OCR
RECOGNISING ACHIEVEMENT

GCE

Physics A

Advanced GCE **2826/03**

Practical

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

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 marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

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 should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Mark Scheme for Question 1

(a)	Circuit correctly set up without help Minor help –1. Major help, i.e. complete circuit set up for candidate, -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.	**2/1/0**
(b) **(iii)**	Readings Write the number of readings as a ringed total by the results table. 6 sets scores 3 marks; 5 sets scores 2 marks; 4 sets scores 1 mark.	**3/2/1/0**
(b) **(iii)**	Value of ln(I/mA) Check one value and ✓ if correct. One mark. (do not credit log(I/mA))	**1**
(b) **(iii)**	Repeated values of I. One mark. Do not award this mark if all the repeats are the same.	**1**
(b) **(iii)**	Consistency of raw readings. One mark. All values of V should be to the nearest 0.01 V or 0.001 V All values of I should be to the nearest 0.1 mA or 0.01 mA	**1**
(b) **(iii)**	Column headings. One mark. There must be some distinguishing mark between the quantity and its unit. E.g. I/mA, I(mA), I in mA, are OK, but not (I)mA, I mA, or just "mA" Ignore logs.	**1**
(b) **(iii)**	Quality. One mark. There must be 5 or 6 good trend points on the best straight line. Allow one anomalous point. 5 points must be within 0.01v of examiner's best fit line.	**1**
(c) **(i)**	Axes. Each axis must be labelled with a quantity. Ignore unit. One mark for each axis. Scales much be such that the plotted points occupy at least 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, 8:10 etc.).	**2/1/0**
(c) **(i)**	Plotting of points. 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 with the number of observations. 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 plots should have been. Allow errors up to and including half a small square. Do not allow 'blobs' of diameter greater than ½ small square.	**1**

(c) (i)	Line of best fit There must be a reasonable balance of points about the line of best fit. If one of the points is a long way from the trend of the other plots then allow this plot to be ignored when the line is drawn. The mark can be awarded if the line of best fit is 'reasonable' but not quite right. This mark can only be awarded if a straight line has been drawn through a linear trend. Do not allow thick or "hairy" lines. Do not allow a line of thickness greater than ½ a small square.	**1**
(c) (ii)	Measurement of gradient. Read-offs must be accurate to half a small square and the ratio must be correct, one mark. Please indicate the vertices of the triangle used by labelling with Δ. The hypotenuse of the triangle must be greater than half the length of the drawn line, one mark.	**2/1/0**
(c) (ii)	y-intercept Check the read-off. Allow errors up to and including half a small square. One mark. If a read-off is not possible, correct substitution from a point on the line into y = mx + c scores one mark. Do not credit algebraic errors e.g. c=y/mx If the point is not on the line, or the answer is not the same as the graph read-off (no false origin), then this method scores no marks. A read-off taken from a graph with an x-axis false origin scores zero. A bald intercept with no working/possible read-off from graph scores zero.	**1**
(d)	Largest percentage uncertainty in I. Smallest value of I selected. One mark Sensible value for ΔI, compatible with d.p. of I in table. Allow half range. One mark Correct formula ΔI/I x 100. No need to check calculation. One mark.	**3/2/1/0**
(e) (ii)	Correct ln equation. One mark. Ln I = ln I_0 + bV/T, or implied use later on.	**1**
(e) (ii)	Gradient = b/T, hence value of b = T x gradient. One mark.	**1**
(e) (ii)	Intercept = ln I_0, hence a value for I_0 (= $e^{\text{y-intercept}}$) Allow $10^{\text{y-intercept}}$ if a log graph has been drawn in error**.**	**1**
(e) (ii)	Unit for b. $V^{-1}K$ or K/V. One mark.	**1**
(e) (ii)	Unit for I_0. Expect mA. Do not allow A if ln(I/mA) has been plotted. One mark. Allow any correct unit compatible with answer given.	**1**
(e) (ii)	Significant figures for I and V. 2 or 3 s.f. One mark.	**1**
(f) (i)	The current heats up the diode hence increasing T for larger I, thus altering the gradient, b/T. Ignore references to resistance change.	**1**
(f) (i)	Gradient b/T will decrease as T increases for larger I. This explanation needed.	**1**

