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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 6456

Specification B

PHB6 Practical Examination

Mark Scheme

2007 examination - June series

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.

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Dr Michael Cresswell Director General

NOTES

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.

e.c.f is used to indicate that marks can be awarded if an error has been carried forward (e.c.f. must be written on the script). This is also referred to as a 'transferred error' or 'consequential marking'.

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.

c.n.a.o. is used to indicate that the answer must be numerically correct but the unit is only penalised if it is the first error or omission in the section (see below).

Only **one** unit penalty **(u.p.)** in this paper unless there is a mark allocated specifically for giving a correct unit in the marking. Note that the unit is only penalised in the final answer to the question.

Only **one** significant figure penalty **(s.f.)** in this paper.
Allow 2 or 3 s.f unless otherwise stated. s.f penalties include recurring figures and fractions for answers.

Marks should be awarded for **correct** alternative approaches to numerical question that are not covered by the marking scheme. A correct answer from working that contains a physics error (PE) should not be given credit. Examiners should contact the Team Leader or Principal Examiner for confirmation of the validity of the method, if in doubt.

Quality of Written Communication

Before accessing marks for the Quality of Written Communication (QWC) a candidate must first score a minimum of one mark for the physics that is being communicated – this will allow access to 1 mark for QWC. If the candidate scores more marks for physics (a minimum of two or three – depending upon the total mark for that part of the question) then this will allow access to 2 marks for QWC.

Good QWC: the answer is fluent/well argued with few errors in spelling, punctuation and grammar	**2**	
Poor QWC: the answer lacks coherence or spelling, punctuation and grammar are poor	**1**	**Max 2**
Very Poor QWC: the answer is disjointed, with significant errors in spelling, punctuation and grammar	**0**	

PHB6 Practical Examination

Exercise 1

Question 1				
(a)		sensible reading n $\geq$ 10	C1	2
		repeated + averaged, *T* evaluated, accept 3 s.f. only	A1	
(b)	(i)	correct sub	C1	5
		1.42 **s**	A1	
	(ii)	states measured period is greater/same (must be reasonable)	B1	
		mentions non-rigidity of **hacksaw blade** (*not* non-rigid support)	M1	
		hacksaw increases (effective) height of suspension point/(effective) length of pendulum	A1	
(c)	(i)	*A* is the amplitude of the swing	C1	4
		amplitude is max displacement from equilibrium position	A1	
	(ii)	angular speed/velocity/frequency	B1	
		rad(ians)/s **or** $2\pi/T$ **and** s^{-1}/Hz/specifies *T* or $2\pi f$ where *f* = frequency + units	B1	
(d)	(i)	n> 20 for all readings	B1	13
		minimum of 6 values recorded, suitable range, evenly spread	B3	
		-1 for each missing		
		l range $\geq$ 40 cm	B1	
		minimum of 2 repeats per length (3 readings in all)	B3	
		-1 for each missing or identical		
		all *l* to nearest mm	B1	
	(ii)	table includes *n* explicit, all *t*, all *T*, all T^2, all *l* present	B1	
		mark lost for missing unit anywhere		
		consistent decimal places in each column	B1	
		overall presentation	B1	
		calculation of all T^2 correct; check 1 and indicate which	B1	

(e)	correct as instructed, units correct (allow ecf from table)	**B1**	**5**
	non-awkward scales, plots occupy greater than half	**M1**	
	minimum of 5 plots, check two points for accuracy	**A1**	
	best straight line	**B1**	
	overall quality, axes must be drawn	**B1**	
(f)	gradient = $4\pi^2/g$ explicit or obvious	**B1**	**5**
	large triangle used > ½ drawn line	**B1**	
	readoffs or triangle sides correct, check needed	**M1**	
	correct calculation of gradient	**C1**	
	correct evaluation of *g* to 2/3 s.f. + unit *allow range 9.3 → 10.3*	**A1**	
(g) (i)	correct readoff/calculation for intercept *false origin must have correct working for mark*	**M1**	**5**
	correct calculation of *k*	**A1**	
	2/3 s.f.	**B1**	
(ii)	metre or m	**B1**	
(iii)	effective length of pendulum when length of string is 0		
	or extra length of pendulum for all measurements	**B1**	
	or effective length increase due to non-rigid blade		
		Total	**39**

