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Centre number

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Candidate signature

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I declare this is my own work.

# A-level PHYSICS

## Paper 3 Section B Medical physics

Monday 17 June 2024

Morning

Time allowed: The total time for both sections of this paper is 2 hours. You are advised to spend approximately 50 minutes on this section.

### Materials

For this paper you must have:

- a pencil and a ruler
- a scientific calculator
- a Data and Formulae Booklet
- a protractor.

### Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 35.
- You are expected to use a scientific calculator where appropriate.
- A Data and Formulae Booklet is provided as a loose insert.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
<b>TOTAL</b>	



J U N 2 4 7 4 0 8 3 B B 0 1

1B/M/Jun24/E8

**7408/3BB**

**Section B**Answer **all** questions in this section.**0 1 . 1** A human eye has a far point of 6.0 m.

State the name of this defect of vision.

**[1 mark]**

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**0 1 . 2** Calculate the power of the correcting lens required for this eye.**[2 marks]**

power = \_\_\_\_\_ D

**0 1 . 3** An eye with astigmatism requires the following prescription:

-4.00    -0.75    ×30

Which row identifies the meaning of each number?

Tick (✓) **one** box.**[1 mark]**

-4.00	-0.75	×30	
axis	cylinder	spherical	<input type="checkbox"/>
cylinder	axis	spherical	<input type="checkbox"/>
spherical	cylinder	axis	<input type="checkbox"/>
cylinder	spherical	axis	<input type="checkbox"/>

**4**

0 2 . 1

A stadium is full of spectators. The peak sound-intensity level at the centre of the stadium is 110 dB.

On another occasion the number of spectators in the stadium is reduced by 60%.

Estimate the peak sound-intensity level at the centre of the stadium.

You should assume that on both occasions:

- the sound intensity produced by each spectator is the same
- the spectators are distributed evenly around the stadium.

[4 marks]

peak sound-intensity level = \_\_\_\_\_ dB

0 2 . 2

Describe the changes to a person's hearing that may result from **prolonged** exposure to sound at 110 dB.

[2 marks]

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6

Turn over ►



03.1

Name the two types of optical fibre bundle used in an endoscope.

Go on to discuss whether the optical fibres in either of these bundles require cladding.

**[4 marks]**

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03.2

Modal and material dispersion can cause problems in fibre-optic communications.

Discuss why the methods used to reduce modal and material dispersion are not required in an endoscope.

In your answer you should:

- describe the methods used to reduce dispersion in an optical fibre used for communication
- explain why the methods are not required in an endoscope
- explain how using these methods in an endoscope would affect its function.

**[6 marks]**

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0 4

Fluorine-18 has a biological half-life of 6.0 hours.

0 4 . 1

Explain what is meant by this statement.

**[2 marks]**

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In a PET scan, fluorine-18 is used as a tracer and is injected into the person being scanned.

0 4 . 2

The physical half-life of fluorine-18 is 110 minutes.

Calculate the percentage of fluorine-18 that remains in the person 4.0 hours after it is injected.

**[3 marks]**

percentage = \_\_\_\_\_ %

0 4 . 3

Name the particles emitted when a fluorine-18 nucleus decays.

