Version 1.0: 0905

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 6456
Specification B

PHB6 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.

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**	

PHB6 Practical Examination

Exercise 1

Question 1 (a)	value ≈ 200 mm to nearest mm repeated and averaged in cm	**B1** **B1**	**2**
(b)	0 V or value much smaller than value for shortest length allow 0.0 V etc	**B1**	**1**
(c) (i)	(energy/photons supplied) releases charge carriers/electrons	**B1**	**1**
(ii)	photons release charge carriers/electrons allow the word 'photon' to be carried forward from (i) different potential in different semiconductor material/expect different numbers of charge carriers in different materials/any equivalent argument with difference between the materials	**B1** **B1**	**2**
(d)	minimum of 6 sets of values of *d* and *V* (deduct 1 for each missing set of values) 5 readings every 1cm scores 3 6 readings every 1 cm or more scores 4 5 readings every 2 cm or more scores 5 6 readings every 2 cm or more scores 6 repeat and averages of *V* shown (deduct 1 for each missing set of values) table to include *d*, *V*, log (*d*/cm) and log (*V*/mV) – *any units for d and V but logs must be taken for cm and mV values* consistent decimal places in each column (including logs) overall presentation of table (no scribbling/overwriting/freehand 'straight' lines, no correction fluid etc)	**B6** **B3** **B1** **B1** **B1**	**12**
(e)	logs correctly calculated (check one and tick in table) to 2/3 d.p. consistently (tick table)	**B1** **B1**	**2**

(f)	log V on vertical axis – either no units or log (V/mV) and log (d/cm) – allow ecf from table	**B1**	**5**
	scales non-awkward and at occupying greater than half actual grid in each direction	**M1**	
	minimum of five points plotted	**A1**	
	best straight line (0 if less than four points plotted)	**B1**	
	overall quality of the graph	**B1**	
(g)	log V = log c – k log d	**B1**	**7**
	statement or clear use showing that – k = gradient	**B1**	
	gradient triangle larger than half used sides of graph	**B1**	
	correct calculation of m (2/3 s.f.) including minus	**B1**	
	substitute coordinates for point on line and k value ecf for – signs **or** allow intercept if true intercept	**M1**	
	consistent calculation of log c **or** correct reading of intercept	**A1**	
	correct antilog of value (even false origin intercept)	**B1**	
(h)	intensity of lamp (**or** current, filament temperature, power supply voltage, resistance etc)	**M1**	**Max 4**
	brighter lamp at same distance would increase V	**A1**	
	surface of tube	**M1**	
	more reflective would increase V etc	**A1**	
	wavelength of incident light	**M1**	
	proportion of green in incident light	**A1**	
	temperature of surrounding	**M1**	
	higher temperature would increase V	**A1**	
	tightness of fit of lamp or cork	**M1**	
	consistent argument for light entering or leaving	**A1**	
	degree of translucency of tube	**M1**	
	consistent argument for light entering or leaving	**A1**	
	allow any sensible led characteristic (not resistance)	**M1**	
	allow effect on voltage only if it is reasoned sensibly	**A1**	

(i)	statement of need to measure distance from filament to one end of tube – can be seen on clear diagram statement of need to measure distance from end of LED to other end of tube – can be seen on clear diagram sensible detail of measurement (e.g. marking position of tube on cork, use if vernier callipers when measuring filament height etc) and subtraction of values allow compensation for *2 max* of components in darkened room (M1) clamped and direct measurement with ruler (A1)	**M1** **M1** **A1**	**3**

Exercise 2

Question1 (a) (i)	Pa **or** Nm^{-2} **or** any force unit divided by area unit	**B1**	**1**
(ii)	non-linear extension or *A* decreases as *e* increases (allow *A* changes as *e* changes **or** reference to Hooke's law not being obeyed) do not accept reference to passing elastic limit	**B1**	**1**
(b)	mark the top portion of the rubber above screws – see if the marks move apart when lower portion extended	**B1**	**1**
(c)	correct diagram showing three forces only include arrows allow forces shown in equilibrium triangle correctly labelled weight (*mg*), tension (*T*) and tension (*T*) $2T\sin\theta = mg$ or equivalent	**M1** **M1** **A1**	**3**
(d) (i)	measurement of lengths of two appropriate sides of triangle leading to $\theta \approx 30^\circ$ ($15^\circ \rightarrow 35^\circ$ approx) or equivalent correct calculation of $T \approx 0.5$ N (up) (0.4 → 1.0 N approx)	**M1** **M1** **A1**	**3**
(ii)	evidence of recognition of % error in *T*= % in *m* + % in g + % in $\sin\theta$ (% in *l* or hypotenuse + % in *d* alternative to % in $\sin\theta$) (allow fractions) **condone 2 here in sin** appropriate %'s for *m* and *g* seen (= 12%) any sensible method for dealing with % in $\sin\theta$ condone % in $\tan\theta$ resulting in sensible outcome (care that % in $\sin\theta$ is not doubled) (allow max over min method for uncertainties)	**M1** **M1** **M1** **A1**	**4**

(e)	recognition of need to measure *T, l. e, A* (or equivalent) n.b. candidates listing all quantities talk themselves out of this mark (care with *m*, *l*, *d*, or $\sin\theta$ and *T*)	**B1**	**Max 5**
	named instruments for lengths	**B1**	
	named instrument for thickness (vernier or micrometer)	**B1**	
	description for calculating cross-sectional area of band (rectangular/circular)	**B1**	
	allow use of protractor for angle **or** calc using *d* and *l*	**B1**	
	method for calculating extensions – Pythagoras etc	**B1**	
	sensible range of masses max between 130 – 300 g; minimum of 5 values	**B1**	
	graph of *M* vs *m* or logs of these	**B1**	
	use of safety goggles	**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 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**

Question 2 (a) (i)	resistance in 10's or 100's of kΩ or equivalent	**B1**	**1**
(ii)	(sensible description of) changing scales	**B1**	**2**
	until most significant figure obtained/only scale giving reading/allow credit for trying to avoid continually changing reading	**B1**	
(b) (i)	folded value smaller than (a) (i) value	**B1**	**1**
(ii)	half length or effectively two resistors in parallel	**B1**	**3**
	double cross-sectional area or each of value *R*/2	**B1**	
	sensible comment on how close their value is to expected ¼ of (a) (i)	**B1**	
	allow compensation of 1 for general description of shorter length and/or larger area decreasing the resistance		

(c)	$R = \frac{\rho l}{A}$ shown or clearly used	**B1**	**4**
	length (20 cm), breadth (3 cm) and thickness (12 mm) shown to the nearest mm	**B1**	
	process of $A = b$ x t seen (probably 0.03 x 0.01)	**B1**	
	value of resistivity consistent with candidate's results in Ωm, kΩm etc (u.p.) *approx double (a) (i) value in kΩm gives answer in Ωm*	**B1**	
(d)	(statement that with high resistance) either current very small or need for very high supply voltage	**B1**	**Max 6**
	thus EHT supply (danger) or very sensitive ammeter	**B1**	
	cell voltage <100 V	**B1**	
	resistor of same order of magnitude to resistance of strip in (a)	**B1**	
	comment on high resistance of digital voltmeter ($I \approx 0$)	**B1**	
	idea that each resistance carries same current clearly stated	**B1**	
	idea that $V \propto R$ or $X = (V_1/V_2)\, R$	**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 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**