Exercise 2

Question 1				
(a)		table extends to 2 minutes, no out of trend readings	**B1**	**1**
(b)	(i)	fractional decrease in temperature in equal time intervals is the same (2 routes possible) **or** time for temperature to halve is consistently the same **or** graph of ln (temp) vs time is linear (condone lg)	**C1**	**4**
	(ii)	carries out specified analysis correctly *must see **exact** half values not approx on route 2* *must see plotted graph on printed grid on route 3*	**C1**	
		on more than two ratios/graph reasonable and complete	**A1**	
	(iii)	agree with candidate conclusion [exponential usually]	**A1**	

(c)		temperature change seen	**C1**	**3**
		energy lost water correct, can be equation	**M1**	
		mass of ice melted by this energy, 2/3 s.f. [$=m_{water} \times c \times \Delta T/L$]	**A1**	
(d)	(i)	±0.5	**M0**	**4**
	(ii)	2 × their di ºC/deg/K must have units	**A1**	
	(iii)	percentage uncertainty for ΔT correct	**C1**	
		sum of % uncertainties seen	**A1**	
(e)		**candidate must answer the question which is about mass melted, not exponential experiment up to 6 max** apparatus/analysis improvements		**max 6**
		1A insulate beaker	**B1**	
		1B to reduce heat gain to beaker from air etc	**B1**	
		2 lid on boiling tube	**B1**	
		3 stirrer	**B1**	
		4 change tube/beaker shape to cover more hot water	**B1**	
		5 use of temperature sensor and data logger (*not 'data logger' bald*)	**B1**	
		6 more **precise** thermometer or specified precision	**B1**	
		7 means to prevent tube 'steaming up'	**B1**	
		8 allow for shc of glass, thermometer etc not '*more accurate values*'	**B1**	
		9 greater temperature range not '*results*'	**B1**	
		10 significantly more than 40 g water	**B1**	
		11 any method that allows for mass of ice melted by surroundings	**B1**	
		12 any other relevant improvement to analysis	**B1**	
		13 any other relevant improvement to method	**B1**	
		At least 2 marks for physics + **Good QWC**	**2**	**max 2**
		At least 2 marks for physics + **Poor QWC**	**1**	
		At least 2 marks for physics + **Very Poor QWC**	**0**	
		1 mark for physics + sufficient attempt + **Good or Poor QWC**	**1**	
		1 mark for physics + insufficient attempt or **Very Poor QWC**	**0**	
		No marks for physics or **Very Poor QWC**	**0**	
				Total 20

Question 2				
(a)	(i)	clear tabulation + units; 6 readings taken	**C1**	**5**
		readings evenly spread along the wire, <15>85 cm required, rest spread	**A1**	
	(ii)	axes labelled clearly *units not required*	**C1**	
		straight line	**M1**	
		through origin	**A1**	
(b)		correct sub into $R = \rho l/A$	**C1**	**2**
		26×10^{-3} ohm	**A1**	
(c)	(i)	gradient greater at right hand end [condone error in end point here]	**B1**	**4**
		end points coincide both ends	**B1**	
	(ii)	resistance increases with decreasing area	**B1**	
		V/m depends on R/m so gradient greater at right-hand end *e.g. V increases at a greater rate*	**B1**	
(d)	(i)	readings taken (about 20/80 cm), *must see both units*	**B1**	**6**
	(ii)	1 (off in centre because) cells oppose/cancel out	**B1**	
		2 current zero in centre/when bulb is off	**B1**	
		3 idea that at one end p.d. increases		
		and max 2 from:		
		4 same p.d. across bulb/same current at 'just glows'	**B1**	
		5 current in opposite directions in two 'just glows' cases	**B1**	
		6 p.d. across bulb is difference between wire potential and cell potential *will be expressed poorly*	**B1**	
		7 between limits current lower than required to light (because p.d. lower) **or** inverse	**B1**	
		8 explanation/mention of circuit as potential divider	**B1**	
		At least 2 marks for physics + **Good QWC**	**2**	**max 2**
		At least 2 marks for physics + **Poor QWC**	**1**	
		At least 2 marks for physics + **Very Poor QWC**	**0**	
		1 mark for physics + sufficient attempt + **Good or Poor QWC**	**1**	
		1 mark for physics + insufficient attempt or **Very Poor QWC**	**0**	
		No marks for physics or **Very Poor QWC**	**0**	
				Total 19