**[1 mark]**

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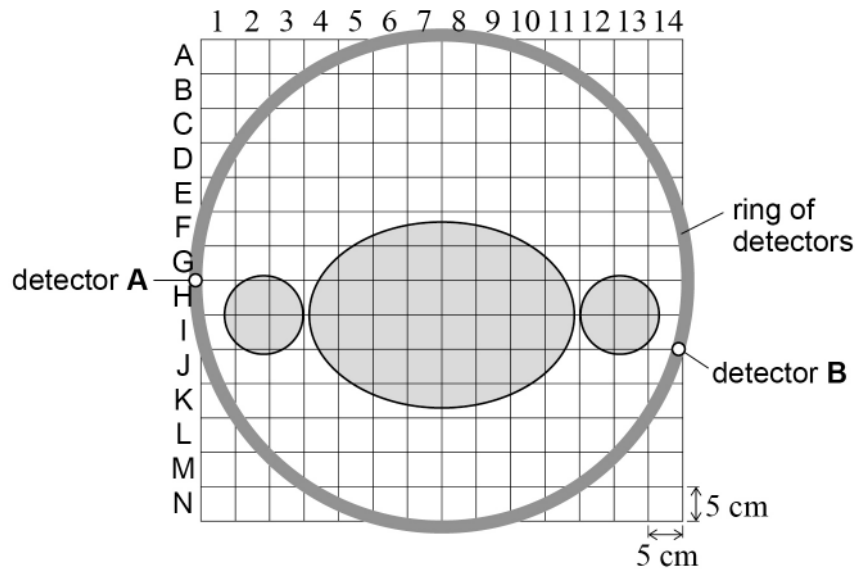


0 4 . 4

**Figure 1** shows the cross-section of a body inside a ring of detectors during a PET scan.

The side of each square represents 5 cm.

**Figure 1**



One of the products from the fluorine-18 decay goes on to produce two new particles. These particles travel in opposite directions in the plane shown in **Figure 1**.

The particles are then detected by the detectors labelled **A** and **B**.

Detector **A** detects a particle 0.79 ns before detector **B**.

Determine the square in **Figure 1** in which the particles were produced.

You should identify the square with a letter and a number, eg B5.

**[4 marks]**

square = \_\_\_\_\_

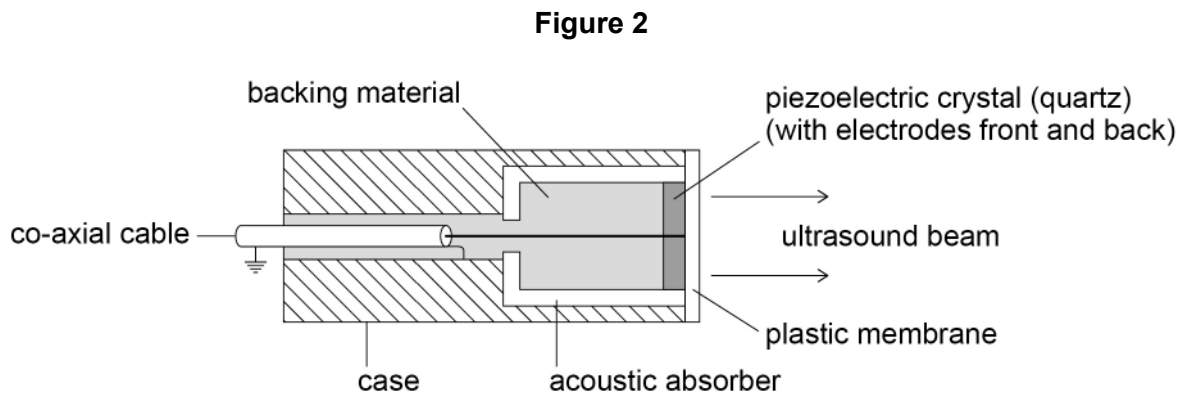
10

Turn over ►



0 5 . 1

**Figure 2** shows a transducer used in a medical ultrasound scanner.



Explain why a backing material is used.

**[2 marks]**

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0 5 . 2 A beam of ultrasound is transmitted from muscle into bone.

Calculate the percentage of the incident intensity that is transmitted.

acoustic impedance of bone =  $5.3 \times 10^6 \text{ kg m}^{-2} \text{ s}^{-1}$

density of muscle =  $1100 \text{ kg m}^{-3}$

speed of ultrasound in muscle =  $1600 \text{ m s}^{-1}$

[3 marks]

percentage = \_\_\_\_\_ %

5

END OF QUESTIONS



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outside the  
box*

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ANSWER IN THE SPACES PROVIDED**





