Version 1.0: 03/06

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456
Specification B

PHB1 Foundation Physics

Mark Scheme

2006 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.

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**	

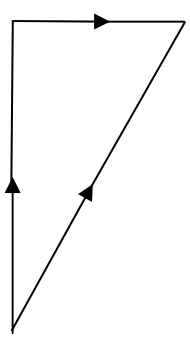
PHB1 Foundation Physics

Question 1			
	vector metre scalar joule scalar watt allow capital letters, misspellings and plural units *accept v, s for vector and scalar*	**B1** **B1** **B1**	**3**
		Total	**3**

Question 2			
	I = nAvq	**C1**	**3**
	correct substitution [$n = 2.4/(8.0 \times 10^{-8} \times 2.2 \times 10^{-3} \times (\pm 1.6) \times 10^{-19})$] *ignore unit but penalise negative answer*	**C1**	
	$I = 8.52 \times 10^{28} (m^{-3})$	**A1**	
		Total	**3**

Question 3			
(a)	(moment) = 72 × 9.8 × 2.4 *penalise 1 mark for g = 10 m s^{-2}* = 1690 N m	**C1** **A1**	**2**
(b)	½ mv^2 = mgΔh **or** v^2 = u^2 + 2gs v^2 = 9.8 × 3.2 × 2 *allow e.c.f. g =10 m s^{-2}* v = 7.92 m s^{-1} (8.0 m s^{-1} with e.c.f.)	**C1** **C1** **A1**	**3**
		Total	**5**

Question 4			
(a)	R = V/I	**M1**	**2**
	with all **three** variables defined *accept voltage*	**A1**	
(b)	*use of* $1/R = 1/R_1 + 1/R_2$	**C1**	**3**
	effective resistance of parallel resistors = 2	**C1**	
	total resistance = 11 Ω	**A1**	
(c) (i)	ratio 2/3 seen/ V= 4.8 V used		**4**
	/clear attempt to find pd across parallel resistors	**C1**	
	current = 1.6 A c.a.o.	**A1**	
(ii)	*use of* $P= I^2R$ *(= $2.4^2 \times 11$)*	**C1**	
	total power = 63.4 W *allow e.c.f. from (b)*	**A1**	
		Total	**9**

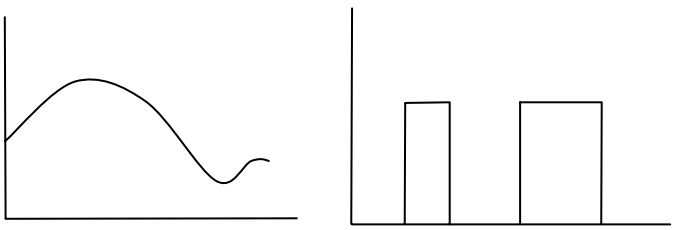
Question 5			
	 scale clearly stated	**B1**	**5**
	correct triangle drawn	**B1**	
	all arrows shown	**B1**	
	1.8 m s^{-1} < speed ≤ 2.0 m s^{-1}	**B1**	
	direction = N (16 ± 2)º E *or unambiguous alternative*	**B1**	
	or *use of* $c^2 = a^2 + b^2$ **or** *use of* $\tan\theta = a/b$	**C1**	
	$v^2 = 1.80^2 + 0.50^2$	**C1**	
	$\theta = \tan^{-1}(0.50/1.80)$ *or other valid angle*	**C1**	
	speed = 1.87 ms^{-1}	**A1**	
	direction N 15.5º E *or unambiguous alternative*	**A1**	
		Total	**5**

Question 6			
(a)	clear statement that gradient = acceleration *accept $\Delta v/\Delta t$* **or** statement of v = u + at suitable values taken from graph *i.e. (5.0, 13.5± 0.5) (4.0, 11± 0.5) (3.0, 8± 0.5)* acceleration = 2.7 ± 0.1 (m s^{-2})	**B1** **M1** **A1**	**3**
(b) (i)	*use of* m = F/a mass = 740 kg *accept 741 kg or answer consistent with part (a)*	**C1** **A1**	**3**
(ii)	resistive force = 2.0 kN c.a.o.	**B1**	
(c)	clear attempt to count squares/estimate area *(37 ± 2 cm^2)* scale factor 1 cm^2:25 m distance = 925 ± 50 m	**C1** **C1** **A1**	**3**
		Total	**9**

