Version 1.0: 0905

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 5456
Specification B

PHB1 Foundation Physics

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**	

PHB1 Foundation Physics

Question 1 (a)	(2) T cos 45 = 25 or T cos 45 = 12.5 (or equations with sin 45) **or** T = 25 cos 45 adequate scale (minimum 10 mm = 5 N) T = 17.7(18 N) 17 – 18 N	**C1** **A1**	**2**
(b)	energy = ½ F ΔL or (25 x 0.7) seen or ½ $k\Delta L^2$ and $F = k\Delta L$ 8.75 (J) (condone omission or incorrect unit here)	**C1** **A1**	**2**
(c)	0.73 x their (b) 6.4(3) if correct J (allow in (b) or (c) (condone N m) no mark if incorrect unit in (b) or (c) condone if correct in (b) but omitted (c) or vice versa	**B1** **B1**	**2**

Question 2 (a) (i)	1.05 (1.1) N m (up for J)	**B1**	**2**
(ii)	0.70 N m (condone 1 sf)	**B1**	**1**
(iii)	weight of bar = 1.59 N (1.8 if (a) (i) = 1.1)	**B1**	**1**
(b) (i)	3.4 N (3.2 N if weight =1.8 N) {ecf 5 – (a) (iii)}	**B1**	**1**
(ii)	upwards (not clockwise) (allow ecf for answer consistent with weight i.e. down if (weight +2)>7)	**B1**	**1**

Question 3 (a)	$R = \rho L/A$ area = 3.14 x 10^{-8} m^2 or 12.6 x 10^{-8} or $\pi(1\text{x}10^{-4})^2$ or $\pi(2\text{x}10^{-4})^2$ 1.7 (1.74 or 1.75) m (not 1.8 m)	**C1** **A1** **A1**	**3**
(b)	correct curvature for positive V (decreasing gradient) consistent graph for negative V through origin	**B1** **B1**	**2**

Question 4 (a) (i)	0 (V) or near 0 or negligibly small	**B1**	**1**
(ii)	2.5 mA (allow 3 mA)	**B1**	**1**
(iii)	power = $I^2 R$ or any other correct power formula 12.5 W (18 W if 3 mA) (ecf for current or incorrect conversion for M in (b))	**C1** **A1**	**2**
(b)	so that **current** is restricted **below danger level** i.e. idea of limiting current for safety	**B1**	**1**

Question 5 (a)	superconductor has zero resistance/resistivity (**not** very little) when at (condone below) the **transition temperature** (not critical or low)	**B1** **B1**	**2**
(b)	no/less/lower **power/energy lost** (in conducting wires) less fuel needed (so less CO_2 emitted to produce the required power)	**B1** **B1**	**2**

Question 6 (a) (i)	clear attempt to draw tangent at ≈5±0.5 s or states that gradient = acceleration 2.3 to 2.9 m s^{-2}	**M1** **A1**	**2**
(ii)	falls with time from 0 to 15 s ending at 0 at 11 to 15 s (allow flat part for up to 2 s) start at 9.5 to10 m s^{-2} and their (a) (i) at 5 s	**M1** **A1**	**2**
(b)	distance per square = 5 m (method clearly uses scales) number of squares = 90±2 (or correct use of trapeziums) multiplies number of squares by distance per square or otherwise worthless attempt to determine area under graph **maximum 2 if process is unclear**	**B1** **B1** **B1**	**3**
(c) (i)	8800 (8820)J i.e. 2 x 9.8 x (450 or their (b))	**B1**	**1**
(ii)	½ mv^2 or 38 to 39 m s^{-1} max v used (**not** 8800=½ mv^2) 1440 to 1520 J	**C1** **A1**	**2**

(iii)	PE is not all converted to KE (explicit) some (P)E converted into heat or internal/kinetic energy of air or raises the temperature of the air (condone some PE lost as heat) there is air resistance/drag/friction **or** mentions terminal velocity work is done against resistance when terminal velocity reached KE constant (but PE still changing)	**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**

