

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

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	
TOTAL	



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

1B/M/Jun24/E8

7408/3BB

Section BAnswer **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]

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	☐
cylinder	axis	spherical	☐
spherical	cylinder	axis	☐
cylinder	spherical	axis	☐

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]

Turn over ►



[illegible]



[illegible]

Turn over ►



0	4
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Fluorine-18 has a biological half-life of 6.0 hours.

0	4	.	1
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Explain what is meant by this statement.

[2 marks]

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

0	4	.	2
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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
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Name the particles emitted when a fluorine-18 nucleus decays.

[1 mark]

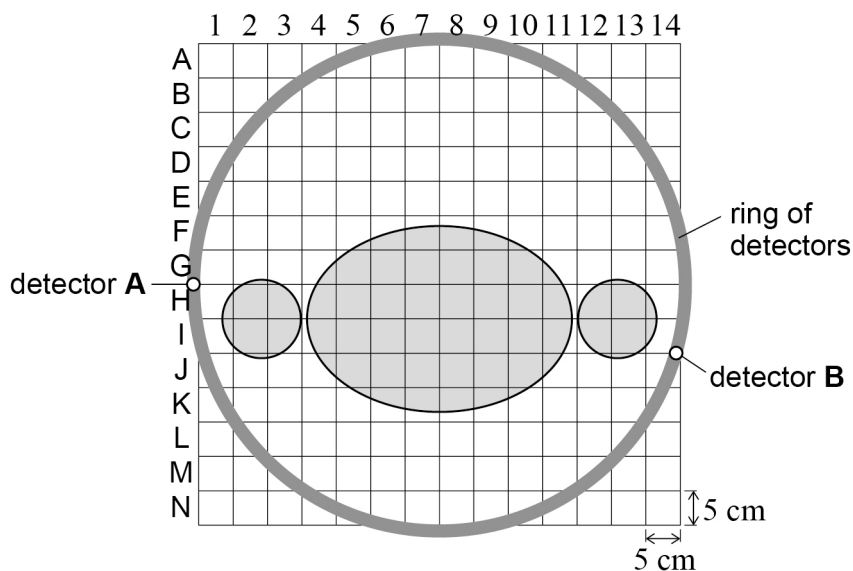


0 4 . 4

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

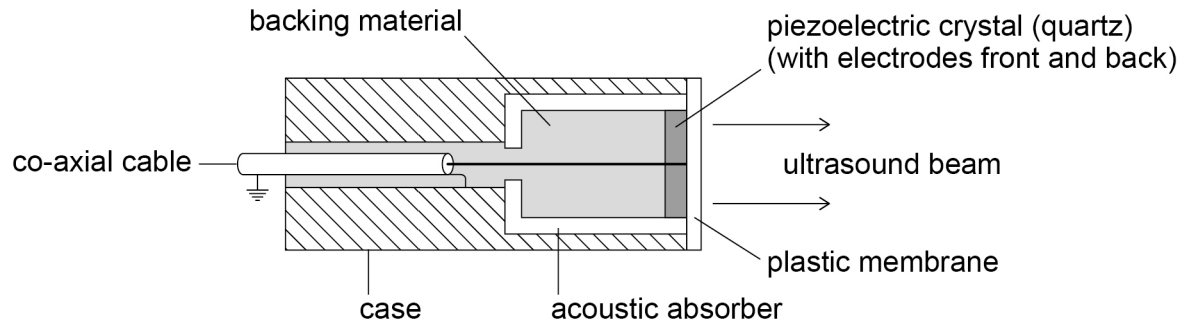
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0 5 . 1

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

Figure 2



Explain why a backing material is used.

[2 marks]



0	5	.	2
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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 kg m^{-3}

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

[3 marks]

percentage = _____ %

5

END OF QUESTIONS



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