Question 7			
(a) (i)	mass = volume × density or $1.3 \times 3.0 \times 10^9$ seen	**C1**	**6**
	use of $\frac{1}{2}mv^2$	**C1**	
	K.E. = 1.41×10^{11} J c.a.o.	**A1**	
(ii)	*use of* P = W/t	**C1**	
	× 0.45 seen	**C1**	
	average power output = 734 kW *allow e.c.f. from (i)*	**A1**	
(b)	tidal flow can be used to turn water turbines *1*	**B1**	**5**
	waves can be used to drive pistons/'ducks' *2*	**B1**	
	either/both incur no fuel costs/consumption *3*	**B1**	
	either/both require large development costs and/or high capital cost/investment *4*	**B1**	
	either/both require high maintenance costs *5*	**B1**	
	either/both may impede shipping *6*	**B1**	
	justified comment about pollution/climate change *7*	**B1**	
	justified comment about available sites *8*	**B1**	
	waves are unpredictable/intermittent *9*	**B1**	
	tides are predictable *10*	**B1**	
	(but) tidal flow is not constant/continuous *11*	**B1**	
	there may be a negative impact on wildlife *12*	**B1**	
	maximum of 5 marks or 3 marks if waves and/or tides not mentioned		
	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**
		Total	**13**

Question 8			
(a)	the (total) energy transferred/work done when one unit/coulomb of charge is moved around a circuit/provided by the supply	**B1** **B1**	**2**
(b)	work is done inside the battery/there is resistance inside the battery so less energy is available for the external circuit/some voltage is lost between the terminal/mention of lost volts	**B1** **B1**	**2**
(c) (i)	9.00 V c.a.o.	**B1**	**5**
(ii)	lost voltage = E - V or E = I(R + r)	**C1**	
	0.82r = 0.59	**C1**	
	internal resistance = 0.720 Ω	**A1**	
(iii)	because the battery has to provide more energy/power	**B1**	
		Total	**9**

Question 9			
(a)	2.2 s c.a.o.	**B1**	**1**
(b)	*exactly two* reasonable sine wave cycles drawn displacement = 10 cm when time = 0 time = 2.2 s after one cycle peaks decrease to approximately 7.0 cm after two cycles or 8.4 cm after one cycle **award two marks if half-cycle confused with full cycle but otherwise correct**	**B1** **B1** **B1** **B1**	**4**
(c) (i)	the period would be decreased	**B1**	**2**
(ii)	there would be less damping/more oscillations before the pendulum comes to rest	**B1**	
		Total	**7**

Question 10			
(a) (i)	 any **three** out of four of: sketch showing an analogue signal *without loop-back* sketch showing a digital signal *with two levels only* clear indication of which graph is which statement to the effect that an analogue signal is *continuous*/digital signals have only two levels	 **B1** **B1** **B1** **B1**	**5**
(ii)	microphone, sound (intensity) /electronic thermometer or thermistor or thermocouple or electrical resistance, temperature /strain gauge, pressure or compression or extension /LDR or photocell or photodiode, light (intensity) /position sensor, displacement *accept height*	 **B1** **B1**	
(b)	**advantage** reduces human error/readings can be more frequent/remote monitoring is possible/can be left unattended/can be used when event unpredictable/for rapid changes/over a long time interval **disadvantage** expensive/system would not notice obvious errors/possible malfunction *if well argued*	 **B1** **B1**	**2**

(c)	chosen experiment clearly better/only possible with data-logging logged variable clearly stated correctly named sensor being used diagram of suitable potential divider circuit sensor output connected to a computer *could be shown on diagram* other good experimental detail given	**B1** **B1** **B1** **B1** **B1** **B1**	**Max 3**
	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**
		Total	**12**