



A-level  
**Physics**

7408/3BB Paper 3 Section B Medical Physics

Report on the Examination

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## General Comments

Overall, the paper proved more accessible than the previous year's paper, with a significant increase in the mean mark achieved and a very small proportion of any questions left not attempted. In general, calculation questions were answered much more successfully than non-calculation questions. This was the case both when a question was looking for recall of knowledge and in application questions.

### Question 1

01.1 The majority of student were able to correctly identify the defect of vision, most of whom used the correct medical term, myopia.

01.2 Around a third of students gained both marks on this calculation. For the majority of those who gained one mark, it was due to an incorrect sign leading to a positive power for the lens. There was also a small number of students who gave their answer as a fraction and hence lost a mark.

01.3 This was the first time this aspect of the specification has been examined, and around half of the students selected the correct answer.

### Question 2

This question exemplifies the general comments above comparing students' success with quantitative versus qualitative questions.

02.1 This multi-step calculation was handled well, with almost half of the students gaining full marks. A further 20% of students lost only one mark, most commonly due to use of a factor of 0.60 rather than 0.40 when finding the reduced intensity, within an otherwise correct approach. Those students who were not able to progress beyond a single mark generally displayed confusion about the difference between intensity and intensity level and were unable to substitute valid data into the relevant equation.

02.2 This was poorly answered, with around 70% of students failing to gain either mark despite very similar questions having been asked in previous series. Many students gave very vague answers about hearing loss, or focussed on the anatomy of the ear, describing how that would be affected rather than describing the impact of that damage on the person's hearing.

A significant proportion of students did not appear to have a clear understanding of the difference between frequency and intensity level in this context. Comments about hearing loss being maximum at 110 dB, or sounds of 110 dB needing to now be louder were common, often even referring to this as the frequency of the sound. Many students also suggested that hearing loss would be at a maximum at the frequency of the sound that caused it, rather than at 4000 Hz.

### Question 3

03.1 The majority of students gained at least one mark here, identifying coherent and non-coherent bundles as the two types of bundles used in endoscopy. Many then went on to describe the fibre arrangement, which was not necessary in answering the question. Clear descriptions of the functions, however, were required for the subsequent marking points, and lots of students accessed a second mark by giving at least one of these clearly. For the coherent bundle, as in previous series, 'transmission of light' was considered an insufficient description of the function. Answers needed to make it clear that

the light was being transmitted into the body for the purpose of illumination in order for a mark to be awarded.

The discussion of the requirement for a cladding was less well answered, with just over a third of students gaining 3 or 4 marks. The common misconception highlighted by this question is that total internal reflection will not occur unless there is a cladding on a fibre, with many students arguing on this basis that both bundles would require cladding.

It was clear from responses that students have learnt about several purposes of cladding on optical fibres, and the challenge of this question was to determine which purpose was relevant in this context. In the most successful answers students had recognised that the important issue was whether or not light would be able to pass between the individual fibres in a bundle.

03.2 The 6-mark levels of response question proved significantly more accessible to students than that of the previous year, although fewer than 10% of students achieved the top band of marks.

The most commonly awarded marks were for the first area, with many students successfully recalling at least one method used to reduce dispersion in communication optical fibres. Mono-mode fibres, monochromatic light and repeaters were all commonly mentioned, but surprisingly few students mentioned the use of a cladding with a refractive index close to that of the core. Some students fell into the trap of describing everything they could about modal and material dispersion without applying their knowledge to the specifics of the question, spending a long time addressing only this first area.

When discussing why the methods to reduce dispersion are not required in an endoscope, the most commonly awarded mark was for recognising that endoscopes are much shorter than typical communication fibres. Very few students attributed the difference in design requirements to being due to endoscopes transferring an analogue rather than a digital signal, or the vastly different rate of data transfer. However, some good discussion of these factors was seen in the more successful and considered responses.

In the third area, marks were gained across the range of marking points. The more thoughtful responses clearly linked the effects of using these methods to their potential impact on the function of the endoscope in terms of successful treatment or diagnosis.

#### **Question 4**

04.1 Despite this being a straightforward recall question it was very poorly answered with only a fifth of students gaining both marks and almost half of students not being awarded any. Many students seemed to have no clear understanding of the difference between physical and biological half-lives, giving a generic half-life definition, often with reference to decay of the fluorine-18.

Of those students who did realise that a biological mechanism was at work, a significant number referred to chemical processes within the body. These answers erroneously implied that chemically 'breaking down' the tracer within the body would reduce the activity or mass of the fluorine-18, rather than recognising that the reduction in mass is due to removal of the nuclei from the body.

04.2 The vast majority of students gained at least one mark on this calculation, with over a third obtaining the full three marks. Students were successful with both routes shown in the mark scheme and neither one proved significantly more popular. The question provided data in mixed units, both

minutes and hours. Students were generally very successful in using consistent units in their processing of the data; errors in this were rare.

Many of the students who gained two marks did so through using only the physical half-life rather than calculating the effective half-life. This confirmed the poor understanding of the different half-lives shown in 04.1.

Those students who were unable to secure the higher marks often tried to estimate a remaining percentage by interpolating between whole numbers of half-lives rather than calculating a percentage accurately by using relevant equations.

04.3 This was another example of a poorly answered recall question. A proportion of students demonstrated some knowledge, identifying the emission of positrons but failing to mention the accompanying neutrinos. However, many students did not recognise that for use in a PET scanner, the fluorine-18 must be a positron emitter and gave answers that were completely incorrect rather than incomplete.

A small number of students lost the mark by failing to pay attention to the command word ‘name’ and giving symbols for the particles instead.

04.4 In order to answer this question successfully, students had to deduce that the particles produced in this step would be travelling at the speed of light, and then use this speed in their calculations. Those students who recognised this generally went on to gain the higher marks, whilst those who didn’t were limited in their progress.

## **Question 5**

05.1 Whilst there were some very good answers, explaining incredibly clearly the role of the backing material within the process of an ultrasound scan, there were many students who simply did not demonstrate the correct knowledge. Fewer than a quarter of students gained both marks.

05.2 The vast majority of students accessed at least one mark, usually by calculating the acoustic impedance of the muscle. Over three-quarters of students then used the correct equation to calculate the percentage of the ultrasound that would be reflected, but the majority omitted the final step of the calculation and did not find the percentage transmitted.

## **Mark Ranges and Award of Grades**

Grade boundaries and cumulative percentage grades are available on the [Results Statistics](#) page of the AQA Website.