Mark scheme
June 2002

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 Awardsmeeting 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. Themaximum 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.

Question 1

(a)(i)	store spring potential energy [goes…]	B1	
	and 2 of:		
	to kinetic energy	B1	
	all ke is transferred to **gravitational** pe at top	B1	
	where speed is zero	B1	
	[on return to bottom]		
	to sound heat deformation friction [only one end-point required]		**max 3**

| (ii) | observations made and recorded, nearest cm or $^1/_2$ cm | C1 | |
| | repeat three times and correct average, 1 d.p. only or whole no., no fractions | | **2** |

| (b)(i) | $[\triangle E]= mgh$ or $mg\triangle h$ | B1 | **1** |

| (ii) | shows $h/x^2 = k/2mg$ | B1 | |
| | states m, g constant | B1 | **2** |

| (c)(i) | uncertainty in h [allow ½ –2 cm]; unit essential | B1 | **1** |

| (ii) | uncertainty in × [allow 1–5 mm]; unit essential | B1 | **1** |

(iii)	percentage uncertainty calculation		
	$[\,100 \times \Delta h/h;\ 100 \times \Delta x/x]$	C1	
	correct combination of fractional uncertainties		
	$[\%\,h + 2 \times \%\,x]$	A1	**2**

(iv)	calculation of both h/x^2 correct	B1	
	h used in calculation in not c of g in spring (as in equation)	B1	**2**
	or large error prevents judgement		

(d)	source 1	B1	
	effect on data	B1	
	source 2	B1	
	effect on data	B1	**4**

examples:
friction twixt sping and rod/ value lower/ parralax error/
either way.

The use of physics terms is accurate, the answer is fluent/
well argued with few errors in spelling, punctuation and
grammar **2**
(must gain at least 3 for Physics)

the use of physics terms is accurate, the answer lacks coherence or
the spelling, punctuation and grammar are poor **1**
(must gain at least 1 for Physics)

the use of physics terms is inaccurate, the answer is disjointed with
significant errors in spelling, punctuation and grammar are poor **0**
max 2

Total for Question 1 = 20

Question 2

| (a) | carries out expt for both cards and trend correct | C1 | |
| | repeats and averages correctly, same rule as Q1 | A1 | **2** |

(b)	states $n \propto 1/A$ (algebraically)	B1	
	so nA = constant or $n=k/A$	B1	
	calculation for both cards	B1	
	decision correct (be generous, but there must be a decision)	A1	**4**

(c)	plot n against $1/A$, A against $1/n$, n against A, A against n, axes labelled	B1	
	line correct [straight line for A vs $1/n$, curvature correct for n vs A]	B1	
	extremes correct [through (0,0) for A vs $1/n$, asympotic for n vs A]	B1	**3**

| (d) | **up to five good points** | B5 | **5** |

uses five cards or more
suitable range of areas (10-100)
repeats measurement and averages
method for ensuring $\frac{1}{2}$ amplitude point is accurate
reliable release of mass
mass included in calculation
keep initial amplitude same
small amplitutude
avoid draught
parallax error prevention
any other good detail

(e)	mention of air resistance	B1	
	air resistance increases with speed	B1	
	so force is maximum in centre of oscillation	B1	
	and zero at maximum amplitude	B1	**4**

The use of physics terms is accurate, the answer is fluent/
well argued with few errors in spelling, punctuation and
grammar **2**
(must gain at least 3 for Physics)

the use of physics terms is accurate, the answer lacks
coherence or the spelling, punctuation and grammar are poor **1**
(must gain at least 1 for Physics)

the use of physics terms is inaccurate, the answer is disjointed
with significant errors is spelling, punctuation and grammar are poor **0**
                                                                    max 2

Total for Question 2 = 20

Question 3

(a)(i)	0.15 kg or 0.20kg recorded	B1	**1**
(ii)	height of beam **from bench** measured	C1	
	heights of **P** and **Q** measured; **both the same**	A1	**2**
(iii)	value of d recorded to nearest mm	B1	
	repeat and average, same or one more s.f. with unit	B1	**2**
(b)(i)	no net force on the beam	B1	
	no net movement on the beam	B1	**2**
(ii)	a force × a distance = another force × distance	C1	
	correct moments equation:		
	$sgd + (0.40\,kg \times 25cm) + (Mg \times 25cm) = (F/40)$	A1	**2**
	condone non-25cm in (mg × 25)		
(c)(i)	table with quantities and units	B1	**1**
(ii)	6 sets of values	B4	
	repeats and averages 6 readings of s		
	(−1 for each missed repeat; not below 0)	B3	
	value in (a) (i) range s to 0.40 kg	B1	
	consistent d.p. in **s**	B1	
	all d value$s$ given to nearest mm, consistently	B1	
	$1/s$ calculated correctly, and expressed to 2 s.f. consistently		
	condone 3 s.f.	B1	**11**
(d)	axes correct and labelled with quantity	B1	
	units on axes [ecf. from table, except in case of no unit]	B1	
	scales non-awkward: points plotted in at least		
	5×6 2cm squares including intercept if on grid	B1	
	six points correctly plotted (−1 for each error; not below 0)		
	(−2 if awkward scale, -2 if ≤ 3 squares used for $^1/_s$ range,		
	−2 if plot off grid)	B2	
	best straight line (mark lost if fewer than 5 points)	B1	
	quality of graphical work	B1	**7**
(e)(i)	large triangle used **or** sufficiently spread co-ordinates ≥		
	half drawn line	B1	
	co-ordinate correct **or** sides of triangle correct	M1	
	correct calculation to 2/3 s.f., must be –ve for this mark	A1	
(ii)	gradient = −1/5 (M+0.40) seen		
	or subst. point ONLINE into equation	M1	
	clear attempt to rearrange equation	A1	
	their answer correct for M, 2/3 s.f. with unit	A1	**3**
(iii)	correct measurement of intercept condone intercept on		
	paper but off grid	B1	
	unit (=$k\,g^{-1}$) correct and 2 to 4 sf answer	B1	**2**
(iv)	use of intercept =4/ (M+0.40) allow ecf. from (iii)	M1	
	their answer correct for M , 2/3 sf with unit	A1	**2**

Total = 38