Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

A-level PHYSICS

Paper 3
Section B Medical physics

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	

Do not write outside the box

Section B

Answer **all** questions in this section.

0 1 An eye condition is corrected using a $+4.0\text{D}$ lens.

0 1 . 1 Which eye condition could be corrected by using this lens?
Tick (✓) **one** box.

[1 mark]

astigmatism ☐

hypermetropia ☐

myopia ☐

0 1 . 2 Calculate the magnification produced by the $+4.0\text{D}$ lens when viewing an object $75\ \text{cm}$ from this lens.

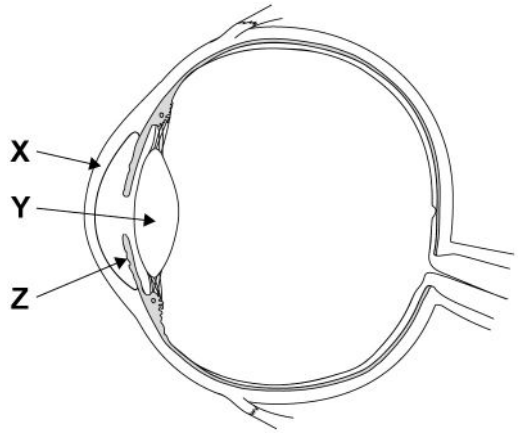
[3 marks]

magnification = _____

Do not write outside the box

0 1 . 3 **Figure 1** shows a diagram of an eye.

Figure 1



State the name and primary optical function of **X**, **Y** and **Z**.

[4 marks]

Name of **X** _____

Primary optical function of **X** _____

_____

_____

_____

Name of **Y** _____

Primary optical function of **Y** _____

_____

_____

_____

Name of **Z** _____

Primary optical function of **Z** _____

_____

_____

_____

8

Turn over ►

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ANSWER IN THE SPACES PROVIDED

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0 2 . 1 An X-ray image is to be made of a broken bone.
The image can be formed on

- photographic film
- a flat panel (FTP) detector or
- an intensifying screen using fluoroscopic image intensification.

State and explain which one of these detection methods should be used in this situation.
Go on to discuss why the other two methods are less suitable.

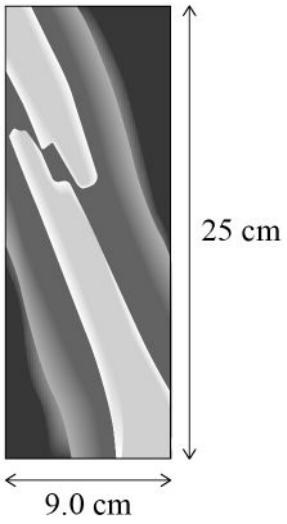
[4 marks]

Question 2 continues on the next page

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Figure 2 shows an X-ray of a broken bone.

Figure 2



mean diameter of bone = 0.040 m

intensity of incident X-rays = 0.013 W m^{-2}

exposure time of X-ray = 0.80 s

linear attenuation coefficient of bone = 58.3 m^{-1}

Do not write outside the box

0 2 . 2 Calculate an estimate for the X-ray energy that is absorbed by the bone.

[5 marks]

energy absorbed = _____ J

0 2 . 3 State **two** reasons why the estimate of energy absorption in Question **02.2** may be greater than the actual value.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

11

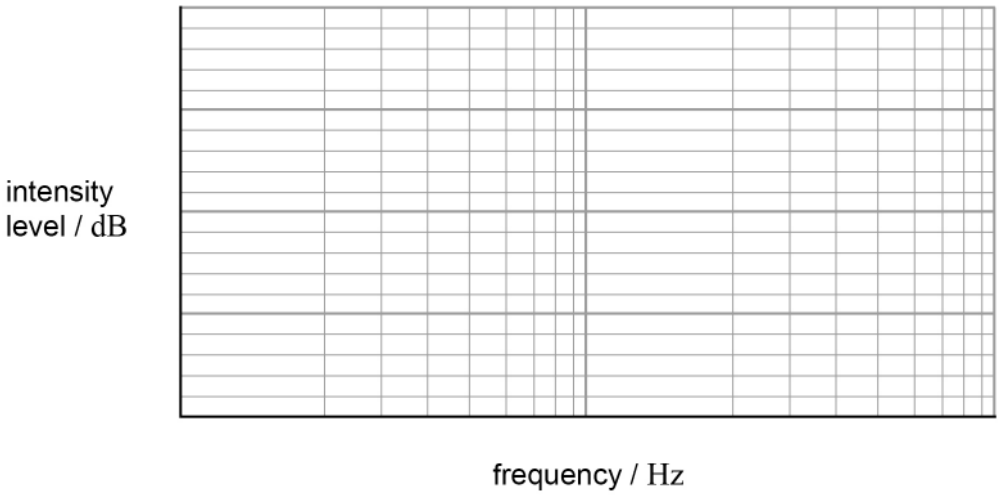
Turn over ►

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0 3 . 1 Sketch an equal loudness curve on **Figure 3** showing the normal response of a healthy ear.
Annotate the **frequency** axis with an appropriate scale.

[3 marks]

Figure 3



0 3 . 2 Describe the procedure used to gather the data for an equal loudness curve.

[2 marks]

Do not write outside the box

0 3 . 3 Calculate the intensity of a sound that produces an intensity level of 30 dB.

[2 marks]

intensity = _____ $W\ m^{-2}$

7

Turn over for the next question

Do not write outside the box

0 4 A patient has calcium kidney stones.
Three types of scan are available to investigate the condition:

- a magnetic resonance (MR) scan
- a CT scan
- an ultrasound scan.

Calcium kidney stones contain no water and appear similar to bone in each of the scans.

Discuss the advantages and disadvantages of each option.
In your answer you should

- refer to the relevant quality of the image obtained from each scan
- identify other factors that should be considered
- justify the type of scan you would recommend.

[6 marks]

Do not write outside the box

6

Turn over for the next question

Do not write outside the box

0 5 . 1 State the purpose of the magnetic field in a magnetic resonance scanner.

[1 mark]

0 5 . 2 Describe the role of the radio frequency pulses in a magnetic resonance scanner.

[2 marks]

3

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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