



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

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# Mark scheme January 2004

## GCE

### Physics B

### Unit PHB1

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# Marking Scheme

## 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 Awards meeting 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. Use the following criteria to award marks:
  - 2 marks: Candidates write legibly with accurate spelling, grammar and punctuation; the answer containing information that bears some relevance to the question and being organised clearly and coherently. The vocabulary should be appropriate to the topic being examined.
  - 1 mark: Candidates write with reasonably accurate spelling, grammar and punctuation; the answer containing some information that bears some relevance to the question and being reasonably well organised. Some of the vocabulary should be appropriate to the topic being examined.
  - 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 AE 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 CE (consequential error).
- 4 With regard to incorrect use of significant figures, normally two, three or four significant figures will be acceptable. Exceptions to this rule occur if the data in the question is given to, for example, five significant figures as in values of wavelength or frequency in questions dealing with the Doppler effect, or in atomic data. In these cases up to two further significant figures will be acceptable. The maximum penalty for an error in significant figures is **one mark per paper**. When the penalty is imposed, indicate the error in the script by SF and, in addition, write SF 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.

**PHB1****Section A****Question 1**

1 mark each correct row B3 3

**Question 2**

- (a) attempt to calculate area B1  
 $2.5 \times 24.5 + 0.5 \times 1.0 \times 24.5 = 73.5 \text{ C}$  *condone 73 C* B1 2
- (b) during the test the temperature increases B1  
 wire resistance increases with temperature B1 2

**Question 3**

- (a) two correct weight arrows *with labels* (100N, W)  
*arrows must **act on beam** (horiz. scope: M, 50 m respectively)* B1  
 normal reaction arrow *at pivot point* (with label) B1 2
- (b) Use of  $36 \times$  a distance C1  
 moment = 43.2 Nm ( $36 \times 1.3 = 46.8$ ) A1 2
- (c) clockwise moment = anti-clockwise moment C1  
 $43.2 = 0.40 \times 100 + 0.55w$  M1  
 $w = 5.8\text{N}$  *allow ecf from (b) (46.8 gives 12.4 N)* A1 3

**Question 4**

- (a) Diode or LED B1 1
- (b) Use of  $V/I$  C1  
 $= 1.03$  **OR**  $1.04$  **OR**  $1.0 \Omega$  A1 2  
*correct numerical answer only*
- (c) rectification/description such as “a.c. to d.c.”  
 /demodulation/protection against current surges B1 1

**Question 5**

- (a)  $PE = mgh$  C1  
 $= 41 \times 9.8 \times 3.0 = 1200$  or  $1210 \text{ J}$  A1 2
- (b) (i)  $mgh = 0.5mv^2$  C1  
 $v = 7.7\text{ms}^{-1}$  *or ecf from (a)* A1 2

- (ii)  $F = mg\cos 50$  C1  
 $= 258\text{N}$  A1 **2 24**

**Section B****Question 6**

- (a) a velocity divided by a time C1  
*single* reading from graph of  $v$  in range 54..56 C1  
 acceleration in range 90..93.4  $\text{ms}^{-2}$  A1 **3**
- (b) clear attempt to estimate area under the curve C1  
 use of correct scale factor:  $1\text{cm}^2$  represents  $10 \times 0.2 \text{ m}$  C1  
 max height in range 80..90 m A1 **3**
- (c)  $t^2 = (2 \times \text{answer to (b)})/9.8$  C1  
 expected answer in range 4.0..4.3 s *allow ecf for height* A1 **2 8**

**Question 7**

- (a)  $R = \rho l/A$  or  $\rho = RA/l$  B1  
 $R = 1.1 \times 10^{-6} \times 3.0 / (1.7 \times 10^{-8})$  B1  
 $= 194$  *at least 3sf* B1 **3**
- (b)  $P = V^2/R$  ( $P = (240)^2/190$  or  $(240)^2/194$ )  
**OR** use of  $I = V/R$  and  $P = I^2R$  C1  
 $= 300\text{W}$  ( $303$  or  $297$  respectively) A1 **2**
- (c) (i) power output of  $R_2 = 2 \times$  power output of  $R_1$  ( $= 600 \text{ W}$ ) B1  
 $R_2 = 0.5 \times R_1$   
**OR** use of  $R_2 = V^2/P_2$  and  $l = RA/\rho$  C1  
 length in range 1.47..1.49 m **OR**  $= 1.5\text{m}$   
 ( $900\text{W}$  gives length in range 0.97..0.99 m **= 2 marks**) A1 **3**
- (ii) Use of  $I = P/V$  **OR**  $I = V/R_1 + V/R_2$  C1  
 $I$  in range 3.7..3.8 A A1 **2 10**  
*allow ecf from (b) or (c)(i)* (eg.  $I$  in range 4.9..5.1 A for 900 W)

