ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
June 2002

GCE

Physics B

Unit PHB1

Unit 1: Foundation Physics

Notes for guidance

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.

Note: 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.

>   Where an error carried forward (e.c.f.) is allowed by the Marking Scheme for an incorrect answer, e.c.f. must be written on the script if an error has been carried forward.

Instructions to Examiners

1   Give due credit to alternative treatments which are correct. Give marks for what is correct; do not deduct marks because the attempt falls short of some ideal answer. Where marks are to be deducted for particular errors specific instructions are given in the marking scheme.

2   Do not deduct marks for poor written communication. Refer the script to the Awardsmeeting if poor presentation forbids a proper assessment. In each paper candidates may be awarded up to two marks for the Quality of Written Communication in cases of required explanation or description. However, no candidate may be awarded more than the total mark for the paper. Use the following criteria to award marks:

   2 marks: Candidates write with almost faultless accuracy (including grammar, spelling and appropriate punctuation); specialist terms are used confidently, accurately and with precision.

   1 mark: Candidates write with reasonable and generally accurate expression (including grammar, spelling and appropriate punctuation); specialist terms are used with reasonable accuracy.

   0 marks: Candidates who fail to reach the threshold for the award of one mark.

3   An arithmetical error in an answer should be marked A.E. thus causing the candidate to lose one mark. The candidate's incorrect value should be carried through all subsequent calculations for the question and, if there are no subsequent errors, the candidate can score all remaining marks (indicated by ticks). These subsequent ticks should be marked C.E. (consequential error).

4   With regard to incorrect use of significant figures, normally a penalty is imposed if the number of significant figures used by the candidate is one less, or two more, than the number of significant figures used in the data given in the question. Themaximum penalty for an error in significant figures is **one mark per paper**. When the penalty is imposed, indicate the error in the script by S.F. and, in addition, write S.F. opposite the mark for that question on the front cover of the paper to obviate imposing the penalty more than once per paper.

5   No penalties should be imposed for incorrect or omitted units at intermediate stages in a calculation or which are contained in brackets in the marking scheme. Penalties for unit errors (incorrect or omitted units) are imposed only at the stage when the final answer to a calculation is considered. The maximum penalty is **one mark per question**.

6   All other procedures, including the entering of marks, transferring marks to the front cover and referrals of scripts (other than those mentioned above) will be clarified at the standardising meeting of examiners.

Question 1

(a)	vector has direction, scalar has no direction / only vector has direction	B1	**1**
(b)	vector: any vector except force (accept weight)	B1	
	scalar: any scalar	B1	**2**
(c)	$F = ma$ in any form	C1	
	maximum: $1.4\,\text{ms}^{-2}$	A1	
	minimum: $0.29\,\text{ms}^{-2}$	A1	**3**

Question 2

(a)	$a = \Delta v/t$	C1	
	$1.3\,\text{ms}^{-2}$	A1	**2**
(b)	(0,4) and (6,12) both marked (accept axes wrong way round)	M1	
	joined by a straight line **and** axes labelled with quantity or unit	A1	**2**

(c)   distance = area under graph **or** average speed $\times$ time

$$s = \frac{v+u}{2}t \quad / \quad s = ut + \frac{1}{2}at^2 \quad / \quad v^2 = u^2 + 2as \qquad \text{C1}$$

48 m (47.9 m)   **ecf from (a) or (b)**   A1   **2**

Question 3

(a)	$\Delta E_p = mg\Delta h$	C1	
	47 J	A1	**2**

(b)   location limitation e.g. meteorological or geographical   B1
continuous generation limit e.g. no power during drought   B1
environmental damage e.g. displaced population,
damage to habitats or visual pollution   B1   **max 2**
any two suitable answers

Question 4

(a) $V = IR$ seen or used (condone $R = \dfrac{\Delta V}{\Delta I}$ for this mark only)   C1

$I = 1.8\,\text{A}$ and $V = 12\,\text{V}$ C1
$6.7\,\Omega$ A1   **3**

(b)   current = 0 for negative voltages (allow no mark seen on
negative voltage axis if graph drawn for positive)   B1
characteristic curve with steep rise: voltage not exceeding 1V   B1   **2**
allow higher turn on voltages if candidates specify that they
have drawn graph for LED

Question 5

(a) (i)	variable resistor / potentiometer	B1	**1**
(ii)	thermistor / resistance thermometer / resistance wire / thyristor	B1	**1**
(b)	situation and reason (condone lack of detail of parameter		
(c)	being measured. Do not accept data logging example	B1	
	different situation and reason	B1	**2**

(medical examples acceptable providing that the observer is physically separated from what is being measured for suitable reasons)

