ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme January 2002

GCE

Physics B

Unit PHB1

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. 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).

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.

Only **one** unit penalty (u.p.) in **Section A** and **one** unit penalty in **Section B** of this paper.

Only **one** significant figure penalty (s.f.) in **Section A** and **one** significant figure penalty in **Section B** of this paper. Allow 2 or 3 s.f. unless otherwise stated.
Significant figure penalties include recurring figures and fractions for answers

Section A: 25 marks

Question 1

	resistance drops to zero (or equivalent statement about current)	B1	
	temperature reduced below transition or critical temperature (not 'low temperature')	B1	
	[powerful electromagnets +] application [medical/computers/etc]	B1	**3**

Question 2

(a)		indication of complete circuit with correct components must show variable resistor/pot divider/variable power supply circuit to be complete thermistor symbol or resistor labelled 'thermistor' can omit ammeter/voltmeter here	B1	
		voltmeter correctly placed	B1	
		ammeter correctly placed	B1	**3**
(b)	(i)	$V = (6/1000) \times 2000$	C1	
		$= 12$ V	A1	**2**
	(ii)	correct readoff	B1	
		power $= I \times V$	M1	
		$= 0.34 \times 10^{-3} * 12 = 4.1$ mW [e.c.f. from I]	A1	**3**
(c)		decrease in resistance	B1	
		more charge carriers released at high temperature	B1	**2**

Question 3

(a)	equilibrium statement	B1	
	clockwise moment = anticlockwise moment	B1	
	sum of anticlockwise moments = sum of clockwise	B1	**3**
(b)	attempt to use moment formula [force x distance is needed as minimum]	B1	
	$T \times 0.03 = 5.0 \times 0.24 + 2.0 \times 0.47$	B1	
	$= 1.20 + 0.94 = 2.14$ N m; T = 71 N (71.3)	B1	**3**

Question 4

tension = 210 cos 30 **or** = 210 sin 30	C1	
both calculated correctly [B = 182 N; C = 105 N]	C1	
either calculation correctly attributed to T_B or T_C	A1	**3**

Question 5

use of mg with $g = 9.8$[use of g 10 –1]	B1	
energy = ½ F l= ½ $(1200 \times 9.8) \times 0.03$	M1	
= 180 J [176] [omission of g will score only 1]	A1	**3**

Section B

Question 6

(a)	charge = area under graph of current vs time for 1 s	B1	
	area of one triangle correctly calculated (0.02 C)	B1	
	= 0.1 C in one second because 5 triangles	B1	**3**
	[allow full credit for counting squares approach]		
(b)	read-off 0.15 – 0.16 A	B1	
	so $V = 0.15 \times 50 = 7.5$ V	B1	
	read-off as 0111	B1	**3**
			Total 6

Question 7

(a)	(i)	$270 \times 4 = 1080$ kN	B1	**1**
	(ii)	$F=ma$	M1	
		$a = F/m = 1080000 / 320000 = 3.38$ [3.375] [m s^{-2}]	A1	**2**
		allow ecf from (ai)		
(b)	(i)	$t = v / a = 90 / 3.37$ e.c.f.	B1	
		= 26.7 s	B1	**2**
	(ii)	effective force = $ma = 320\,000 \times 2 = 640$ kN	C1	
		friction is difference between engine thrust and effective force so frictional force = 1080 – 640 = 440 kN	A1	**2**
(c)		$2as = v^2$	B1	
		leading to 2.03 [2.025] km	B1	**2**
(d)		$t = v – u / 2 = (260 – 90) / 2$	B1	
		= 85 s	B1	**2**
(e)		level because lift = weight	B1	
		zero acceleration because thrust = drag	B1	
		no resultant force in either direction OR clear ‘equal and opposite’ statement	B1	**3**
		the use of Physics terms is accurate; the answer is fluent/well argued with few errors in spelling, punctuation and grammar. **(must gain at least 2 for Physics)**	2	
		the use of Physics terms 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 Physics terms is inaccurate; the answer is disjointed with significant errors in spelling, punctuation and grammar	0	**max 2**
				Total 16

Question 8

(a)		$I = P / V = 48 / 12 = 4.0$ A	B1	**1**
(b)	(i)	0.5 A *ecf their (a)/8*	B1	**1**
	(ii)	$R = V / I = 12 / 0.5$ = 24 ohm	M1 A1	**2**
(c)	(i)	candidate (a) value	B1	**1**
	(ii)	1.50 / 4 = 0.37(5) ohm [ecf]	M1 A1	**2**
(d)		failure of one element breaks whole unit	B1	**1**
(e)	(i)	ohm-metre [allow correct symbols]	B1	**1**
	(ii)	$= RA / l$ [$= 0.375$ (e.c.f.) $\times (3.0 \times 10^{-3}) \times (0.12 \times 10^{-3}) / 0.75$] $= 1.8 \times 10^{-7}$ [Ω m]	M1 A1	**2**

Total 11

Question 9

(a)		$4900 \times 60 \times 60 \times 24 = 4.2(3) \times 10^8$ J	B1	**1**
(b)	(i)	$55000 \times 1.2 \times 1100 = 7.26 \times 10^7$ kg	B1	
	(ii)	$\Delta P_E = mgh = 7.26 \times 10^7 \times 9.8 \times 0.6$	B1	
		$= 4.3\ [4.27] \times 10^8$ J [ecf from $h = 1.2$ m]	B1	
	(iii)	$4.27 \times 10^8 \times 2 / 4 = 2.1\ [2.13] \times 10^8$ J [i.e. uses two tides per day]	B1	
		ecf *their value for (bii)/2*		
(c)	(i)	Sensible mention of internal resistance of panel	B1	
		open-circuit ≡ no load/no current drawn/emf measured as terminal p.d.	B1	
		terminal p.d. = emf – energy required to draw current through panel/lost volts	B1	**3**
	(ii)	assume 10 h of energy production per day [allow 4 – 20 h]	B1	
	(iii)	$2.1 \times 10^8 / (10 \times 60 \times 60) \times 1000$ [= 5.83 kW]	C1	
		so $5.83 / 0.25 = 23.3$ m^2 of panel required [allow range 58 – 12 m^2]	A1	
(d)		advantage of solar	B1	
		disadvantage of solar	B1	
		advantage of wind	B1	
		disadvantage of wind	B1	**4**
		the use of Physics terms is accurate; the answer is fluent/well argued with few errors in spelling, punctuation and grammar. **(must gain at least 3 for Physics)**	2	
		the use of Physics terms 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 Physics terms is inaccurate; the answer is disjointed with significant errors in spelling, punctuation and grammar	0	**max 2**
		Tabulation can only score 1 in spg		
				Total 15