GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B

PHB3 Practical Examination

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.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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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 awarded for the physical principles involved, or for a particular point in the argument of 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 are awarded for correct calculations 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.

Where a correct answer only (cao) is required this means that the answer must be as in the marking scheme, including significant figures and unit. The correct answer may be specified or be required to be within a specified range.

Where an error carried forward (ecf) is allowed by the marking scheme for an incorrect answer ecf must be written on the script if an error has been carried forward.

Help given by supervisor

The amount of help given, if any, should be indicated in a note attached to the script by the supervisor.

If help has been given: each 'minor help' incurs a 2 mark penalty;
each 'major help' incurs a 4 mark penalty.

These penalties should be recorded on the front of the script and subtracted from the total mark previously awarded.

'Major help' might involve assistance without which the candidate would be unable to take the required readings (e.g. incorrect wiring in a circuit).

'Minor help' might involve the answering of an unnecessary question by the candidate.

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**	
Very Poor QWC: the answer is disjointed, with significant errors in spelling, punctuation and grammar	**0**	**Max 2**

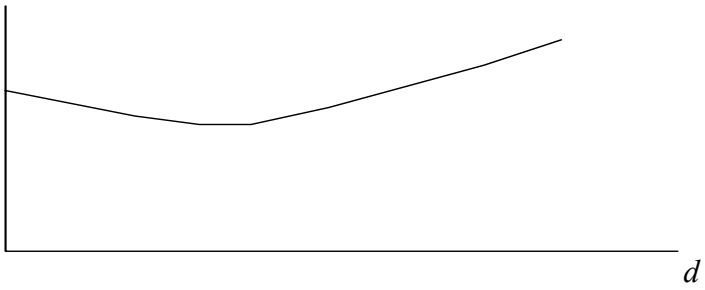
PHB3 Practical Examination

Question 1

(a)		h = 50.0 $\pm$ 0.5 cm, *given to nearest mm with unit*	**B1**	**1**
(b)		five reasonable values for y *(typically 30..40 cm)*	**B1**	
		five reasonable values for x $(x < y)$ *(typically 5..25.cm)*	**B1**	
		award 1 mark if only four values in each column		**2**
(c)	(i)	**either** calculated correctly, 2 or 3 sf *in metres*	**B1**	**1**
	(ii)	Method: ½ x range **OR** (1/5) x range		
		OR ½ x range *without highest and lowest*		
		OR (1/3) x range *without highest and lowest*	**C1**	
		Reasonable answer for **each**	**M1**	
		($\pm$ **)**, unit, 1 or 2sf for **both** *(% is a T/O)*	**A1**	**3**
(d)	(i)	*Correct* calculation	**C1**	
		Any numerical answer with a **valid energy unit**	**B1**	**2**
	(ii)	$\delta(\Delta h)$ = sum of absolute uncertainties	**C1**	
		Add % uncertainties	**C1**	
		OR upper and lower bounds calculated *without* δm *and/or* δg	**C1**	
		OR upper and lower bounds calculated *with* δm *and* δg	**C2**	
		AND *correct* answer in the form ($\pm$) e % with 1 or 2 sf	**B1**	**3**
(e)	(i)	As h increases so will X/X proportional to *h/accept good sketch graph*	**M1**	
		because the ball will have more momentum/K.E. (on rebound)	**A1**	
		The ratio X/h remains constant	**M1**	
		because the proportional energy loss is constant	**A1**	
		For large values of h, X will be constant *(accept good sketch graph)*	**M1**	
		since the ball will reach its terminal velocity	**A1**	**Max 2**
	(ii)	*Mention* of a *reasonable* technique for improving the accuracy of measurement of the rebound height *(e.g. photography)*	**M1**	
		Good further detail of this method	**A1**	
		Plus ***up to three*** *of the following:*		
		Drop the ball from at least 5 different heights	**B1**	
		Within a range *(may be implied)* of at least 0.5 m	**B1**	
		Minimum drop height $\geq$ 20 cm	**B1**	
		For each height calculate E **and** use the formula to find Q	**B1**	
		Plot a graph of Q against h or $1/h$	**B1**	
		Another good experimental point ***(not** repeats and averages)*	**B1**	**Max 4**

		Accurate use of physics terminology + fluent description + good spelling, punctuation and grammar + at least **3 marks for physics**	**2**	
	Or	Good physics but poor QWC Good QWC but only **1 or 2 marks for physics**	**1**	
		No marks for physics/very poor QWC	**0**	**6** **Total 20 Marks**

