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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456

Specification B

PHB3 Practical Examination

Mark Scheme

2008 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

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**	

PHB3 Practical Examination

Question 1				
(a)	(i)	single sensible current reading ≈ few mA (no u.p. here)	**B1**	
	(ii)	$I_{10} > I_{40}$	**B1**	
		$I_{40} \geq I_{ambient}$ (accept slightly less)	**B1**	**5**
		any appropriate unit for current in table and for (a) (i)	**B1**	
	(iii)	idea of need to measure from (window of) LDR to **filament** of lamp/(centre of lamp)	**B1**	
(b)		evidence of use of d^2	**B1**	
		suitable method clearly shown (either ratios or calculation of a constant)	**B1**	**3**
		correctly carried out and suitably stated conclusion	**B1**	
(c)	(i)	colour of filter	**M1**	
		light from lamp may have colour bias – therefore cannot say effect/darker filter transmits less (or absorbs more) light reducing reading	**A1**	**max 2**
		brightness of lamp/supply current/voltage/background	**M1**	
		increased value will increase reading	**A1**	
	(ii)	'more sensitive detector' or LDR with increased sensitivity/ more sensitive ammeter/ not 'computer' without major development	**B1**	
		darkened room/blackened tubes etc/allowance for 'background' or ambient lighting	**B1**	
		minimum of 5 thicknesses	**B1**	
		repeats and averages of thickness measurement	**B1**	
		method of measuring thickness of filter e.g. micrometer/vernier callipers/electronic callipers/travelling microscope	**B1**	**max 6**
		sensible method of holding distance constant/fixing position of **L** and **R**	**C1**	
		L-R distance held constant	**B1**	
		same colour of filter used throughout	**B1**	
		constant supply setting/method of holding brightness of lamp constant	**B1**	
		graph of current against thickness/logs/I v 1/T	**B1**	
		current falls off with increased thickness	**B1**	

	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	**18**

Question 2				
(a)	(i)	three different dimensions measured to a precision of mm (70, 35, 6 expected) **penalise missing or non-cm record once**	**B3**	**9**
		correctly multiplied to give volume ≈ 15 cm^3 (allow m^3 or mm^3)	**B1**	
	(ii)	precision of (±) 1 mm or (±) 2 mm	**B1**	
	(iii)	sum of 3 × % uncertainties consistent with candidate's values for (i) and (ii) [21% or 24% (5 mm ply)]	**B1**	
	(iv)	**use of** density × volume	**B1**	
		correct calculation and unit ≈ 11 g (allow kg here)	**B1**	
	(v)	answer to (iii) + 6.7% c.a.o.	**B1**	
(b)	(i)	recognition that E_{Kmax} = E_{Pmax} (may be implied by $mg\Delta h$)	**B1**	**max 7**
		conversion to kg and m	**C1**	
		correct calculation using height or half height for Δh in J/mJ	**C1**	
		correct calculation using Δh = half the height in (a) (i) – half thickness in (a) (i) in J/mJ	**A1**	
	(ii)	recognition that kinetic energy will be greater in mode **2**	**M0**	
		because Δh greater/taller	**A1**	
	(iii)	**either** smaller angle needed to be rotated through for mode **2 or** falls through smaller height before collision in mode **2**	**M1**	
		therefore rate of energy transfer faster or time interval between collisions shorter in mode **2**	**A1**	
		condone observations related to both amount of energy and time being less in mode **2**	**C1**	

	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**
(c) (i)	sensible value for time for mode **1** (up) – ≤ 1 s	**B1**	**3**
	value for time for mode **2** (similar or shorter)	**B1**	
(ii)	consistent, sensible comment on agreement or disagreement **or** observation that times too close to call (bearing in mind reaction times of ≈ 0.2 s)	**B1**	
		Total	**21**

Question 3			
(b)	sensible current in mA ≈ 100 mA (penalise A)	**M1**	**3**
	second current (ignore unit) - may be in table	**M1**	
	correctly averaged 2 or 3 s.f. - may be in table	**A1**	
(c)	columns for I, L, I^{-1}	**B1**	**5**
	units for I in mA and L in m (penalise cm or mm here)	**B1**	
	1/I units consistent with those of I	**B1**	
	columns for repeats and averages of I	**B1**	
	planned for minimum of 5 readings	**B1**	
(d)	5 sets of readings of I and L (-1 of each missing until 0)	**B5**	**12**
	repeats and averages (-1 of each missing until 0) minus 2 for all repeats being the same in every row	**B3**	
	correct calculation of 1/I (check one)	**B1**	
	measured I and L values to 2/3 s.f.	**B1**	
	all data in columns consistent d.p.s.	**B1**	
	overall neatness (no overwriting/crossings out/general untidiness/illegibility)	**B1**	

(e)	L against $\frac{1}{I}$ with axes labelled	**B1**	
	correct units (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 (no false origin for I^{-1} loses this)	**M1**	
	five points correctly plotted (-1 for each omission until 0)	**A2**	**8**
	overall quality of graphical work – axes drawn and on grid, points not too thick (ignore line quality)	**B1**	
	line of reasonable quality but may be a little thick or not quite the line of best fit – no kinks	**B1**	
	line of good quality in a position that examiner could not improve significantly	**B1**	
(f)	gradient triangle at least half length of line in each direction	**B1**	
	correct coordinates for line (including powers)	**M1**	**3**
	correct coordinates of magnitude of gradient	**A1**	
(g) (i)	Ωm^{-1} or Ωcm^{-1} if consistent	**B1**	
(ii)	recognition that E/k = gradient	**C1**	
	gradient multiplied by 10.0	**C1**	
	E correctly calculated in V	**A1**	
	attempt to substitute coordinates of point into equation – including power	**B1**	**8**
	correct substitution of values – from table ok	**C1**	
	correct value for r	**A1**	
	(**or** recognition the L intercept $= -r/K$	**C1**	
	or correct calculation using this method)	**C1**	
	r in Ω	**B1**	
		Total	**38**