AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Physics A

Unit PHA3/P

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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.

Unit 3

1 AO3a : planning:

measurements:
(to determine the diameter of region A),
measure diameter using a ruler (scale resolving to mm) ✓
non-invasively, i.e. without disturbing the flow or jump ✓
(to determine the volume flow-rate of water in the stream)
collect (variable)volume in (fixed) time measured with stopwatch ✓
and find volume using a measuring cylinder (graduated beaker) ✓
[collect (fixed) volume e.g. using a standard flask ✓ in
(variable) time using stopwatch ✓]
[mass using a balance (allowing for mass of container) and convert
to volume, using $V = \frac{mass}{\rho}$ ✓]

strategy:
find flow-rate by calculating $\frac{V}{t}$, where V and t are sensible ✓
repeat using different flow-rates (experiment must be valid) ✓
determines quantitatively how diameter of region A relates to volume flow-rate, by plotting (suitable) graph and testing for proportionality/ linearity etc., or inspecting for pattern ✓

control:
ensure that vertical distance between tap and plate is constant ✓
[ensure flow-rate in and out of the sink are the same so that the depth of water in the sink is uniform ✓]

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

reduce uncertainty in diameter (✓)
by measuring diameter in different directions and averaging (✓) and/or
by waiting until shape of hydraulic jump is stable (✓) and/or
by using constant flow device (✓) and/or
use large plate to provide wide range of results (✓)

reduce uncertainty in volume [mass] (✓)
by collecting large volume [mass] (✓) and/or
by repeating the volume measurement and averaging (✓) and/or
by using constant flow device (✓)

reduce uncertainty in timing (✓)
by collecting water over a long time (✓) and/or
by repeating the timing and averaging (✓)

✓✓✓✓ max (8)

(8)

2 AO3b : *implementing*

(a)	*accuracy*	Δy recorded to nearest mm (values between 10.0 cm and 25.0 cm accepted)	✓
		from $2\Delta y$ or $3\Delta y$ or $\Sigma 2\Delta y$ or $\Sigma 3\Delta y$	✓
(b)	*tabulation*	y/mm x/mm	✓✓
	readings	5 sets of y and x	✓
		x range ≥ 50 cm	✓
	significant figures	all y and all x to nearest mm	
		tabulation consistent throughout	✓
(c)	*quality*	all 5 points to ± 2 mm of straight line (unsuitable scaled graph - loose 1)	✓

(8)

3 AO3c : *applying evidence and drawing conclusions*
processing

(c)	*axes*	marked y/mm, x/mm (½ deducted for each missing, rounded down)	✓✓
	scale	suitable scale (e.g. 8 × 8) [5 × 5, 2 × 8, 8 × 2 ✓]	✓✓
	points	5 points plotted correctly on best-fit line of positive gradient	✓
	deductions		
(d)(i)		G to 3 s.f., from suitable Δ (e.g. 8 × 8)	✓
(d)(ii)		$\frac{G}{\Delta y}$ in range 3.16 to 3.50, 3.3 or 3.4 m^{-1} [3.00 to 3.67, 3.1, 3.2, 3.5 or 3.6 m^{-1} ✓]	✓✓

(8)

4 AO3d : *evaluating evidence and procedures*

(e)(i) measure vertical height of ruler (above floor) at each end/several points ✓
and check readings are consistent ✓
[measure *y* at each end/several points ✓ check etc ✓]
[measure horizontal distance between wire and spring
at top and bottom ✓ and check readings are consistent ✓]
[measure (at least two) vertical distances between (suspended) ruler
and desk✓ check these are consistent ✓]
(use of set square with one edge against wire not accepted)

(e)(ii) find *y* when $x = 0$ [read vertical intercept from graph] ✓
because this is where mass exerts no moment ✓

(e)(iii) *G* smaller ✓
since for same *y*, *x* is proportionally larger ✓
[*x* values increase to provide same (turning) moment ✓]

(6)
(22)