Total for Section A = 25

Question 6

(a) (i)	force × distance	B1	
	distance is the perpendicular distance (between force and point about which moments are taken	B1	**2**
(ii)	clockwise moment = anticlockwise moment	C1	
	sum of moments is zero (about any point) when the system is in <u>equilibrium</u>	A1	**2**
(b) (i)	any force × distance = any other force × distance	C1	
	$1800 \times 0.35 = F \times 2.5$	C1	
	$250\,\text{N}\ (252\,\text{N})$	A1	**3**
(ii)	$F + F_R = 1800$ or correct moments equation about towbar	C1	
	$1500\,\text{N}\ (1550\,\text{N})$ **ecf from (i)**	A1	**2**
(c)	car pulls trailer (forward) / trailer pulls back on car	B1	
	(new force is created by) air resistance or road friction	B1	
	air resistance or additional towbar force has moment (about P)	B1	**3**

the use of Physics terms is accurate; the answer is fluent/ well argued with few errors in spelling, punctuation and grammar **and** 2 marks for Physics   2

the use of Physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor **and** 1 mark for Physics   1

the use of Physics terms is inaccurate; the answer is disjointed   **max 2**
with significant errors in spelling, punctuation and grammar   0

Total for Question 6 = 14

Question 7

(a) (i)	$v = s/t$	C1		
	19 (18.7) ms^{-1}	A1	**2**	
(ii)	zero tolerate missing unit	B1	**1**	
(iii)	$v^2 = (u^2) + 2as$ $v = u + at$ $s = ut + 1/2at^2$	C1		
	$v = \sqrt{(2 \times 9.8 \times 11)}$	C1		
	15 ms^{-1} / 14.7 ms^{-1}	A1	**3**	

(b) (i)	use of Pythagoras	C1		
	$18.7^2 + 14.7^2 = v^2$ OR $v^2 = \sqrt{(\text{their (a)(i)}^2 + \text{their (a)(iii)}^2)}$	C1		
	24 (23..7 or 23.8) ms^{-1} **ecf**	A1	**3**	
	OR velocities drawn correctly to scale	C1		
	suitable scale used and quoted	C1		
	23 – 25 ms^{-2}	A1		
(ii)	38° to 39° 37° to 40° for scale drawing	B1	**1**	
	ecf $\tan^{-1} \dfrac{\text{their (a) (iii)}}{\text{their (a) (i)}}$			

(c)	when kicked / when landing has max KE	B1		
	has no PE at this point / has max speed and KE = $\frac{1}{2}mv^2$	B1	**2**	
	or loses energy because of (work done against) air resistance	B1		
	total energy greatest just after it's been kicked	B1		

Total for Question 7 = 12

Question 8

(a)	$\left(\dfrac{either R}{R_1 + R_2}\right) \times$ supply voltage or suitable alternative			
	OR $I = V/R_{tot}$ **and** $V = IR_2$	C1		
	use of $R_1 = 2\,000\,\Omega$ and $R_2 = 200\,\Omega$	C1		
	0.54 or 0.55 V	A1	**3**	
(b)	signal is digitised (condone use of ADC)	B1		
	sampled periodically or repeatedly but not continuously	B1		
	assigned binary code (depending on voltage)	B1	**3**	

the use of Physics terms is accurate; the answer is fluent/ well argued with few errors in spelling, punctuation and grammar **and** 2 marks for Physics	2
the use of Physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor **and** 1 mark for Physics	1
the use of Physics terms is inaccurate; the answer is disjointed with significant errors in spelling, punctuation and grammar	**max 2** 0

Total for Question 8 = 8

Question 9

(a) $V = IR$ OR $R = V/I$ **and** 0.13 / 150 or 8.7×10^{-4} seen   B1   **1**
(condone missing unit)

(b) $R = \rho l/A$ C1

$\dfrac{1.6 \times 10^{-8} \times 0.24}{8.7 \times 10^{-4}}$ OR $\dfrac{1.6 \times 10^{-8} \times 0.24}{9 \times 10^{-4}}$ C1

4.27 to $4.4 \times 10^{-6}\, \text{m}^2$ A1   **3**

(c) $I = nAvq$ C1

$\dfrac{150}{1.1 \times 10^{29} \times 4.4 \times 10^{-6} \times 1.6 \times 10^{-19}}$ C1

$1.9 \times 10^{-3}\, \text{ms}^{-1}$ **ecf** 8.5×10^{-9}/their (b)
$(2.0 \times 10^{-3}\, \text{ms}^{-1}$ for those who use $9 \times 10^{-4})$
(allow calculations with or without –ve sign for e)   A1   **3**

Total for Question 9 = 7

Question 10

(a) $P = VI$ OR $P = \dfrac{V^2}{R}$ **and** $V = IR$ OR $P = I^2R$ **and**

$V = IR$ C1
$I = 21/12$ or 1.75 (A)   C1
Divides 15 by their 1.75   C1
8   A1   **4**

    OR max power = 12×15
       Max power = 180
       Max n = 180/21
        8

(b) correct equation given in symbols or words   B1
correct substitution seen (look for 144/21 or 12^2/21 or 12/1.75)   B1   **2**

(c) $\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$ C1

$(1/R_T) = 0.32$ even if they forget to invert   C1
3.1 or $3.2\,\Omega$ A1   **3**

Total for Question 10 = 9