AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Physics B

Unit PHB3

Marking Scheme

NOTES FOR GUIDANCE

Letters are used to distinguish between different types of marks in the scheme.

M indicates OBLIGATORY METHOD MARK
This is usually awarded for the physical principles involved, or for a particular point in the argument or definition. It is followed by one or more accuracy marks which cannot be scored unless the M mark has already been scored.

C indicates COMPENSATION METHOD MARK
This is awarded for the correct method or physical principle. In this case the method can be seen or implied by a correct answer or other correct subsequent steps. In this way an answer might score full marks even if *some* working has been omitted.

A indicates ACCURACY MARK
These marks are awarded for correct calculation or further detail. They follow an M mark or a C mark.

B indicates INDEPENDENT MARK
This is a mark which is independent of M and C marks.

Note: Where a correct answer only (c.a.o.) is required, this means that the answer must be as in the Marking Scheme, including significant figures and units.

Where an error carried forward (e.c.f.) is allowed by the Marking Scheme for an incorrect answer, e.c.f. must be written on the script if an error has been carried forward.

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.

PHB3

Question 1

(a)	(i)	Record of maximum height (30 to 60 mm)	B1	**1**
	(ii)	Curve of correct trend through origin (decreasing rate of rise)	B1	
		Maximum value tendency clear – distinct flat part	B1	**2**
(b)		need to know the amount/volume/mass of water absorbed	C1	
		measure the mass of paper or mass of water in beaker before and mass after and subtract	M1	
		Use a balance	A1	**3**
		OR measure the volume of water before and after and subtract	M1	
		replace beaker with a measuring cylinder	A1	
(c)	(i)	record of time to rise ; 30 s ≥time ≥ 10 s (including unit)	B1	
		repeat and average with average to nearest 0.1 s	B1	**2**
	(ii)	calculation of 0.75 x their (a)(i)/their (c)(i) to 2 or 3 sf	B1	**1**
	(iii)	absolute uncertainty in h 1 or 2 mm (number + unit) allow e.g. 40 ± 1 mm	B1	
		if 1 measurement in (c)(i) absolute uncertainty in t 0.5 –2 s OR uncertainty consistent with their (c)(i) measurements	B1	**2**
	(iv)	percentage uncertainty in either h or t correctly calculated	B1	
		two percentages added (ignore sfs)	B1	**2**

(d)	use strips of constant width (however stated)	B1	**1**	
	measure time to reach each mark/different height or measure heights at different times	B1		
	mark 5 to 10 different distances on the strips or stated method for measuring heights use distances at *H/5* to *H*/10 intervals (use their *H*) or use time intervals of 3 to 6 s	B1 B1		
	repeat timing **(**with several strips) for each distance and average or repeat distance measurement for each time	B1		
	use coloured water (eg add copper sulphate)	B1		
		Max 3		
	plot graph of height reached against time or if a linear graph given in (a)(ii) allow use of ratios *H/t =constant*	B1	**1**	
	At least 3 marks for physics + use of Physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar	2	**2**	
	At least 1 mark for physics + the use of Physics is accurate, but the answer lacks coherence or spelling, punctuation and grammar are poor	1		
	the use of Physics is inaccurate, the answer is disjointed, with significant errors in spelling, punctuation and grammar	0		
				20

Question 2

(a)	(i)	depth measured to cm or mm; depth ≥ 60 mm repeat and average to 1 mm	B1 B1	**2**
	(ii)	record of depth less than (i) (anything less than their (a)(i)) measurements to sfs consistent with those in (a)(i)	B1	**1**

(iii) sensible difficulty M1
sensible way of overcoming it A1 **2**

e.g.