Question 2

(a)	(i)	At least 10 oscillations timed *in total*	**B1**	
		At least one repeat reading	**B1**	
		Answer in range 0.735 .. 0.804 s, 2 or 3 sf, unit*, or centre value* $\pm$*0.02*	**B1**	**3**
	(ii)	Answer in range 19.8 .. 20.2 cm, 3 sf, unit	**B1**	**1**
(b)		Answer in the range 0.635 .. 0.704 s *or centre value* $\pm$*0.02*	**B1**	
		Answer in the range 0.655 .. 0.684 s *or centre value* $\pm$*0.01*	**B1**	**2**
(c)		New side of triangle recorded as 15.0 $\pm$ 0.05 cm, 2 or 3 sf	**B1**	
		Calculation of T^2 for both readings	**M1**	
		Two results correctly stated	**M1**	
		Clearly stated consistent conclusion	**A1**	**4**
(d)	(i)	Reasonable value for T_B *(less than in part (b))* with unit	**B1**	**1**
	(ii)	Reasonable value for T_C *(greater than* T_B*)*	**B1**	**1**
(e)		T  *d*		
		Plotted point on T axis = answer to part (b)	**B1**	
		Line slopes down at first to about d = 3 or 4	**B1**	
		Line curves upwards to a higher point than intercept	**B1**	**3**
(f)		Use **at least five** pivot holes	**B1**	
		(to give) more points on the graph	**B1**	
		Use a larger triangle	**M1**	
		to give a greater range of measurements of *d*	**A1**	
		Use a heavier/metal triangle	**M1**	
		to give more oscillations for better timing	**A1**	
		Use a thicker/more rigid triangle	**M1**	
		For less spurious movement during oscillations	**A1**	

	Use of fiducial mark for better timing	**B1**	
	Use of data logging for better timing	**B1**	
	One other *well–reasoned* modification	**B1**	
	no marks for "repeats and averages"		**Max 3**
	Accurate use of physics terminology + fluent description + good spelling, punctuation and grammar + at least **2 marks for physics**	**2**	
	Good physics but poor QWC		
Or	Good QWC but only **1 mark for physics**	**1**	
	No marks for physics/very poor QWC	**0**	**5**
			Total 20 Marks

Question 3

(a)	I in the range 75..100 (mA), 2 or 3 sf	**B1**	
	V approximately 3 Volts, 1 or 2 dp	**B1**	
	Unit for p.d.	**B1**	**3**
(b)	Neatly drawn table *with data* showing		
	headed columns for *n, I, V, N* and *X*	**B1**	
	units for V and I (V and mA)	**B1**	
	unit for X (V)	**B1**	**3**
(c)	five complete rows of *sensible* data and results *(-1 each one missing)*	**B5**	
	repeats and averages for I	**B2**	
	repeats and averages for V	**B1**	
	N values correct, *(0.92, 1.67, 2.25, 2.67, 2.92)*	**B1**	
	X *(=V/N)* for $n = 1$ correctly calculated from values in table	**B1**	
	X for $n = 5$ correctly calculated from values in table	**B1**	
	All values for V_{av} given to 1 or 2 dp	**B1**	
	All values for I_{av} given to nearest mA or 0.1 mA or to 3 or 4 dp, if given in A	**B1**	
	All values of X given to 2 dp	**B1**	**14**
(d)	Axes correct way round and labelled with quantity	**B1**	
	Units given on both axes *allow ecf from table but not missing*	**B1**	
	Sensible scales *(no 3's etc., zero origin, 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**	**7**
(e) (i)	Triangle at least half the length of the best fit line	**B1**	
	Coordinates correctly read from best fit line	**M1**	
	Accurate calculation of gradient	**A1**	
	2 or 3 sf quoted	**A1**	**4**

	(ii)	Gradient equated to $1/r$	**M1**	
		Accurate calculation of r, 2 or 3sf	**A1**	
		r in range 35 .. 43 Ω with unit *(0.035..0.043 VmA^{-1} ok)*	**A1**	**3**
(f)		Resistance of voltmeter; could affect pd reading/ammeter reading	**M1, A1**	
		Resistance of ammeter; could affect load current/voltmeter reading	**M1, A1**	
		All resistors may not be identical; because of 5/10% tolerance	**M1, A1**	
		Poor contact at joints/clips; could increase circuit resistance	**M1, A1**	
		Internal resistance of the supply; could affect meter readings	**M1, A1**	
		Resistance of connecting wires (may be significant)	**B1**	
		***Not** human errors*		
		*Any **two** for up to 2 marks each*		**4**
				Total 38 Marks
				Paper Total 78 Marks