Any good/further detail **[2]**
Examples of creditworthy points might be:
Take readings with mesh in different positions to average d
Sketch/suggestion of two-dimensional array of dots on screen
Laser + mesh + screen all at same height
λ = 589 nm for sodium lamp or about λ = 630 nm for He/Ne laser/semiconductor laser
D of the order of 1 m to 4 m (laser method)
Measure 2θ and divide by two to reduce uncertainty in θ
Repeat experiment with 2nd order (3rd order etc.) beams
Detail relating to setup/use of spectrometer
Allow other valid points.

[Total: 10 marks]

© University of Cambridge International Examinations 2006