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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456

Specification B

PHB3 Practical Examination

Mark Scheme

2007 examination - January 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 Mark 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 mark 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)	*(condone negative readings)* at least one value given *(0<I< 20 mA)* ***three*** values given *(0<I< 20 mA)* $I_{iii} > I_{ii} > I_i$ (*significant increases needed)* correct unit (mA) for **all** readings quoted	 **B1** **B1** **B1** **B1**	**4**
(b)	three volumes quoted correctly *(25, 50, 75 cm^3)* all three sets of data used in calculation clear attempt to test proportionality numerically *(use of all data not necessary)* consistent conclusion clearly stated	**B1** **B1** **M1** **A1**	**4**
(c)	*up to **two** suitable factors stated e.g.* concentration of the solution/number of charge carriers width of the foil strips length of the foil strips temperature of the **solution** surface area of strip *(but **not** size)* *and only if neither length nor width credited*	 **B1** **B1** **B1** **B1** **B1**	**max 2**
(d)	reasonable quality graph drawn, with both axes labelled, showing *I* decreasing with separation graph curves downwards suggesting current inversely proportional to separation **or** clear statement of inverse proportionality statement to the effect that current decreases with separation because of more scattering/more resistance	**B1** **B1** **B1**	**3**
(e)	clear statement of how separation would be controlled suitable method for *measuring* separation described readings for at least five different separations or five beakers conditions for a fair test *explicit* further experimental detail *(accept 'repeats and averages' provided it is explicit what measurements are to be repeated and how many times)* clear statement of how the measurements would be processed and presented	**B1** **B1** **B1** **B1** **B1** **B1**	**max 5**
	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 mark for physics + sufficient attempt + **Good or Poor QWC** 1 mark for physics + insufficient attempt or **Very Poor QWC** No marks for physics or **Very Poor QWC**	**2** **1** **0** **1** **0** **0**	**max 2**
			Total 11

Question 2			
(a)	angle quoted as less than 5º with unit (ignore sign)	**B1**	**1**
(b) (i) (ii)	angle quoted between 10º and 20º with unit consistent calculation of (b) (i) + (a)	**B1** **B1**	**2**
(c)	reasonable angle for each value of *d (e.g. 15º,30º,40º)* all repeats taken **and** average for *d* = 15 cm correct correct tanϕ found for *d* = 10 cm consistent dps all columns	**B1** **B1** **B1** **B1**	**4**
(d)	uncertainty quoted for zero error absolute uncertainties added (reading and zero error) sensible estimate (between $\pm$ 1º and $\pm$ 5º)	**B1** **B1** **B1**	**3**
(e)	sensible % uncertainties calculated for *d* and ϕ % uncertainties added **or** upper and lower limits found half the range taken consistent final answer *(2 s.f. max with % sign)*	**M1** **M1** **M1** **M1** **A1**	**3**
(f)	*up to **five** marks for description:* at least five sets of readings taken for *d* and ϕ plot graph of tanϕ against *d* **or** calculate *d*/tanϕ for readings expect straight line through origin if relationship true **or** consistent answers for *d*/tanϕ *including up to **four** marks for well described sources of uncertainty and suggestions for improvements, **such as:*** *d* uncertain because of irregular Blu-tack mass hang mass from a loop of thread for more accurate *d* difficult to read the angle use a magnifying glass to see more clearly parallax between thread and protractor plumb line as close as possible without touching protractor	 **B1** **B1** **B1** **M1** **A1** **M1** **A1** **M1** **A1**	**max 5**
	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 mark for physics + sufficient attempt + **Good or Poor QWC** 1 mark for physics + insufficient attempt or **Very Poor QWC** No marks for physics or **Very Poor QWC**	**2** **1** **0** **1** **0** **0**	**max 2**
			Total 20

Question 3				
(a)		a minimum of 10 oscillations (in total) timed	**B1**	**4**
		at least one repeat reading recorded	**B1**	
		T = centre value $\pm$ 0.05 (s) *0.80 $\pm$ 0.05 (s) if no centre value*	**B1**	
		T = centre value $\pm$ 0.02 s *0.80 $\pm$ 0.02 s if no centre value*	**B1**	
(b)	(i)	neatly drawn table with clearly presented data for d, d^2, T and T^2	**B1**	**18**
		column(s) for repeat timings	**B1**	
		separate column for averages	**B1**	
		all columns clearly headed with names/symbols	**B1**	
		all columns clearly headed with appropriate units	**B1**	
	(ii)	**all** correct values of d shown *(0.250, 0.300, 0.350, 0.400, 0.450 m)*	**B1**	
		T_{25} = centre value $\pm$ 0.03 (s) *0.50 $\pm$ 0.03 (s) if no centre value*	**B1**	
		reasonable sets of data for d^2, T_n and T *(including answer to (a)) (T increases with d; d^2 = 0.0625, 0.0900, 0.123, 0.160, 0.203 m^2)*	**B5**	
		repeat readings for T or T_n recorded	**B1**	
		first average for T or T_n calculated correctly	**B1**	
		T^2 calculated correctly *(check last one in the table)*	**B1**	
		consistent dps quoted for d and for T	**B1**	
		2 or 3 s.f.s for d^2 *and* T^2	**B1**	
		consistent dps for d^2 *and* T^2	**B1**	

(c)	(i)	axes correct way round and labelled with quantity	**B1**	**10**
		units given on both axes *allow e.c.f. from table but not missing*	**B1**	
		sensible scales *(true origin, no 3s etc., neither axis could be doubled)*	**M1**	
		five points plotted correctly *(-1 each error or missing point)*	**A2**	
		good best fit line drawn *(at least 4 points used, any ignored point should be **clearly** identified as such)*	**B1**	
		general quality *(neat, tidy, axes drawn in accurately, no blots or blobs or messy corrections)*	**B1**	
	(ii)	suitable triangle	**B1**	
		correct calculation	**M1**	
		consistent answer *quoted to 2 or 3 s.f.*	**A1**	
(d)		equate m with A/k	**C1**	**3**
		consistent calculation of k	**A1**	
		$20 \leq k \leq 30$ *quoted to 2 or 3 s.f. with correct unit ($N\ m^{-1}$)*	**A1**	
(e)	(i)	positive non-zero intercept read correctly	**C1**	**3**
		square root of intercept calculated correctly with unit (s)	**A1**	
	(ii)	*any **one** from:*		
		mass of ruler not taken into account	**B1**	
		mass of spring ignored	**B1**	
		load tended to swing about	**B1**	
		load not a point mass	**B1**	
		not errors and/or uncertainties		
				Total 38