Question 7 (a) (i)	1.5 x 10^4 sin 35 or 1.5 x 10^4 cos 55 seen = 8603.65 (to 4 sf minimum-no up)	**B1**	**1**
(ii)	11 600 N or 12 000 N	**B1**	**1**
(b) (i)	any 2 from the following for C marks accelerating force = 5600 N mass of cable car = 1530 kg (or 15 000/9.8 seen) $F = ma$ 3.7 m s^{-2} (cnao)	 **C1** **C1** **A1**	**3**
(ii)	$v^2 = u^2 + 2as$ 30 (29.6) m s^{-1} (ecf for acceleration $\sqrt{240 \times acc}$)	**C1** **A1**	**2**
(iii)	any equation of uniformly accelerated motion that includes t 8.1 s (ecf for v or a) (correct substitution leading to answer = their v/a or 240/their v)	**C1** **A1**	**2**

Question 8 (a)	$R = V/I$ 10 Ω	**C1** **A1**	**2**
(b)	total resistance = 6/0.25 = 24 Ω or correct substitution in potential divider formula 14 Ω	**C1** **A1**	**2**
(c)	correct substitution in parallel resistance formula $\frac{1}{R} = \frac{1}{10} + \frac{1}{15}$ or current through 15 Ω = 0.16 A or $R_{\square} = \frac{2.5}{3.5} \times 8.4$ or $2.5 = \frac{R}{R + 8.4} \times 6$ resistance of parallel combination = 6.0 Ω or parallel combination resistance + 8.4 (allow in substitution form) or total current = 0.41 A 14.4 Ω (cnao) {$\frac{1}{\frac{1}{15} + \frac{1}{10}} + 8.4$ = incorrect answer would get C1, C1 (may use incorrect (a) value here}	 **C1** **C1** **A1**	**3**
(d)	identifies circuit with lower or higher total resistance correctly (e.c.f.) power = V^2/R or VI V is same for both so circuit with higher resistance dissipates lower power or V is same for both and circuit with lower current dissipates lower power or reason by means of calculations	**B1** **B1** **B1**	**3**

Question 9 (a)	copper wire	electrons	**B1**	**3**
	copper sulphate solution	ions (not lattice ions/molecules) (condone Cu^+ &SO_4^- (electrons is TO)	**B1**	
	hydrogen gas	electrons or ions(condone H+)	**B1**	
(b)	calculates three resistances correctly (0.05 Ω; 10 Ω; 2 MΩ)		**B1**	**Max 3**
	resistance depends on collisions of charge carriers (with lattice or other ions) **or** collisions make it hard for charge carriers to flow (**note** collisions between electrons is TO)		**B1**	
	in solution ions (are large so) collide frequently with other ions or water molecules		**B1**	
	any two from: resistance depends on density (condone number) of charge carriers (this can be awarded for an answer that suggests effect of charge carrier concentration even if incorrect conclusion)		**B1**	
	in copper there are many electrons/charge carriers		**B1**	
	in hydrogen gas there are relatively few charge carriers		**B1**	

Question 10 (a) (i)	event that happens very quickly or humans can't take readings quickly enough/comment on human reaction (owtte) must have idea of taking readings quickly–not just accuracy	**B1**	**1**
(ii)	40 + samples per second (or interval <1/40 s)	**B1**	**2**
	sensible comment on time comment must relate to: need to sample during initial rise/curved part of graph/during first ≈0.5 s/reference to peak **and** suggest minimum rate of 10 per second	**B1**	

(b)	resistance initially low **so high current**	**B1**	
	temperature of filament increases/filament heats up	**B1**	
	resistance increase with temperature	**B1**	
	when resistance increases the current falls	**B1**	
	steady current when energy produced = energy lost from the filament or when temperature becomes constant	**B1**	**Max 5**
	maximum power/heating/temperature is produced immediately after switching on/when current is highest	**B1**	
	appreciates that failure is due to melting of filament or mechanical failure caused by temperature rise	**B1**	
	when switching on energy produced quicker than it is lost so filament melts	**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**