Ensuring pencil was vertical	parallax problem	event over quickly
Use pendulum bob/plumb line	method of reducing	use a camera (not light gates)

(b) (i) three sets of values for D (as D increases H increases) B1
$D \geq 20$ mm and their (a)(i) – (40 to 60 mm)
repeat and average for each set B1
measurements to mm precision consistently B1 **3**

(ii) Suitable method: M1
calculates D/H or $H_2/H_1 = D_2/D_1$
3 calculations correct 2 calculations correct A1
clearly stated conclusion which is reasonable for the data A1
ratios given to 2 or 3 sf consistently A1 **4**

(c) mass/density of the pencil (allow length of pencil) M1
more mass/potential energy initially so greater depth A1
needs to decelerate for a longer time A1
or gravity exerts a greater force on the pencil

angle made by sharpening the pencil/shape of pencil M1
more acute angle gives greater penetration A1
more streamlined flow of liquid A1

density of the liquid
higher density gives less penetration
more upthrust/resistive force

viscosity of the liquid
more viscous liquid means less penetration
viscous liquid provides greater resistive force **Max 6**

At least 3 marks for physics + use of Physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar **Max 2**

At least 2 marks for physics + the use of Physics is accurate, but the answer lacks coherence or spelling, punctuation and grammar are poor **Max 1**

the use of Physics is inaccurate, the answer is disjointed, with significant errors in spelling, punctuation and grammar **0**

20

Question 3

(a)	(i)	record of p and q ($q \approx 0.75 - p$) ; in mm, cm or m, condone no unit if in m since in question; unit otherwise essential p in range 0.440 to 0.520 m in mm or to nearest cm accepted here	B1	
		repeat and average and final values of p and q in m	B1	**2**
	(ii)	absolute uncertainty 0.002 m to 0.005 m	B1	
		range of movement of crocodile clip when determining null or reference to thickness of the crocodile clip or other sensible comment (allow ruler can be read to nearest mm for second mark only)	B1	**2**
	(iii)	use a more sensitive/precise meter (not a more accurate meter) a more pointed 'jockey'; wire attached to clip; thinner croc clip a longer wire a battery with larger emf not a more 'accurate' ruler or parallax problems	B1 B1	**2**
	(iv)	X **or the wire resistor**	B1	**1**
(b)	(i)	Correct substitution of data	M1	
		Answer to 2 or 3 sf (6.3 –7.7)	A1	
		unit Ω	B1	**3**
	(ii)	Balance point would be close to B or p will be small or p/q = 0.1/3.9 = 0.026 (1/40) so p would be about 19 mm	M1	
		so high percentage uncertainty/error in p or difficult to measure p accurately	A1	**2**
(c)	(i)	table with quantities R, p, $1/p$,	B1	
		units all present and correct	B1	
		table is well presented: neat rows and columns not necessarily ruled; no overwriting and has columns for repeat and average values of p	B1	**3**

	(ii)	table contains four further sets of measurements of R and p (–1 for each missing set)	B3	
		p values given to nearest 0.001m and consistent	B1	
		repeats and averages for p (–1 for each missing repeat and average)(–1 for any average > 3sf)	B3	
		$1/p$ correctly calculated (check one) and given consistently to 2 or 3 sf	B1	
		R stated to 1 dp consistently	B1	**9**
(d)	(i)	axes correct and labelled quantity (must be correct plot)	B1	
		units on axes ;correct or consistent with table; (must be correct plot) not allowed if no units in table or on graph	B1	
		scales non-awkward and as large as possible (must be correct plot) allow origin on both axes in scale assessment.	M1	
		five points correctly plotted –1 for each omission	A2	
		best straight line (0 if less that four points are plotted) points well off line must be acknowledged	B1	
		quality of graph work	B1	**7**
	(ii)	large triangle used or sufficiently spread co-ordinates ≥half drawn line	B1	
		co-ordinates correct or sides of triangle correct	M1	
		correct calculation with value to 2 or 3 s.f.(no unit required)	A1	**3**
(e)	(i)	gradient of line = 0.75 X stated explicitly	B1	
		X = their (ii)/0.75 number + unit allowing ecf from (b)(i)	B1	**2**
	(ii)	second value more reliable	M1	
		graphical approach averages more data obtained from a range of readings/line of best fit	A1	**2** **38**