ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme January 2003

GCE

Physics B

Unit PHB3

Unit 3: Practical Examination

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. However, no candidate may be awarded more than the total mark for the paper. Use the following criteria to award marks:

2 marks: Candidates write with almost faultless accuracy (including grammar, spelling and appropriate punctuation); specialist terms are used confidently, accurately and with precision.

1 mark: Candidates write with reasonable and generally accurate expression (including grammar, spelling and appropriate punctuation); specialist terms are used with reasonable accuracy.

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 A.E. 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 C.E. (consequential error).

4 With regard to incorrect use of significant figures, normally a penalty is imposed if the number of significant figures used by the candidate is one less, or two more, than the number of significant figures used in the data given in the question. 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 S.F. and, in addition, write S.F. 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.

Section A

Question 1

(a)(i)	record of length ≈ 0.06 m	All to nearest mm penalise and u.p. A maximum of once each in (a)	B1
			1
(ii)	record of l_1		B1
			1
(iii)	record of l_2		B1
			1
(iv)	correct subtraction of l from l_1		B1
	correct subtraction of l from l_2		B1
			2
(b)(i)	attempt to take ratios or plot W vs Δl graph		M1
	both ratios correctly calculated or straight line graph		B1
	relevant comment relating to comparing ratios or line through origin		B1
			3
(ii)	comment relating to precision of measurement or equivalent sentiments or deviations from the line		B1
			1
(c)(i)	imprecise statement regarding equality of moments		C1
	precise statement including mention of equilibrium		A1
			2
(ii)	both moments correctly calculated		M1
	and equated		A1
			2
(d)	idea of keeping the rod horizontal for each position of unknown weight		B1
	idea of adjustment of spring suspension position		B1
	s or d held constant		B1
	5 – 10 sets of readings of d (or s) and Δl		B1
	idea of working in elastic region of springs		B1
	use of k to calculate T or values of T from calibration graph		B1
	rod length 30 cm – 100 cm		B1
	position of weight increments 5 – 10 cm (consistent with chosen length)		B1
	graph of T vs d or Ts vs d *or* $k\,\Delta ls$ vs d etc		B1
	gradient = W/s or equivalent		B1
			Max 5
	the use of physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar (**must gain at least 3 for Physics**)		Q2
	the use of physics is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor (**must gain at least 1 for Physics**)		Q1
	the use of the physics is inaccurate, the answer is disjointed with significant errors in spelling punctuation and grammar.		Q0
			Total 20

Question 2

(a)	value of $V \approx 50$ mV (no sfp)		B1
			1
(b)(i)	substitution of values without considering powers	1 up for the question	C1
	substitution of values with correct use of powers		C1
	correct value for $R_L \approx 3000 \times V$ (2/3 sf)		A1
			3
(ii)	sensible estimate for uncertainty in voltmeter (same no. of d.p. as reading as supplied by centre)		B1
			1
(iii)	0.1 + (b)(ii)		B1
			1
(iv)	at least two % errors seen to be added		C1
	6% + (b)(ii)/(a) + (b)(iii)/1.5 (ignore sf)		A1
			2
(c)	$E = I(R_L + R)$ or V/R_L or E/5.0 x10^3		C1
	correct value for candidate's $I \approx$ 0.3mA (ignore sf) ecf		A1
			2
(d)(i)	V_{red} value		B1
	V_{green} value		B1
	V_{blue} value		B1
			3
(ii)	appropriate voltage scale marked on		B1
	values for red, green and blue in correct order		B1
	sensibly shaped curve for candidate's points (3 points must be seen)		B1
			3
(e)	thickness of filters		B1
	distance between lamp/filament and LDR		B1
	allow one of background illumination/supply voltage /emf of cell/ resistance of resistor - **must be clear reference to LDR circuit**		
			Max 2
(f)	same general shape as candidate's line		B1
	shifted below the original line and labelled unambiguously		B1
			2
			Total 20

Section B

Question 3

(a)(i)	value within 2mm of that supplied by centre		B1
	value halved correctly (nearest mm or 0.5 mm) in m	apply one up to distances	B1
			2
(ii)	repeat and average of reading		B1
	sensible procedure – use of set square/graph paper		B1
	not simply using ruler etc		**2**
(b)(i)	y value recorded in m		B1
			1
(ii)	correct addition		B1
			1
(iii)	timing for minimum of 20 oscillations*		B1
	repeat*		M1
	average* and period correctly calculated (≈ 1.2 s)		A1
	**half oscillations and number in fixed time lose these*		**3**
(c)(i)	well-planned, neatly drawn table with columns for repeats and averages, data		B1
	entered neatly, no overwriting, crossing out etc.		B1
	all quantities included and units		**2**
(ii)	4 further sets of values (correct trend $y\uparrow$ as $T\downarrow$)*	* lose 2 if less than 10 oscillations used	B4
	4 sets further sets of repeats and averages		B2
	data to consistent d.p. within each column		B1
	T^2 correctly calculated (check one)	single oscillations lose all 4	B1
	T^2 to 1/2 d.p.		B1
			9
(d)	axes correct way round and quantities correctly labelled		B1
	units on axes correct or consistent with those in table		B1
	scales non-awkward (as large as possible with d scale starting at 0 and appropriate **false origin** for T^2)		M1
	five points correctly plotted (-1 for each omission)* lose if poor scale		A2
	best straight line (0 if less than four points plotted)		B1
	overall quality of graphical work		B1
			7
(e)	large triangle used (> ½ plotted area in either direction)		B1
	co-ordinates correct		M1
	correct calculation with value to 2 or 3 s.f ($k \approx 4$) **ignore sign; no unit penalty**		A1
			3
(f)	co-ordinates of point **on line** used		B1
	correct substitution of values		C1
	correct calculation of value of h (≈ 0.500 m) (u.p.) ecf		A1
			3

(g)	Clear description of **complete** oscillations described	B1
	20+ oscillations	B1
	repeat and average of values	B1
	timing from centre of oscillation/sensible use of fiducial point/sensible explanation of avoiding parallax	B1
	further repeats/use of larger *n*/use of electronic instead of manual timing / logged using position or displacement sensor/ light gates and timer – **no credit for idea of using a computer**	B1
		Max 3
	the use of physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar (**must gain at least 2 for Physics**)	Q2
	the use of physics is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor (**must gain at least 1 for Physics**)	Q1
	the use of the physics is inaccurate, the answer is disjointed with significant errors in spelling punctuation and grammar.	Q0
		Max 2
		Total 38