GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics B
Unit PHB3

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from:

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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.

PHB3 Experimental Work

Question 1

(a)	(i)	record of emf ≈ 1.1 – 1.7 V	B1	**1**
	(ii)	sensible absolute uncertainty (allow unless good reason not to allow such as. 0.0005V)	B1	**1**
	(iii)	(a) (ii)/(a) (i) x 100% - only %	B1	**1**
(b)		two readings of ammeter (expect ≈ 0.3A and 0.1A)	B1	
		two readings of voltmeter (expect ≈ 1.2V and 1.5V)	B1	**2**
(c)	(i)	both scales sensible and marked on grid (allow 0 → 0.4A on large divisions for *I*)	B1	**1**
	(ii)	points correctly plotted on grid	B1	**1**
	(iii)	straight line passing through both points, reasonable quality (no need to cut *V* axis)	B1	**1**
(d)		attempt to use intercept **Or** grad and sub to find *E*	M1	
		correct reading or calculation of *E* (= c value) (no u.p.)	A1	**2**
(e)	(i)	second value likely to be the more reliable	M1	
		two values used to obtain it	A1	**2**
	(ii)	mean value for *E* (must be 2 values to score) (no up)	M1	
		uncertainty = deviation from mean or other sensibly argued value	A1	
(f)	(i)	*sampled* at finite time intervals/logger introduced error by *digitizing*	B1	
	(ii)	need some sleep in this long period/boredom factor etc	B1	
	(iii)	emf or current falls off with time	B1	
		reference to large drop after 32-4 hours / this makes it unpredictable over this time period / could lead to experiment or device failing etc.	B1	
		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	
				6
				Total 20

Question 2

(a)	(i)	**P** (starts to oscillate) with increasing amplitude amplitude of **P** decreases **P** stops sensible mention of phase or phase difference energy exchange comments **P** & **Q** periods the same amplitude of **Q** decays (a little) when that of **P** increases	B3	**3**
	(ii)	surface area (to mass ratio much) higher for ball **P**/ air resistance much greater on ball **P**	B1	**1**
(b)		timing of min of 10 oscillations	B1	
		time ÷ number of oscillations value recorded in seconds 2/3 s.f. (u.p.)	B1	**2**
(c)		(0.20±0.01) m 2/3 sig figures	B1	**1**
(d)	(i)	evidence of correct substitution of values ecf from (b) and (c)	C1	
		value of g consistent with candidate's T and l (expect very low value for $g \approx 7–8$ ms^{-2}) (no u.p. unless value in cm s^{-2} etc) ($8/T^2$ – by inspection) (no sf penalty)	A1	**2**
	(ii)	Δg shown $\Delta g/g$ shown (condone candidate's value for g) correct calculation (no s.f. penalty) must % value allow other routes to this e.g. % of g value and then ǀ100% – this valueǀ	C1 C1 A1	**3**
(e)		appropriate scale to measure amplitude of oscillations clearly described heavy pendulum always given the same initial displacement at least 5 different lengths for **P** minimum of 10 cm range maximum amplitude of **P** noted repeat and average measurement of amplitude named fiducial marker length of string measured with rule use of vernier or micrometer for diameter of bob graph of amplitude against length	B1 B1 B1 B1 B1 B1 B1 B1 B1 B1	**Max 6**

		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 3

(a)		reading of force in N (u.p.) ≤ 10.0 N	B1	
		repeated and averaged	B1	
		measured values to same precision as quoted by supervisor	B1	**3**
(b)	(i)	frictional force or *f* etc. + weight or *w* or *mg* + normal reaction or *R* or *N* (not "g" for weight)	B1	
		all forces in correct directions	B1	
		all forces with sensible points of application	B1	**3**
	(ii)	F = frictional force + $mg\sin\theta$	B1	
		$R = mg\cos\theta$ ecf with cand's symbols *credit correct resolving of horizontal and vertical components*	B1	**2**
(c)	(i)	well-planned, neatly drawn table with columns for repeats and averages, data entered neatly, no overwriting, crossing out etc.	B1	
		F/N and *h*/mm or cm or m included in table	B1	**2**
	(ii)	5 sets of values (deduct one for each missing value down to 0) (accept $h = 0$ values in table)	B5	
		5 sets of repeats and averages (deduct one for each missing value down to 0)	B3	
		h's to nearest mm, *F*'s consistent with supervisor value (nearest 0.1 or 0.2N)	B1	
		range of *h* minimum of 15 cm	B1	**10**

(d)	neat table to include G and W and consistent d.p. in cols		B1	
	units consistent for each quantity (J or Nm)		B1	
	correctly calculated value for G (=mgh) allow Ncm etc (expect max ≈ 2.0–2.5J)		B1	
	correctly calculated value for W (= FL) allow Ncm etc (expect max ≈ 4 J)		B1	
	correct general trend of results (from graph)		B1	**5**
(e)	(i)	G vertical and W horizontal with axes labelled	B1	
		each quantity in J (or units consistent with table – but penalise no units even when repeated)	B1	
		scales non-awkward covering at least half plotting area in each direction	M1	
		five points correctly plotted (–1 for each omission until 0)	A2	
		overall quality of graphical work	B1	
	(ii)	appropriate choice straight line or curve to fit general shape of points	B1	
		line of good quality not feathery, thin etc.	B1	
	(iii)	comment on linearity – "marked tendency to curve" or "no tendency to curve" or "no points far from the line" or "no anomalous points"	B1	
		further detail – "not reliable results" or "could have chosen curve but marginal" or "balanced distribution of points"	B1	**2**
(f)	efficiency increases with h, W ,G or θ (straight line or upward curve) efficiency decreases with h, W ,G or θ (downward curve)		B1	
	support for this either by statement that ratio G/W increases/decreases or by *attempt* to take ratios		B1	
	further evidence: **either** two or more ratios **taken** and shown to support assertion **or** else comment regarding difficulty in drawing firm conclusion: unreliability of points or method sensible argument relating to vertical lift (ramp has no effect => 100% efficient) lack of reliability with apparatus (different friction in different parts etc)		B1	**3**
				Total 38