ASSESSMENT and QUALIFICATIONS ALLIANCE

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 x 24.5 + 0.5 x 1.0 x 24.5 = 73.5 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 x a distance	C1
	moment = 43.2 Nm *(36 x 1.3 = 46.8)*	A1 **2**
(c)	clockwise moment = anti-clockwise moment	C1
	43.2 = 0.40 x 100 + 0.55w	M1
	w = 5.8N *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 Ω	
	correct numerical answer only	A1 **2**
(c)	rectification/description such as “a.c. to d.c”	
	/demodulation/protection against current surges	B1 **1**

Question 5

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

	(ii)	F = mgcos50	C1		
		= 258N	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 ms^{-2}	A1	**3**	
(b)	clear attempt to estimate area under the curve	C1		
	use of correct scale factor: $1cm^2$ represents 10 x 0.2 m	C1		
	max height in range 80..90 m	A1	**3**	
(c)	t^2 = (2 x 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 = ρl/A or ρ = 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		
		= 300W *(303 or 297 respectively)*	A1	**2**	
(c)	(i)	power output of R_2 = 2 x power output of R_1 *(= 600 W)*	B1		
		$R_2 = 0.5 \times R_1$ **OR** use of $R_2 = V^2/P_2$ and l = RA/ρ	C1		
		length in range 1.47..1.49 m **OR** = 1.5m *(900W 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 *allow ecf from (b) or (c)(i) (eg. I in range 4.9..5.1 A for 900 W)*	A1	**2**	**10**

Question 8

(a)		1200N	B1	**1**
(b)	(i)	E = 0.5Fx	C1	
		= 0.5 x 1200 x 0.40 = 240J	A1	**2**
	(ii)	$k = E/(0.5\Delta l^2)$ **OR** $k = F/\Delta l$	C1	
		= 240 x 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 + 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 /more charge carriers are released	B1	
	increasing the current in the circuit /changing the ratio of resistance/reducing pd across T	B1	
	(so that so that the pd across the resister increases)		**2**
(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 Vout = $R_1/(R_1 + R_2)$ x Vin **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 **showing clearly only two (voltage) levels**	B1	
	comment to the effect that analogue signals are continuous 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**