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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456

Specification B

PHB3 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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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)	at least one sensible reading taken and recorded for either sample	**B1**	**5**
	at least two readings taken and averaged for each sample	**B1**	
	at least three readings taken and averaged for each sample	**B1**	
	$T_B > T_A$	**B1**	
	both answers in seconds to 1 decimal place	**B1**	
(b)	volume of *both* samples = 25 ± 2 (cm^3)	**B1**	**2**
	rate of flow calculated correctly **for either** with correct unit (e.g. cm^3 s^{-1} or ml s^{-1}) **for both** *ignore s.f.*	**B1**	
(c)	sample A flows more quickly than sample B/sample A has smaller grain size	**B1**	**2**
	rate of flow decreases as grain size increases	**B1**	
(d)	any **two** from:		**4**
	length of tube, longer tube gives slower **flow**	**M1, A1**	
	curvature of tube, more curves give slower **flow**	**M1, A1**	
	density of solid, denser solids **flow** faster	**M1, A1**	
	inner surface of tube, rougher surface means slower **flow**	**M1, A1**	
	weight of granules in the funnel/pressure difference across tube ends, when increased gives faster **flow**	**M1, A1**	
	grain shape, round grains **flow** faster than angular ones	**M1, A1**	
	dampness of sample, higher water content slower **flow**	**M1, A1**	

(e)	any **five** from: 1 use only one type of granular solid 2 keep length constant 3 consideration of how tube fits the funnel 4 use at least five different diameters 5 one other well-reasoned experimental point *e.g. constant volume/method of measuring diameter* **but not repeats and averages** 6 test of the formula $R = kd^2$ 7 plot a graph of rate of flow against diameter squared **or** plot a graph of $1/t$ against d^2 **if constant volume stated** 8 straight line through origin verifies prediction *award 6 or 7 or 7 & 8* ***not all three***	B1 B1 B1 B1 B1 B1 M1 A1	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 2			
(a)	reasonable answer (15 cm < H_0 < 50 cm) quoted to nearest mm with unit	B1	1
(b)	$H_0 > H_{200} > H_{400} > H_{600}$ *in cm* all three *s* calculations correct all values quoted to the nearest mm	B1 B1 B1	3
(c)	absolute uncertainty in a reading given as either ±1 or ±0.5 mm δH_0 and δH clearly added consistent answer for δs with unit	B1 C1 A1	3

(d)		suitable numerical test (*M*/*s*) used all three data sets used consistent conclusion clearly stated	**M1** **M1** **A1**	**3**
(e)		valid calculation of a % uncertainty in *s* or *l* 3 times % uncertainty in *l* consistent answer for 3 δl% + δs% **ignore s.f.** **or** upper and lower bounds calculated using to (c) half the range found expressed as a % uncertainty **ignore s.f.**	**B1** **M1** **A1** **B1** **M1** **A1**	**3**
(f)	(i)	any **two** from: *d* is very small so (%) uncertainty large uncertainty in d^3 three times larger than that in *d* use a micrometer to measure *d*	 **B1** **B1** **B1**	**5**
	(ii)	any **three** from: 1 use (vernier) callipers to measure *b* 2 use a travelling microscope (or some other accurate method) to measure *s* 3 use extra values of *M* 4 repeats and average for a **specified** measurement 5 measure *H* when uploading as well as when loading 6 plot *M* against *s* 7 use gradient of best straight line to find *M*/*s* 8 clearly stated worthwhile improvement for measuring *l*	 **B1** **B1** **B1** **B1** **B1** **M1** **A1** **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 20

Question 3			
(a)	V_0 = 3 V (approx) **or** a fraction of a volt larger than the specimen reading for 3.9 Ω *2 or 3 s.f. with unit*	**B1**	**1**
(b)	neatly drawn table with clearly presented data for repeats and averages, R, V_X, V and $1/V$	**B1**	**5**
	column(s) for repeat readings of V_X	**B1**	
	separate column for average values of V_X and V	**B1**	
	all columns clearly headed with names/symbols	**B1**	
	all columns clearly headed with appropriate units	**B1**	
(c)	5 reasonable sets of data (V_X approx 2.5, 2.0, 1.5, 1.0, 0.5 V)	**B5**	**11**
	repeat readings shown all five rows	**B1**	
	(average) value for V when R = 3.9 Ω correctly calculated	**B1**	
	$1/V$ correctly calculated for R = 3.9 Ω	**B1**	
	consistent dps quoted for V	**B1**	
	consistent dps quoted for $1/V$	**B1**	
	2 or 3 s.f. for $1/V$	**B1**	
(d) (i)	axes correct way round and labelled with quantity	**B1**	**10**
	units given on both axes (*allow ecf from table but not missing*)	**B1**	
	sensible scales (*no 3's 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 (*at least half length of best line and points taken from the line*)	**B1**	
	correct calculation	**M1**	
	final answer to 2 or 3 s.f.	**A1**	

(e)	intercept read accurately (± half small square) intercept equated with $1/(2V_0)$ consistent answer with unit (V)	**B1** **C1** **A1**	**3**
(f)	equate m with $1/(2V_0S)$ consistent calculation of *S* $S = 100 \pm 10$ correct unit (Ω)	**C1** **A1** **A1** **B1**	**4**
(g)	any **two** good points but **not** heating effects **or** poor best fit line e.g. resistors used in the experiment have a (5 or 10 %) tolerance, this would introduce uncertainty into the results the battery might 'run down' during the experiment (so) V_0 at the end not the same as at the start poor electrical contacts, could produce inconsistent readings internal resistance of battery, would have a greater effect on second V_0 value	 **M1, A1** **B1** **B1** **M1, A1** **M1, A1**	**4**
			38