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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456
Specification B

PHB3 Practical Examination

Mark Scheme

2005 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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Notes for Examiners

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 questions 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**	

PHB3 Practical Examination

Question 1 (a) (i)	reasonable time measured and repeat recorded and units measures distance across tray to cm or mm and units	**B1** **B1**	**2**
(ii)	use of $v = s/t$; s must be value related to length of tray not to depth both calculations correct from correct tray length + unit	**C1** **A1**	**2**
(b)	suitable test evaluated twice correct calculations from correct depths [ecf for c from (a) (ii)] appropriate conclusion drawn and explained	**M1** **M1** **A1**	**3**
(c)	line straight; +ve gradient origin marked or can be inferred	**M1** **A1**	**2**
(d)	up to **two** improved tank designs (for one mark each) longer (not 'larger')/flat base/vertical sides/transparent sides/rigid (not 'metal tray') buoy to register small waves/ripple tank + visualization of wave video/data logging (must specify instrument, vague reference not enough) more depth readings 3 or more traverses/travels greater distance improved depth measurement	**B1** **B1** **B1** **B1** **B1** **B1**	**Max 4**
	At least 2 marks for physics + **Good QWC** At least 2 marks for physics + **Poor QWC** At least 2 marks for physics + **Very Poor QWC** 1 or 2 marks for physics + sufficient attempt + **Poor QWC** 1 or 2 marks for physics + insufficient attempt or **Very Poor QWC** No marks for physics or **Very Poor QWC**	**2** **1** **0** **1** **0** **0**	**Max 2**

(e)	reflection (not deflection **or** bounce **or** rebounds)	**B1**	**Max 4**
	(wave) loses energy/amplitude/momentum as it travels **not** speed **not** size	**M1**	
	at sidewall of tray **or** base **or** surface of tray	**A1**	
	absorbed by water	**A1**	
	up to **two** physical reasons e.g. viscosity/friction at tray surface/internal friction between water molecules/air damping of wave etc	**A2**	

Question 2 (a)	records drop height + unit [to nearest cm or mm]	**B1**	**1**
(b) (i)	equates mgh and $\frac{1}{2}mv^2$ or uses equation of motion	**M1**	**2**
	substitutes correct algebraic symbols	**A1**	
(ii)	correct substitution and correct evaluation (condone cm for m in this mark)	**C1**	**2**
	answer correct; 2/3 sf	**A1**	
(c) (i)	allow 0.1 – 2.0 cm (1 – 20 mm; 0.001 – 0.02 m) unit required	**B1**	**1**
(ii)	{(i)/their x} * 100 [ecf]	**B1**	**1**
(iii)	uses (0.1/9.8) **and** candidate's (ii)	**C1**	**2**
	correct calculation of ½ ($\Delta g/g + \Delta x/x$) 100	**A1**	
(d)	(gravitational) potential energy accept pe, E_p	**B1**	**Max 4**
	to kinetic (in mass) accept ke, E_k	**B1**	
	to stored/elastic/strain pe in thread	**B1**	
	to vibration or sound **in the stand** or **in the string**/mention of energy change in oscillation of mass on thread ('sound' bald, not acceptable)	**B1**	
	some energy to air resistance in falling/internal energy change in string ('heat' or 'friction' bald, not acceptable)	**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 or 2 marks for physics + sufficient attempt + **Poor QWC**	**1**	
	1 or 2 marks for physics + insufficient attempt or **Very Poor QWC**	**0**	
	No marks for physics or **Very Poor QWC**	**0**	

(e) (i)	**only penalise units once in part (e)** force = 0.10 × 9.8 = 0.98 N	**B1**	**1**
(ii)	**upwards [**could be drawn on a sketch] evaluates force on card – 0.98 N	**B1** **B1**	**2**
(iii)	uses $F = ma$ evaluates answer to (ii)/0.10 [ecf from (ii)] 2/3 sf only allow N/kg	**C1** **A1**	**2**

Question 3 (a) (i)	weight/*mg* labelled, direction acceptable ['gravity' not acceptable] 3 forces shown (downwards from bottom of mass, to right, upward) restoring force labelled, direction acceptable, all forces touching mass	**B1** **M1** **A1**	**3**
(ii)	centre/equilibrium position/**O** stated or indicated on diagram	**B1**	**1**
(iii)	(damping greatest at) centre/equilibrium position/**O** stated mentions air resistance/loss in spring or wood as damping mechanism greatest where speed or k.e. greatest/where rate of flexure greatest (alt: at mass/air resistance/greatest area means greatest resistance owtte)	**B1** **M1** **A1**	**3**
(b) (i)	measurement recorded and unit (2 cm/20 mm/2.0 cm ± 2 mm) do not accept 20.0 mm (must be within 18 – 22 mm unless centre comment on supervisor's report) (condone 1 more dp in any average made)	**B1**	**1**
(ii)	one measurement + unit (1 or 2 dp in *t,* i.e. to 0.1 s or 0.01 s) repeated and averaged correctly (condone extra dp in average) *n* quoted and >= 5 (could appear as 20*T* etc)	**B1** **B1** **B1**	**3**

(c) (i)	table present and all units correct	**B1**	**1**
(ii)	5 sets of sensible values (-1 for each missed); all within range initial value to 12 cm (-1 for each outside range) -3 for use of frequency instead of period; or unrecognised half period -3 for number of oscillations counted in a certain time	**B3**	**12**
	three values of t for each tabulated row with correct average -1 for two repeats; -3 for no repeats; -3 for all t identical in rows	**B3**	
	all $n >= 20$	**B1**	
	T calculations correct no T shown loses this mark; no n loses this mark	**B1**	
	all x d.p. consistent (to nearest mm)	**B1**	
	all t d.p. consistent (either to 0.1 or 0.01 s; not mixed in column)	**B1**	
	highest quoted value **greater than** 10 cm checked $T^{0.67}$ calculation correct	**B1** **B1**	
(d)	axes correct as described in question and labelled with quantity	**B1**	**7**
	units on axes (ecf from table unless a blank in the table in which case -1)	**B1**	
	non-awkward scales; no 1:7 1:3 etc scales, plotting on at least ½ grid, no plots off grid	**M1**	
	all tabulated points correctly plotted (-1 per error)	**A2**	
	best straight line (do not award for <4 points) if point ignored by candidate, expect written comment (e.g. anomalous point) not just circle around point	**B1**	
	quality of graphical work	**B1**	
(e) (i)	large triangle seen **or** sufficiently spread co-ords > half drawn line	**B1**	**4**
	co-ordinate read-offs correct **or** sides of triangle correct	**M1**	
	correct calculation to 2/3 sf	**A1**	
	sign **–ve** (ecf)	**B1**	
(ii)	$s^{0.67}$ (their length unit)$^{-1}$ (ecf)	**B1**	**1**
(iii)	recognition that $x = 0$ and therefore that $T = C^{3/2}$ or $T^{0.67} = C$	**B1**	**3**
	determination of C (condone **correct** read-off)	**M1**	
	correct calculation of $C^{1.5}$ + unit; 2/3 sf	**A1**	