GCE

Physics B

Unit PHB2

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**

                                                                                         B1

    (b)   absorption OWTTE   B1

        absence of light at dark line   B1   **3**
        correct reason

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   A1
                      interference **OR** discusses path difference

              (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** $0.45/0.8 \times 10^{-4}$ 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   B2
             with few errors in spelling, punctuation and grammar
             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 1st/2nd 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 $\theta = 11.2°$ 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   B2
with few errors in spelling, punctuation and grammar
And gains at least 3 marks for physics
Use of physics terms is accurate but the answer lacks coherence   B1
or the spelling, punctuation and grammar are poor
and gains at least 1 mark for physics
Use of physics terms is inaccurate, the answer is disjointed with   B0
significant errors in spelling, punctuation and grammar   **14**