Total 28 marks

Question 2

(b) (ii)	Value of raw times for first value of T must be > 10 s, and to nearest 0.1 s or .01 s. T calculated correctly.	**1**
(b) (ii)	Repeated and averaged readings for first value of T.	**1**
(c)	Justification for number of sf in T Answer must relate sf in raw data (or t) to sf in T. Do not allow answers in terms of decimal places	**1**
(d)	Second value of T The value must be less than half the first value	**1**
(e)	Ratio T/r^2 is constant One mark for ratio idea, or calculation of k. One mark for conclusion that $T \propto r^2$ which follows from the reasoning (± 10%)	**2/1/0**
(f)	Evaluation of procedure. Relevant points must be underlined and ticked. One mark for each line. Some of these might be: P = problem S = solution 1 P 2 sets of readings are not enough 2 S Take more sets of readings of T and r, and plot a graph 3 S The graph plotted should be T against r^2, and it should be a straight line through the origin 4 P Raw time too small 5 S Time more oscillations 6 S But damping makes it difficult to time a lot of oscillations 7 P Oscillations may not be completely torsional; allow "swaying", "wobbling", "pendulum motion", or hitting clamp stand. 8 S Use smaller amplitude / care needed when releasing disc 9 S Avoid draughts by closing windows and doors 10 P Human error in timing/ hard to see beginning and end of oscillation 11 S Use an external (fiducial) marker (at centre of oscillation) 12 S Use a high speed camera, with time indication (e.g. clock in frame) 13 P/S Period may vary with amplitude/use same start angle each time 14 P Wire is kinked/not straight when card is suspended 15 S Use thicker/heavier card or thinner wire to overcome this problem 16 P Cu wire is easily stretched or deformed beyond the elastic limit 17 S Use steel wire Do not give marks for repeating readings of T for the same r (already credited in (b). Do not allow vague "light gates", "use a computer", "motion sensor" or "video the mass", unless detailed clarification is given. Allow other relevant points (8 maximum)	**8**
	2 marks are reserved for quality of written communication	**2**
	Total 16 marks	

Mark Scheme – Plan – Radioactivity

A1	Labelled diagram showing sensible layout of equipment, including source, steel sheet, GM tube, and counter/ratemeter. Do not credit rollers in apparatus.	**1**
A2	Workable method, measure steel thickness x and count-rate; alter x and measure count-rate again until a set of several readings is obtained. Count-rate should be measured or averaged for at least a minute, or repeated ratemeter use. Do not credit rollers.	**1**
A3	(Co60), because readily available, but half life of only 5 years. Check other sources suggested. Allow Radium	**1**
B1	Expected results in the form of thickness/count-rate graph (or ln count-rate). Allow exponential graphs or straight line log graphs. Line must touch y-axis. (see D).	**1**
B2	Micrometer, or digital calipers, used to measure steel thickness x	**1**
B3	Measurement of background radiation and subtract from count-rate.	**1**
C1	Safety precautions. Tongs or gloves. Do not credit goggles. Don't award this mark if precautions are over the top i.e. lead screens everywhere etc.	**1**
C2 1 2	β particles and X-rays β-particles have a maximum range of 1.3 mm (accept 1.0 to 1.5 mm) in steel, so would not work / range in Al is 5mm, so would not work for 5mm steel. X-rays would work in some circumstances, but the apparatus is complex and expensive, and involves high voltage.	**2/1/0**
D 1 2 3 4 5 6	Good further detail/research of material. Examples of creditworthy answers might be: Labelled diagram of GM tube / further details Awareness of random source fluctuations Evidence, with data, of preliminary work Awareness of sensible range of steel thicknesses, (perhaps 2 mm) to at the most 1 or 2 cm. Further details of ln graph, with equation $I_0 = I\, e^{-\mu x}$, explaining terms Collimated source, shown in diagram Underline and tick each relevant point in the body of the text. The ticks must have a subscript showing which marking point has been awarded (e.g. $\checkmark_{D2}$).	**3/2/1/0**
R	Evidence of research of material. More than one source (books or internet), with chapter and page numbers, for 2 marks. Two vague sources, one mark. One vague source, no marks.	**2**
Q	**2 marks** are reserved for quality of written communication (organisation). Rambling and poorly presented material cannot score both marks.	**2**

16 marks for this question

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553