GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B

PHB1 Foundation Physics

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

PHB1 Foundation Physics

Section A

Question 1

(a)	km h^{-1} ➔ ms^{-1} (27.8 ms^{-1}) or 100000/(5.8 x3600)	**C1**	
	acceleration equation or correctly substituted values	**C1**	
	4.79 cao	**A1**	**3**
(b)	equation of motion or correctly substituted values ($s=ut + ½at^2$; $s=(v+u)t/2$; $v^2=u^2+2as$)	**C1**	
	80.6 m e.c.f. from (a)	**A1**	**2**
			Total 5 Marks

Question 2

(a)	air resistance (drag) /friction with correct arrow from or towards body	**B1**	
	weight (force of gravity/ 838 N) not *gravity* with correct arrow from somewhere on skier or ski – vertically downwards	**B1**	**2**
(b)	clear attempt to resolve weight (not mass) or equate normal reaction with component of weight (condone $\sin\theta$)	**C1**	
	$mg\cos\theta$ or substituted values	**C1**	
	815 (or 810 or 820) N	**A1**	**3**
(c)	constant speed/velocity or zero acceleration	**B1**	**1**
			Total 6 Marks

Question 3

(a)	region from –50 °C ➔max of –40°C	**B1**	**1**
(b)	electrons/charge carriers released	**B1**	
	more charge carriers/electrons available for conduction	**B1**	
	this effect more than compensates for increased **(**rate of **)** collision *allow compensation of one mark for increased rate of collision argument => increase of resistance*	**B1**	**3**
(c)	(117±2) kΩ	**B1**	
	total resistance correctly calculated or potential divider formula shown	**C1**	

	current correctly calculated for candidate's data or correct substitution into potential divider formula		**C1**	
	6.41 V–6.52 V (ecf for 120 kΩ etc)		**A1**	**4**
				Total 8 Marks

Question 4

(a)	½ Fx or ½ kx^2		**C1**	
	29.4 mJ		**A1**	**2**
(b)	(i)	amplitude clearly marked on diagram – must touch lines or be an accurately drawn equivalent distance	**B1**	**1**
	(ii)	idea of interchange of p.e. and k.e.	**B1**	
		appropriate use of elastic p.e. at start of cycle and of gravitational p.e. at highest point + some k.e. in between	**B1**	**2**
				Total 5 Marks

Section A Total 24 Marks

Section B

Question 5

(a)	clockwise moment(s) = anticlockwise moment(s)	**C1**	
	precise statement including idea of equilibrium and sum of	**A1**	**2**
(b)	use of sum of upward forces = sum of downward forces/578 N	**C1**	
	400 N cao	**A1**	**2**
(c)	reasonable attempt to take moments (min. of two F x s)	**C1**	
	correct anti-clockwise moment (= 745 or 5 x 149**)**	**C1**	
	correct total clockwise moment (445 + (b) x x) /(178 x 2.5 + (b) x x)	**C1**	
	0.75 m e.c.f. from (b) = 300/(b)	**A1**	**4**
			Total 8 Marks

Question 6

(a)	idea of maximum voltage between terminals of source or open circuit p.d. or any W/Q or P/I idea	**C1**	
	work done per coulomb in separating a charge internally or work done per coulomb in moving charge around complete circuit	**A1**	**2**

(b)	E = I(R + r) or E = V + Ir or lost volts = 0.16V		**B1**	
	I = 0.175(A) or I = 1.4V/8Ω		**B1**	
	r = 0.16 V/ 0.175A = 0.914Ω or lost volts/I		**B1**	**3**
(c)	(i)	statement or use of parallel formula	**C1**	
		6.0 Ω	**A1**	**2**
	(ii)	0.9 Ω added to (c) (i)	**C1**	
		I = 1.56V/6.9Ω =0.22 A or 0.23 A e.c.f.	**C1**	
		0.22A x 6Ω = 1.35 V or 1.36 V e.c.f.	**A1**	**3**
		(allow 1.56/6.9 = V/6.0 for 2nd C Mark)		
	(iii)	voltmeter resistance too similar to circuit or significant p.d. dropped internally or condone significant number of "lost volts"	**B1**	**1**
(d)	area = 3.1 x 10^{-6} (m^2) or π (condone error in power of 10) or $\pi d^2/4$ stated or used (not πr^2 stated alone)		**C1**	
	$R = \rho l/A$ (or 1.6 x 10^{-3} (condone error in power of 10))		**C1**	
	V = (0.2 x R value) or ~ 0.3 mV		**C1**	
	~0. 6 mV c.a.o. (unit must be present – extra up)		**A1**	**4**
				Total 15 Marks

