AQA

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

A-level

PHYSICS

Paper 3

Section B Medical physics

7408/3BB

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.

[Turn over]

JUN247408 3BB01

On the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.

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.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write 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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

SECTION B

Answer ALL questions in this section.

0 1 . 1

A human eye has a far point of $6.0\ \mathrm{m}$.

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

[Turn over]

4

0 2 . 1

A stadium is full of spectators. The peak sound-intensity level at the centre of the stadium is $110\ \text{dB}$.

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

[Turn over]

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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]

6

0 3 . 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]

[Turn over]

0 3 . 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]

[Turn over]

10

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]

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 = _____ %

[Turn over]

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0 4 . 3

Name the particles emitted when a fluorine-18 nucleus decays. [1 mark]

_____

_____

_____

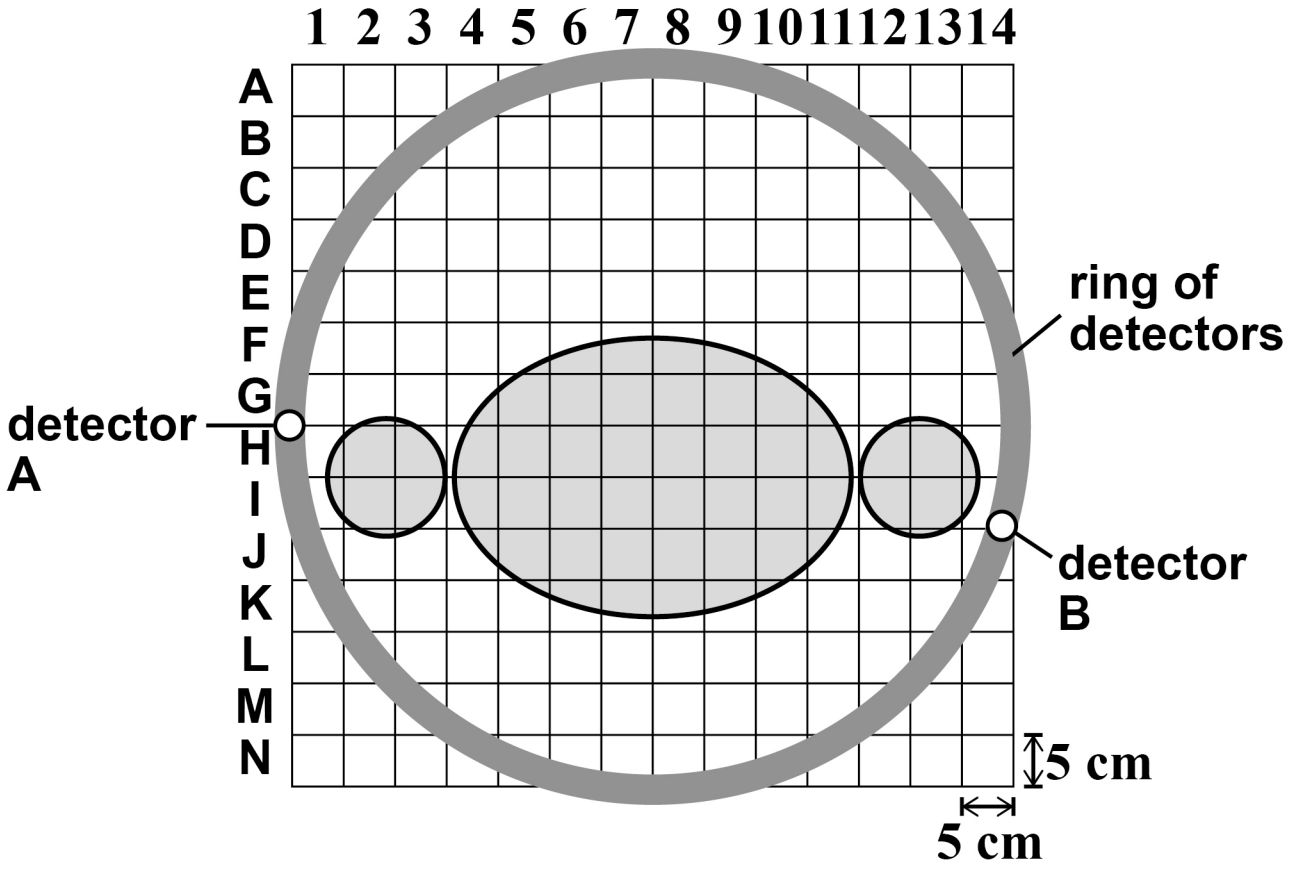
[Turn over]

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 $0.79\ \text{ns}$ 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 = _____

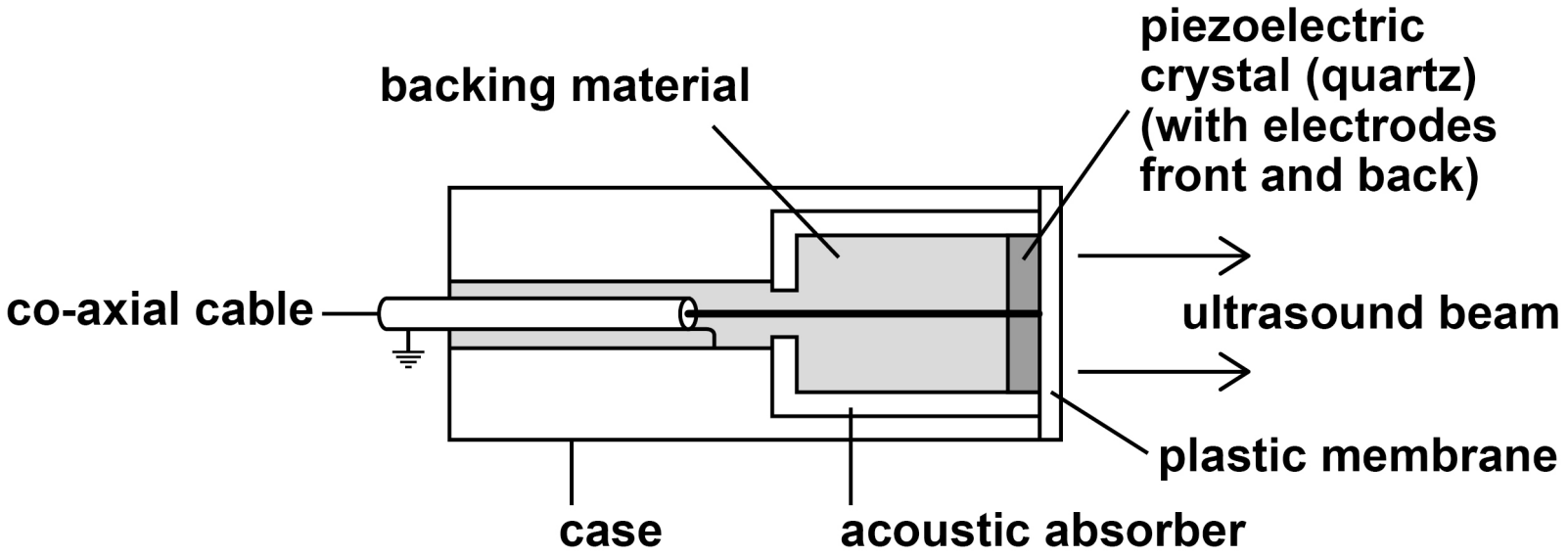
[Turn over]

10

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]

[Turn over]

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 = 5.3×10^6 kg m^{-2} s^{-1}

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

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

[3 marks]

percentage = _____ %

END OF QUESTIONS

5

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
TOTAL	