AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Physics B

Unit PHB2

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Registered address AQA, Devas Street, Manchester M15 6EX. *Dr Michael Cresswell Director General*

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.

PHB2

Section A

Question 1

(a)	A	B1	
(b)	D	B1	**2**

Question 2

(a)	Three quarks mentioned; at least one u, one d	C1	
	udd	A1	**2**
(b)	hadron	B1	
	baryon	B1	**2**

Question 3

	Two of	B1	
	Mass or mass/unit length	B1	
	Tension		
	Length		
	Temperature		**2**

Question 4

	use of r^2	C1	
	$P = 1.4 \times 10^3 \times 4 \times 3.14 \times (1.5 \times 10^{11})^2$	C1	
	$= 3.96 \times 10^{26}$ W	A1	**3**

Question 5

	Anti-neutrino indicated appropriately	B1	
	Beta **0, and -1**	B1	
	Tl **81** Pb**208**	B1	**3**

Question 6

(a)	(i)	continuous range of frequencies not discrete frequency	B1		
	(ii)	glowing/incandescent/white hot body /example of same	B1	**2**	
(b)		absorption OWTTE	B1		
		absence of light at dark line correct reason	B1	**3**	

Question 7

(a)		Constant/zero phase difference/in phase	B1		
		same frequency/wavelength	B1	**2**	
(b)	(i)	mention of interference	C1		
		describes constructive interference **OR** destructive interference **OR** discusses path difference	A1		
	(ii)	[$\lambda D/d$] 0.77*65/8.5	C1		
		=5.9 [5.89] m	A1	**4**	**25**

Section B

Question 8

(a)	longitudinal	B1		
(b)	reflection	B1		
(c)	use of *speed = distance/time*	C1		
	(0.45 **or** 0.9)/1.6 × 10^{-4} **or** 0.45/0.8 × 10^{-4}	C1		
	= 5.6 km s^{-1} [5.625]	A1	**5**	

Question 9

(a)	One benefit	B1		
	Second benefit	B1		
	One drawback	B1		
	Second drawback	B1		
	states physical principle of one of above [notate ✓^{p}]	B1		

(b)	Use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar		B2		
	And gains at least 3 marks for physics		B1		
	Use of physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor				
	and gains at least 1 mark for physics		B0		
	Use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar			**7**	
	(i)	Stated technique (e.g. ultrasound)	B1		
	(ii)	Explanation of how technique overcomes limitation	B1	**2**	**9**

Question 10

(a)	Appropriate method		B1		
	sensible and correct readoffs		B1		
	correct evaluation from readoffs		B1	**3**	
(b)	correct readoff on *y*-axis		B1		
	use of $\lambda = A/N$		C1		
	correct evaluation from readoff [condone use of 6.0 here]		A1	**3**	**6**
	or determines $T_{1/2}$ /uses $T_{1/2} = 0.69/\lambda$ /$\lambda = 0.69/725$				

Question 11

(a)	correct use of parsec conversion		C1		
	correct use of $v=Hd$		C1		
	$= 9.43 \times 10^6$		A1	**3**	
(b)	(i)	use of $\Delta\lambda/\lambda = v/c$	C1		
		$\Delta\lambda = 5.8 \times 10^{-7} \times 9.43 \times 10^6/3 \times 10^8$	C1		
		$= 18.2 \times 10^{-9}$ m	A1	**3**	
	(ii)	**adds** wavelengths… correctly; cand ans to b + 580.0 [ecf]	C1		
			A1	**2**	**8**

Question 12

(a)	Separation = 1/630000		B1	**1**
(b)	(i)	quote $n\lambda = d \sin\theta$	C1	
		$\lambda = 1.59 \times 10^{-6} \times \sin(25.4)$	C1	
		$= 6.8 \times 10^{-7}$ m or 6.8×10^{-4} mm	A1	**3**
	(ii)	Central maximum/zeroth order mentioned	B1	
		Central maximum is white	B1	
		Describe/draw $1^{st}/2^{nd}$ orders colours in correct order	B1	
		Third order overlap	B1	
		symmetry of pattern		
		dispersion change		
		fainter away from centre	**Max 4**	**8**

Question 13

(a)	(i)	$\lambda = 3 \times 10^8/1.5 \times 10^9$	C1	
		$\lambda = 0.20$ m	A1	**2**
	(ii)	$\theta/2 = \sin^{-1}$ (or $\tan^{-1}$) 3500/36000 **or** $\theta = \sin^{-1}$ 7000/36000	C1	
		= sin-1 (0.098) = 5.6° so θ = 11.2°	A1	**2**
	(iii)	b = 0.2 /0.098	C1	
		[ecf ai/0.5 × sin (aii); condone use of θ or $\theta/2$]		
		= 2.0(4) m [condone use of 5.6° c.f. from aii]	A1	**2**
	(iv)	satellite small /need to concentrate energy on it so θ small too/less diffraction with bigger dish	B1	**1**
(b)	binary code/01 etc. required		B5	
	many samples transmitted down same channel or at same frequency/in short period of time			
	sampling process required			
	signals transmitted in sequence			
	good description or diagram of process			
	method is secure			
	cheaper/lighter/more efficient than multi-transmitter/more satellites without tdm			
	considers bandwidth or bit rate issue			
	calculates no of channels available from reasonable estimates of bandwidth and frequency range		**Max 5**	**5**

Use of physics terms is accurate, the answer is fluent/well argued with few errors in spelling, punctuation and grammar **And gains at least 3 marks for physics**	B2	
Use of physics terms is accurate but the answer lacks coherence or the spelling, punctuation and grammar are poor **and gains at least 1 mark for physics**	B1	
Use of physics terms is inaccurate, the answer is disjointed with significant errors in spelling, punctuation and grammar	B0	**14**