ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme January 2002

GCE

Physics B

Unit PHB2

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

1				
(a)		$v = f\lambda$ or 330/512	C1	
		0.64(5)m	A1	2
(b)	(i)	very approximately size of doorway is same as λ of note	B1	1
	(ii)	$\sin\theta = \lambda/b$ seen	C1	
		$\theta = \sin^{-1}$(answer to (a)/ 0.81) or $\sin\theta$ = ans to (a)/0.81	C1	
		52.7^o / 52.8^o / 52.2^o / 53^o	A1	3
2				
(a)	(i)	mention of radioactivity/decay/nuclear radiation	B1	
		ever present/independent of source being in proximity/always there/cannot be eliminated	B1	2
	(ii)	radon/rocks/cosmic rays/nuclear fallout / medicine / space / sun	B1	1
(b)		A – activity/rate of decay	B1	
		λ - decay constant/probability of decay	B1	
		N – number of nuclei (radioactive atoms) present not number of isotopes/atoms/particles	B1	3
3				
(a)		source/scatterer/detector labelled	**M1**	
		vacuum	A1	
		(thin/gold/metal) foil	A1	3
(b)		some backscattered ($>90^o$) => α's and nuclei both +ve	B1	
		few deflections/most pass through ∴ nuclei small	B1	2
4				
(a)		wave speed is very much greater than source speed	B1	1
(b)	(i)	substitution condone missing 0.5	C1	
		10.9/11.0ms^{-1} condone 21.9 ms^{-1}	A1	2
	(ii)	correct answer without power considered	C1	
		2.5 x 10^3 Hz	A1	2
5		2 quarks	M1	
		down and anti-up	A1	
		$-1/3 + (-2/3) = -1$	A1	3

Section B: 50 marks

6

(a)

-1/3 → +2/3 –1 + 0	condone	B1	
0 → 0 +1 –1	missed	B1	
+1/3 → +1/3 + 0 + 0	zeros	B1	3

allow +2/3 –1 ok
allow +1 –1 ok
not 1/3 ok

(b)

diagram of method based on range/absorption/deflection	B1	
explanation of what is being done	B1	
detector named	B1	
differentiation of α,β and γ i.e. clearly β alone	B1	4
cloud chamber diagram	B1	
sensible description of tracks of β's	B1	
no other type of track present	B1	

max 3 (+2) for cloud chamber

The use of physics terms is accurate, the answer is fluent/ well argued with few errors in spelling, punctuation and grammar. The candidate must have scored at least 3 marks for physics to access this.	**2**
The use of physics terms is accurate, but the answer lacks coherence or the spelling, punctuation and grammar are poor. The candidate must have scored at least 2 marks for the physics to access this.	**1**
The use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar.	**0**
	MAX 2

(c) (i) $1.24\text{-}1.26 \times 10^{-13}$ J B1 1

(ii) energy is shared between electron and antineutrino B1
total energy is constant/ range of β energies B1 2

Total mark 12

7

(a)		tension – newtonmeter	B2	
		or tension – from mass on balance B1		
		and – multiply by g B1		
		mass – balance/scales	B1	
		length – rule/tape/ruler	B1	4
(b)		frequency read from signal generator when standing wave produced/use of strobe etc.	B1	
		measure λ using several loops or full length of string	B1	
		node → node/ each loop = $\lambda/2$	B1	
		use of $c = f\lambda$	B1	4
(c)		$\lambda = 0.40$ (m)	C1	
		$c = 60.8$ (ms^{-1}) e.c.f. from λ	C1	
		$T = 7.06$ (N)	C1	
		$\mu = 1.9(1) \times 10^{-3}$ ($kg\ m^{-1}$) c.a.o.	A1	
		m = 2 x μ value (= 3.8×10^{-3} kg or equivalent unit) e.c.f. s.f.p. applied only at this answer	B1	5
				Total mark 13

8

(a)		filament lamp/sun etc.	B1	1
(b)	(i)	$d = 1.0 \times ^{-4}$ m	C1	
		use of $\lambda = d\sin\theta$ or substituted values	C1	
		$\theta_1 = 0.286^o$ /0.29^o	A1	3
	(ii)	$\Delta\theta = 0.115^o$ (c.a.o.)	B1	1
	(iii)	width = 4.0×10^{-3} m or 3.9×10^{-3} m (e.c.f. for 2 x sin (b(ii)) or 2 x tan (b(ii)); allow 1 s.f.)	B1	1
(c)		lower intensity	C1	
		because energy spreads	C1	
		use or statement of inverse square law	C1	
		ratio 0.16 or falls by factor of 6.25 c.a.o.	A1	4
				Total mark 10

9

(a)	(i)	continuously (continually) varying (changing) quantity/voltage/amplitude	B1	
		mention of frequency	M1	
		range of frequencies or highest f - lowest f	A1	3
	(ii)	human hearing 20 Hz – 15-20 kHz (or range 15-20 kHz)	B1	
		telephone bandwidth much smaller	B1	
		full bandwidth not needed for acceptable communication	B1	3
(b)	(i)	$f = 1/T$	C1	
		1250 Hz	A1	2
	(ii)	2 x (b)(i) answer (e.c.f.) allow 2500 Hz but otherwise s.f.p.	B1	1
	(iii)	capacity of transmission medium usually much greater than that needed for single signal/**spare capacity**	B1	
		digital or sampled signals used	B1	
		each signal broken into a fixed **chunks (of data)**	B1	
		sent sequentially	B1	
		each signal recompiled	B1	
		need for synchronisation	B1	max 4

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The use of physics terms is accurate, but the answer lacks coherence or the spelling, punctuation and grammar are poor. The candidate must have scored at least 2 marks for the physics to access this.	**1**
The use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar.	**0**
	MAX 2

Total mark 15