**Question 8**

- (a) 1200N B1 1
- (b) (i)  $E = 0.5Fx$  C1  
 $= 0.5 \times 1200 \times 0.40 = 240J$  A1 2
- (ii)  $k = E/(0.5\Delta l^2)$  OR  $k = F/\Delta l$  C1  
 $= 240 \times 2/0.16 = 3000$   $= 1200/0.4 = 3000$  A1 2
- (c) (i)  $a = (12.0-6.0)/5.0 = 1.20$  C1  
 use of  $F = ma$  C1  
 increase in T = 84N A1 3
- (ii) the resistive forces increase with speed/velocity B1  
 mention of drag/air resistance/water resistance (**NOT** friction) B1  
 tension increase = accelerating force B1  
 + force equal to extra resistance B1  
 increase in tension produces a forward moment B1  
 skier must lean (further) backwards B1  
 to produce a balancing moment M1  
 using his/her body weight A1  
 lower centre of gravity/mass (also) increases stability B1  
**Max 5, at least 2 from each group** 5

**QWC marks:**

- accurate use of physics terms, fluent well-argued prose,  
 good punctuation and grammar + **at least 3 physics marks** 2
- OR** accurate use of physics terms in comprehensible prose but  
 poor spelling/grammar + **at least 1 physics mark** 1
- OR no marks for the physics** and/or very disjointed  
 prose with poor spelling 0 15

**Question 9**

- (a) as the temperature of T increases its resistance decreases B1  
 /more charge carriers are released B1  
 increasing the current in the circuit 2  
 /changing the ratio of resistance/reducing pd across T  
 (so that so that the pd across the resistor increases)
- (b)  $T/20.0 = 1.0/5.0$  OR  $5.0/6.0 = 20/(20+T)$  OR equivalent M1  
 (Therefore T = 4.0 ohms)  
*Note T = (1/5)20 just ok but T = 20/5 not enough* 1
- (c) Use of  $V_{out} = R_1/(R_1 + R_2) \times V_{in}$  OR  $I = 6/44.5 = 0.135$  A C1  
 $V = 2.7$  V A1 2

- (d) (i)  $V/6.0 = 20.0/(20.0+4.0+3.0)$  **OR**  $I = 0.222$  A C1  
 $V = 4.4$ V A1 **2**
- (ii) The measure temperature would be lower because the pd across the resistor would be less (*ie 2.53V*) B1 **1 8**

**Question 10**

- (a) sketch graph of a reasonable analogue signal B1  
 sketch graph of a square waveform B1  
**showing clearly only two (voltage) levels** B1  
 comment to the effect that analogue signals are continuous B1  
 whereas digital signals are discrete B1  
*accept good reference to 0s and 1s and/or binary* B1 **4**
- (b) signal strength falls **with distance** *accept power/energy loss* B1  
 this is called attenuation B1  
 the reason is energy loss due to the **heating effect/ $I^2R$  effect** B1  
 using superconductors reduces resistance and therefore heating B1
- noise/random electrical energy/**electrical** interference  
 may get added to the signal B1  
 this could be from e-m induction/thunderstorms  
 /other named cause B1  
 it is easier to remove noise from digital signals B1
- both types of signal can be **boosted** B1  
 digital signals can travel further before they need boosting B1  
**digital signals** are boosted by **regenerators** B1  
**analogue signals** are boosted by **repeaters/amplifiers**  
*accept amplification* B1
- metal cables are vulnerable tapping B1
- replacing metal cables with optical fibres  
 addresses all of these problems B1
- Don't credit radio transmission as a solution*
- any 4 points from the list including a reference to two problems* **4**

**Notes** If a candidate implies a valid problem without gaining the mark associated with stating it, the other marks relating to it can still be awarded.

**3 marks max** if only **one problem** given; **no problem = no marks**

**QWC marks:**

- accurate use of physics terms, fluent well-argued prose,  
 good punctuation and grammar + **at least 2 physics marks** **2**
- OR** accurate use of physics terms in comprehensible prose but  
 poor spelling/grammar + **at least 1 physics mark** **1**
- OR no marks for the physics** and/or very disjointed  
 prose with poor spelling **0 10**