GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics A
Unit PHAP

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from:

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or

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Instructions to Examiners

1 Give due credit to alternative treatments which are correct. Give marks for what is correct; do not deduct marks because the attempt falls short of some ideal answer. Where marks are to be deducted for particular errors specific instructions are given in the marking scheme.

2 Do not deduct marks for poor written communication. Refer the script to the Awards meeting if poor presentation forbids a proper assessment. In each paper candidates may be awarded up to two marks for the Quality of Written Communication in cases of required explanation or description. Use the following criteria to award marks:

2 marks: Candidates write legibly with accurate spelling, grammar and punctuation; the answer containing information that bears some relevance to the question and being organised clearly and coherently. The vocabulary should be appropriate to the topic being examined.

1 mark: Candidates write with reasonably accurate spelling, grammar and punctuation; the answer containing some information that bears some relevance to the question and being reasonably well organised. Some of the vocabulary should be appropriate to the topic being examined.

0 marks: Candidates who fail to reach the threshold for the award of one mark.

3 An arithmetical error in an answer should be marked AE thus causing the candidate to lose one mark. The candidate's incorrect value should be carried through all subsequent calculations for the question and, if there are no subsequent errors, the candidate can score all remaining marks (indicated by ticks). These subsequent ticks should be marked CE (consequential error).

4 With regard to incorrect use of significant figures, normally two, three or four significant figures will be acceptable. Exceptions to this rule occur if the data in the question is given to, for example, five significant figures as in values of wavelength or frequency in questions dealing with the Doppler effect, or in atomic data. In these cases up to two further significant figures will be acceptable. The maximum penalty for an error in significant figures is **one mark per paper**. When the penalty is imposed, indicate the error in the script by SF and, in addition, write SF opposite the mark for that question on the front cover of the paper to obviate imposing the penalty more than once per paper.

5 No penalties should be imposed for incorrect or omitted units at intermediate stages in a calculation or which are contained in brackets in the marking scheme. Penalties for unit errors (incorrect or omitted units) are imposed only at the stage when the final answer to a calculation is considered. The maximum penalty is **one mark per question**.

6 All other procedures, including the entering of marks, transferring marks to the front cover and referrals of scripts (other than those mentioned above) will be clarified at the standardising meeting of examiners.

Units 5 - 9: PHAP: Practical

1 AO3a: *Planning*

measurement :
(to determine the healing distance, L),
use a ruler or tape measure (can be shown in diagram) ✓
(to determine the diameter, D, of the wire),
use a micrometer screw gauge [travelling microscope] ✓

strategy:
move screen [wire] to locate the **position** where light at centre of
diffraction pattern **changes** from dark to bright or from bright to dark ✓
measure L for **different diameters** [thickness] of wire ✓
plot a graph of $\log L$ against $\log D$ (sketch accepted) ✓
correct explanation of how n found from gradient of graph ✓

control:
use monochromatic (light) source
(laser accepted: can be shown in diagram) ✓
ensure wire is parallel to the screen or
ensure wire is perpendicular to the beam or (any one) ✓
ensure screen is perpendicular to the beam

difficulties:
(*difficulty* + *how overcome* = 2)
any **two** of the following

reduce uncertainty in locating the position of the screen (✓)
use hand lens or travelling microscope to observe fringes (✓)
(must be a safe method) and/or
find the position as central fringe changes from dark to bright and repeat as
central fringe changes from bright to dark: find **mean** position (✓)

reduce the uncertainty in L (✓)
by using wires of suitable diameter to ensure L is large (✓) and/or
by using light of suitable wavelength to ensure L is large (✓)

reduce the uncertainty in D (✓)
check the zero error on the micrometer (✓) and/or
repeat the measurement at **different positions** [**different directions**]
on the wire and find average [confirm that diameter is uniform](✓)

reduce the uncertainty in n (✓)
by using a wide range of wire diameters (✓)

ensure the diffraction pattern on the screen is easily seen (✓)
cut down background illumination/use dark room or blackout (✓) and/or

use white screen (✓)

(no credit given for unqualified comments, e.g. 'repeating measurements and averaging/eliminating anomalous results) ✓✓✓✓ max (*8*)

(*8*)

2 AO3b: *Implementing*

(a)	*accuracy*	V_0 recorded, sensible values	✓
(b)/(c)	*tabulation*	V_1 and V_2/V t/s	✓✓
	readings	8 or more sets for V_1 and t	✓
		8 or more sets for V_2 and t	✓
		[6 or 7 sets for each]	
		t range ≥ 60 s, V_1 and V_2 from repeated readings	✓
	significant figures	V_1, V_2 (and V_0) recorded to 0.1 V, tabulation consistent throughout (a)(b)and (c)	✓
(d)	*quality*	(at least) 6 points **on each curve** to ± 2 mm of best-fit line (must be suitably scaled graph)	✓

(*8*)

3 AO3c *Applying Evidence and Drawing Conclusions*

Processing

(d)	*axes*	marked V/V, t/s (½ deducted for each missing, rounded down)	✓✓
	scale	suitable scale (e.g. 8 × 8) [5 × 5, 2 × 8, 8 × 2 ✓]	✓✓
	points	6 points plotted correctly on each line, V_1 of negative decreasing gradient, V_2 of positive decreasing gradient	
		curves to show or suggest, when $t = 0$, $V_1 \approx V_0$, and $V_2 = 0$	✓

Deductions

(e)(i)	V_S to 0.1 (V) or better and correct from graph ± 1 mm	✓
(e)(ii)	$\frac{V_0}{V_S}$, no unit, 3 s.f. in range 2.26 to 2.36 [2.21 to 2.41, 2.3]	✓✓

(*8*)

4 AO3d *Evaluating Evidence and Procedures*

(f)(i)	τ_b correct from graph to nearest s, (expect τ_b in range 30 s to 40 s)	✓
	τ_c correct from graph to nearest s, (expect τ_c in range 40 s to 50 s)	✓
	$\frac{\tau_b}{\tau_c}$ in range 0.62 to 0.69	✓

(f)(ii) (working to show) correct evaluation of resistance of any of the circuits 1, 2 (i.e. with S closed and S open) ✓
correct evaluation of **both** resistances of either remaining circuit ✓
[for correct evaluation of both resistances of circuit 3 ✓✓]
typical results shown in table

	R_b, resistance with S closed	R_c, resistance with S open	ratio of resistances
circuit 1	R	$3R$	1 : 3
circuit 2	$R/2$	$2R/3$	3 : 4
circuit 3	$2R/3$	R	2 : 3

$\therefore$ circuit 3 is correct because $\frac{\tau_b}{\tau_c} = \frac{R_b}{R_c}$ (only if calculations are correct)

[for wrongly labelled switch: $\frac{V_0}{V_s}$ in range 1.73 to 1.80,

$\frac{\tau_b}{\tau_c}$ in range 1.42 to 1.58] ✓

(*6*)
(*22*)