Question 7

(a)	use renewable energy resource	**B1**	
	island likely to be windy (most of the time)	**B1**	
	oil powered generators can be back-up when low (no) wind	**B1**	
	no fuel costs/low running costs – with wind turbine	**B1**	
	less (no) air pollution	**B1**	
	no (fewer) problems with importing diesel to island/no need to run (costly) cable from mainland or no loss of power (idea) in the long cables needed.	**B1**	**Max 3**
	the use of physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar (must gain 3 for Physics)	**2**	

		the use of physics is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor (must gain at least 1 for Physics)	**1**		
		the use of the physics is inaccurate, the answer is disjointed with significant errors in spelling punctuation and grammar.	**0**	**5**
(b)		Sun's radiation warms air or Earth's surface or sea	**B1**		
		(idea that differential) temperatures/pressures set up convection currents or air movement or wind	**B1**		
		winds blow across seas creating waves	**B1**	**3**
(c)	(i)	corresponding power ~ 14 kW (13.0-14.5)	**B1**		
		years ➔ seconds ((3.2 x10^7or 60 x 60 x 24 x 365 **)**	**C1**		
		4.1– 4.6 x10^5 (MJ) e.c.f. (allow 4.7 x 10^5 for 15 kW as e.c.f.)	**A1**	**3**
	(ii)	graph not linear	**B1**		
		close down if wind speed too high or not operate if too low	**B1**		
		closed down during maintenance	**B1**		
		mean power less than (doesn't correspond to) value given by mean wind speed	**B1**	**Max 2**
				Total 13 Marks

Question 8

(a)	(i)	digital	**M0**	
		sampled data/ data to be stored on computer must be digital	**A1**	**1**
	(ii)	data produced of higher quality/less risk of data being missed not simply " more accurate" without explanation/ **NOT** "more reliable" or "more data to analyse" without further detail	**B1**	**1**
	(iii)	mention resistance of wire	**B1**	
		joule heating/current heats wire/I^2R/energy wasted or transferred to surroundings	**B1**	
		signal becomes weaker or attenuated or degraded/ electromagnetic interference	**B1**	**3**

	(iv)	I^2R or I^2Rt	**C1**	
		24 hours ➔ seconds (8.64×10^4) or 24 x 60 x 60	**C1**	
		2.33x 106 J c.a.o.	**A1**	**3**
(b)		can be positioned in smaller space so more versatile	**B1**	
		higher density of thermal energy is generated condone "(smaller so) gets hot"/difficulty with attaching leads/more difficult maintenance do NOT allow cost argument	**B1**	**2**
(c)		appropriate named situation with sensible named physical quantity (temp./light intensity/count rate etc.)	**B1**	
		explanation of need for remoteness in terms of inaccessibility or health hazard	**B1**	
		named sensor that will perform task e.g. LDR, thermistor etc. not temperature sensor/light sensor etc.	**B1**	
		physical changes (e.g. resistance changes according to light intensity, resistance changes with temperature etc.)	**B1**	**Max 3**
		the use of physics is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar (must gain 3 for Physics)	**2**	
		the use of physics is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor (must gain at least 1 for Physics)	**1**	
		the use of the physics is inaccurate, the answer is disjointed with significant errors in spelling punctuation and grammar.	**0**	**5**

Total 15 Marks

Section Total 51 Marks

Paper Total 75 Marks