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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456
Specification B

PHB1 Foundation Physics

Mark Scheme

2006 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 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.

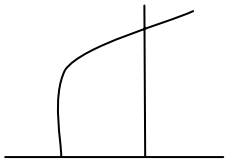
Good QWC: the answer is fluent/well argued with few errors in spelling, punctuation and grammar	**2**	
Poor QWC: the answer lacks coherence or spelling, punctuation and grammar are poor	**1**	**Max 2**
Very Poor QWC: the answer is disjointed, with significant errors in spelling, punctuation and grammar	**0**	

PHB1 Foundation Physics

Question 1			
	joule coulomb A s	**B1** **B1** **B1**	**3**
			Total 3

Question 2			
(a)	two tension arrows, directions correct, on cord weight arrow, *starting from centre of mirror,* acting downwards two arrows labelled tension or T + one arrow labelled weight, W or mg (not gravity) **and** *no other arrows*	**B1** **B1** **B1**	**3**
(b)	vert comp = T sin 40 (39 sin 40) = 25(.1) N weight = 50 (.1 or .2) N *allow e.c.f. from (b)* **or** *graphical method:* 25 $\pm$ 2 N, 50 $\pm$ 5 N ***(s.f. error** if not 2 s.f.)*	**C1, A1** **B1** **A1, A1** **max 2**	**3**
			Total 6

Question 3			
(a)	force × distance mention of perpendicular distance/force	**B1** **B1**	**2**
(b)	when a system is in equilibrium, the sum of clockwise moments is equal to the sum of the anticlockwise moments *clockwise moment(s) = anticlockwise moment(s)* *mention of equilibrium **and** sum or total*	 **B1** **B1**	**2**
(c)	R × 3.00 **or** 400 × 1.50 **or** 540 × 2.60 R × 3.00 = 400 × 1.50 + 540 × 2.60 R = 668 N	**C1** **C1** **A1**	**3**
			Total 7

Question 4				
(a)	(i)	(a substance/component/…with) no (electrical) resistance	**B1**	**3**
	(ii)	 graph showing *transition temperature*	**B1**	
		temperature below which/at which a material is superconducting	**B1**	
(b)		(no resistance) means no energy/heat/power loss	**B1**	**3**
		any two from: power/electrical cables, generators, transformers, motors, electromagnets, MRI scanners, monorail trains, particle accelerators, fusion reactors **not** *supercomputers*	**B2**	
				Total 6

Question 5				
	1000 4.0		**B1**	**3**
	0110 3.0	*condone 3, 4*	**B1**	
	0101 2.5		**B1**	
				Total 3

Question 6				
(a)	(i)	$V/50 = 6/155$ *or equivalent method*	**B1**	**5**
		$V = 1.94\,\text{V}$	**B1**	
	or	$R/105 = 2/4$ *or equivalent method*	**B1**	
		$R = 52.5\,\text{k}\Omega$	**B1**	
		correct conclusion based on correct R or V ($V<2$, $R>50$)	**B1**	
	(ii)	$V/6.0 = 50/(50 + 1.25)$	**C1**	
		$V = 5.85\,\text{V}$	**A1**	
(b)		**potential divider** circuit with		**2**
		battery, LDR and **105 kΩ** in series	**B1**	
		V_{out} clearly shown across the LDR	**B1**	
				Total 7

Question 7			
(a)	(180/7.2) $= 25\,m\,s^{-1}$	**B1**	**1**
(b)	$v = u - 9.8t$ $= 35.3\,m\,s^{-1}$	**C1** **M1**	**2**
(c) **or** **or**	*use of* $c^2 = a^2 + b^2$ *use of* $\theta = \tan^{-1}(y/x)$ *or equivalent* correct triangle drawn to scale $u = 43.2\,m\,s^{-1}$, $\theta = 54.7°$ *allow consistent answers from scale drawing* *allow ecf from (a) and (b)*	**C1** **A1, A1**	**3**
(d)	the maximum height would be less the horizontal distance would be less air resistance would decelerate the ball/reduce kinetic energy/reduce momentum the flight time would be different the flight path would not be a parabola/symmetrical *award the **flight path** mark for a clear diagram showing a steeper descent than the ascent* a diagram of the ball in flight with drag weight and velocity correctly shown	**B1** **B1** **B1** **B1** **B1** **B1**	**max 4**
	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 + **Good or 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**
			Total 12

Question 8			
(a)	R = V/I (*R must be the subject*) *I* = 0.34 A *(make allowance for visually impaired candidates)* *R* = 4.7(1) Ω	**C1** **C1** **A1**	**3**
(b)	statement that the area under the graph represents the charge **or** a *clear attempt* to count squares/estimate area scale factor = 0.05 × *(correct conversion to amperes)* 1800 *(conversion to seconds)* *Q* = 5700 ± 200 C *2 s.f. only*	**C1** **C1** **C1** **A1**	**4**
(c)	W = VQ *W* = 8000 J (*answer to (b) × 1.4*)	**C1** **A1**	**2**
			Total 9

Question 9				
(a)	(i)	3.5/1.5 = 2.33 ms^{-2}	**C1** **A1**	**4**
	(ii)	F = ma *F* = 1.52/1.50 N	**C1** **A1**	
(b)	(i)	(0.65 × 0.60) = 0.39 N	**B1**	**2**
	(ii)	(1.52 + 0.39) = 1.91 N *allow ecf from (a) (ii) and/or (b) (i)*	**B1**	
(c)		0.5 × 3.5 × 1.5 **or** 0.5 × 3.5 × (3.5/0.60) (*d* = 2.63 + 10.21) = 12.8 m	**C1** **A1**	**2**
				Total 8

Question 10			
(a)	$R = \rho l/A$	**C1**	
	$A = \pi(1.5 \times 10^{-3})^2$	**C1**	**3**
	$R = 0.793\,\Omega$	**A1**	
(b)	$E = \frac{1}{2} F\Delta l$ *or equivalent*	**C1**	**2**
	$E = 472\,J$	**A1**	
(c) (i)	power loss = I^2R *or equivalent*	**C1**	**2**
	$= 6500\,W$	**A1**	
(ii)	power = VI = 40 MW	**B1**	
	current = 1000 A	**B1**	
	power loss = 650 kW	**B1**	
or	*(alternative 'show that')*	**B1**	
	(for same power) lower voltage means higher current and (so greater power loss)	**B1**	
	mention of transformers	**B1**	**max 5**
	stepping up and/or down of current/voltage	**B1**	
	transformers only work with a.c.	**B1**	
	power stations/generators produce a.c.	**B1**	
	easier to convert from a.c to d.c. (than the other way round)	**B1**	
	high voltage transmission means thinner/lighter cables	**M1**	
	hence cheaper engineering	**A1**	
	At least 2 marks for physics + **Good QWC**	**2**	**max 2**
	At least 2 marks for physics + **Poor QWC**	**1**	
	At least 2 marks for physics + **Very Poor QWC**	**0**	
	1 or 2 marks for physics + sufficient attempt + **Good or Poor QWC**	**1**	
	1 or 2 marks for physics + insufficient attempt or **Very Poor QWC**	**0**	
	No marks for physics or **Very Poor QWC**	**0**	
			Total 14