ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme January 2004

GCE

Physics B

Unit PHB6

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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.

PHB6

Exercise 1

(a)	(i)	Energy is lost **from the system**	B1	
		due to air resistance/friction at pivot	B1	
	(ii)	larger amplitude implies larger energy loss	B1	
		so constant fraction of energy removed per cycle	B1	
		OR good description of consequent exponential behaviour		**4**
(b)		one determination to nrst mm	M1	
		2+ determinations and average	A1	**2**
(c)	(i)	correct manipulation to yield $xT^2 = 4\pi^2k^2/g + 4\pi^2x^2/g$	B1	
	(ii)	identifies gradient as $4\pi^2/g$	B1	
		so $g = 4\pi^2$/gradient	B1	
	(iii)	$k = \sqrt{(\text{intercept/gradient})}$	B1	**4**
(d)		at least 6 sets of readings tabulated (-1 for each set missed)	B2	
		n quoted for all sets ($n \geq 10$)	B1	
		2 timings per x + correct average [to same sf or one less]	B1	
		x to nrst mm	B1	
		raw t to 0.1 s or 0.01 s	B1	
		xT^2 and x^2 correct and to 3+ sf	B1	
		x range 10 – 40 cm	B1	
		all units correct and tabulation quality (one table, legible, ruled)	B1	**9**

(e)	one step	B1	
	explanation	B1	
	second step	B1	
	explanation	B1	
	(e.g. step: repeat and average/use fiducial mark/start & end point sensible expl^{n} : uniform fiducial mark where rule moves fastest/minimise uncertainty/allow oscillation to settle/remove unevenesses) etc		**4**
(f)	labels and units accurate	B1	
	points and intercept occupy >½ printed grid	B1	
	plotting accurate, 5+ points for mark	B2	
	best straight line plotted, line thin	B1	
	intercept on graph or 2nd graph plotted to include it.	B1	
	generally neat and presentable work	B1	**7**
(g)	states confirmation	B1	
	states good reason	B1	**2**
(h)	*g*: large Δ	B1	
	coord read-off correct	B1	
	answer calculated correctly + units	B1	
	k: intercept read-off correct	B1	
	calculation correct	M1	
	value (0.29 ± 0.03) and unit correct	A1	**6**
(i)	Mass of rule distributed along length not at end	B1	**1**
			39

Exercise 2

Question 1

(a)	I measured and close to M form value	B1		
	V measured and close to M form value	B1	**2**	
(b)	(i) Uses energy = eV	M1		
	Carries through calculation correctly with V	A1		
	(ii) Uses $I = Q/t$; and $Q = ne$	M1		
	Calculate n correctly	A1	**4**	
(c)	Lost in resistance of LED/electron collisions with atoms in lattice	B1	**1**	
(d)	(i) At least 2 calculations of $V\lambda$ correct	M1		
	4 calculations correct	A1		
	conclusion correct	B1		
	(ii) average of $V\lambda$ calculated	B1		
	one substitution and calculation of h	B1		
	unit for h (J s)	B1	**5**	
(e)	Use of diffraction grating	B1		
	Details of set-up e.g. set up clear and complete/distances sensible and quoted	B1		
	Measurements described (i.e. measure theta)	B1		
	$n\lambda = d \sin \theta$ in correct context	B1		
	Repeat for several orders/use highest order visible/measure range of theta and say why	B1		
	Use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar **And gains at least 3 marks for physics**	B2		
	Use of physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor **and gains at least 1 mark for physics**	B1		
	Use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar	B0	**7**	
				19

Question 2

(a)	length about 0.45 m	B1	
	50 Hz	B1	
	coverts mass to tension correctly (0.98 N usually)	B1	
	calculates $\mu = T/4l^2f^2$ correctly	B1	**4**
(b)	(i) Absolute uncertainty in l (± 0.5 - 2 cm)	B1	
	Calcs % ΔT and $\%\Delta l$ correctly	B1	
	(ii) $\%\Delta\mu = \%\Delta T + 2 \times \%\Delta l$ seen	M1	
	Correct calc	A1	**4**
(c)	There is force on a current-carrying wire in magnetic field	B1	
	Good detail (e.g. description of catapult field or correct statement of force direction related to magnetic field)	B1	
	Idea of current reverses and therefore force reversing	B1	
	f_{mains} matches $f_{natural}$	B1	
	good detail [e.g. resonance described well, uniqueness of length]	B1	
	Use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar And gains at least 3 marks for physics	B2	
	Use of physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor and gains at least 1 mark for physics	B1	
	Use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar	B0	
(d)	**Use of a.f.o. or alternative to set/measure frequency**	B1	
	Set T **within safe limits** [quoted range < 20 N or statement]	B1	
	Keep both L, μ constant **both stated explicitly**	B1	
	Plot f^2 against T [or f vs $\sqrt{T}$ or ln-ln graph or calculate f^2/T]	B1	
	Should be straight line thru origin [ln-ln gradient 2/½]		
		Max 4	
			20