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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456

Specification B

PHB1 Foundation Physics

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**	

PHB1 Foundation Physics

Question 1			
(a)	resistance caused by obstruction of electron movements by atoms/ions (not particles)	**B1**	**2**
	ions/atoms vibrate more at higher temperature	**B1**	
(b)	$R = \rho l/A$	**C1**	**3**
	correct substitution and rearrangement $\frac{6.0 \times \pi (2.1 \times 10^{-5})^2}{0.17}$	**A1**	
	$4.9(0) \times 10^{-8}\,\Omega$m **including unit**	**A1**	
		Total	**5**

Question 2				
(a)	(i)	kinetic energy or potential energy (of water) to electrical energy	**B1**	**2**
	(ii)	inefficiency of turbine or turbulence or reference to viscous resistance/(work done against) friction in a sensible named place/electrical heating in generator of connecting wires	**B1**	
(b)		**any two**		**max 4**
		no fuel costs	**B1**	
		low capital cost	**B1**	
		renewable	**B1**	
		no visual pollution/atmospheric pollution/no harmful gases given off	**B1**	
		any two		
		harsh or corrosive working environment/high maintenance/inaccessible	**B1**	
		limited availability of sites	**B1**	
		may affect habitats	**B1**	
		not 24 hours per day	**B1**	
		hazard to shipping	**B1**	
		new technology	**B1**	
		only small power supply	**B1**	
			Total	**6**

Question 3				
(a)		shows reduction in amplitude over time	**B1**	**2**
		period remains the same over at least 3 cycles	**B1**	
(b)	(i)	attenuation clearly greater in (a), condone wrong period, crosses axis at least once	**B1**	**3**
	(ii)	energy extracted from system	**B1**	
		because of resistance forces/friction operating	**B1**	
			Total	**5**

Question 4				
	(i)	negative electrons in **R**	**B1**	**3**
		in **S** negative ion	**B1**	
		in **S** positive ion	**B1**	
	(ii)	all negative charges shown move to the left	**B1**	**2**
		all positive charges shown move to the right	**B1**	
			Total	**5**

Question 5				
(a)	(i)	a conductor, the resistor of which is zero	**B1**	**3**
		at a transition/critical temperature	**B1**	
	(ii)	resistance falling with temperature in a straight line with a sudden drop to zero	**B1**	
(b)	(i)	any appropriate use	**B1**	**2**
	(ii)	eliminates or reduces energy losses or availability of strong fields	**B1**	
			Total	**5**

Question 6			
(a)	any closed triangle or parallelogram featuring forces from diagram – not necessarily to scale	**B1**	**4**
	scale drawing of correct shape and labelled	**B1**	
	2400 (N) to 2700 (N) found by scale drawing only	**B1**	
	2500 (N) to 2600 (N) by scale drawing or calculation	**B1**	
(b)	the boat will rotate in the correct direction/front of boat moves left	**M1**	**4**
	there is a (net) anticlockwise moment owtte	**A1**	
	the boat will move forward/along the wall	**M1**	
	there is a (net) force in a forward direction	**A1**	
		Total	**8**

Question 7				
(a)		basic method is correct and doable	**B1**	**4**
		method of calculating answer described	**B1**	
		accurate method described with procedural details correct	**B1**	
		means of measuring s and T stated	**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**
(b)	(i)	$s = ½ gt^2$	**C1**	**4**
		4.2 (s)	**A1**	
	(ii)	horizontal & vertical components independent/vertical acceleration still g	**B1**	
		time not affected	**B1**	
			Total	**10**

Question 8				
(a)	(i)	$P = VI$	**C1**	**6**
		42 (W)	**A1**	
	(ii)	7.0 Ω **unit required - allow 1 s.f. answer**	**B1**	
	(iii)	$1/R_T = 1/R_1 + 1/R_2$	**C1**	
		2.3 (Ω) **e.c.f.** – 1/3 of their (a) (ii)	**A1**	
	(iv)	one breaks, others remain/brighter/independently switchable	**B1**	
(b)	(i)	total resistance = 4.8 (3) Ω or suitable internal resistance equation	**C1**	**3**
		internal resistance = 0.33 Ω	**A1**	
	(ii)	their 0.33 × 2.9/0.95 (V)	**B1**	
			Total	**9**

Question 9				
(a)	(i)	$F = k\Delta l$	**B1**	**4**
		4.83 seen	**B1**	
	(ii)	stored energy = ½ $F\Delta l$	**C1**	
		0.50 (J) or 0.51 (J) or 0.507 (J)	**A1**	
(b)	(i)	upward arrow and downward arrow shown touching the mass	**M1**	**7**
		magnitude correct: their (a) (i) up and 3.7 N down	**A1**	
	(ii)	1.1(3) N (upwards) **e.c.f.**	**B1**	
	(iii)	$a = F/m$	**C1**	
		2.97 (m s^{-2})/**e.c.f.**	**A1**	
		force in spring will get smaller (so resultant force is smaller)	**B1**	
		acceleration will reduce	**B1**	
			Total	**11**

Question 10				
(a)		chooses 600 Ω	**C1**	**3**
		use of ratios or potential divider formula	**A1**	
		either maximum calculated (5.4 (V)) or minimum calculated (3.0 (V))	**A1**	
(b)	(i)	T = 0; V = 3.6 V; code = 0010		**6**
		T = 6; V = 5.1 V; code = 1000		
		T = 12; V = 4.7 V; code = 0110		
		all V correct	**C1**	
		1 code correct	**C1**	
		all codes correct	**A1**	
	(ii)	signal not perfect since it's being sampled/small variations in V may not be picked up/value may change between sampling times/reference to noise/interference	**B1**	
		increase sampling rate	**B1**	
		increase number of voltage divisions within the range	**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	**11**