



**Surname** \_\_\_\_\_

**Other Names** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** \_\_\_\_\_

**Candidate Signature** \_\_\_\_\_

**I declare this is my own work.**

# **A-level**

# **PHYSICS**

**Paper 3**

**Section B    Medical physics**

**7408/3BB**

**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.**

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**



**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
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**An eye condition is corrected using a +4.0D lens.**

0	1	.	1
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**Which eye condition could be corrected by using this lens? [1 mark]**

**Tick (✓) ONE box.**

☐

**astigmatism**

☐

**hypermetropia**

☐

**myopia**



0	1	.	2
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**Calculate the magnification produced by the +4.0D lens when viewing an object 75 cm from this lens.  
[3 marks]**

**magnification = \_\_\_\_\_**

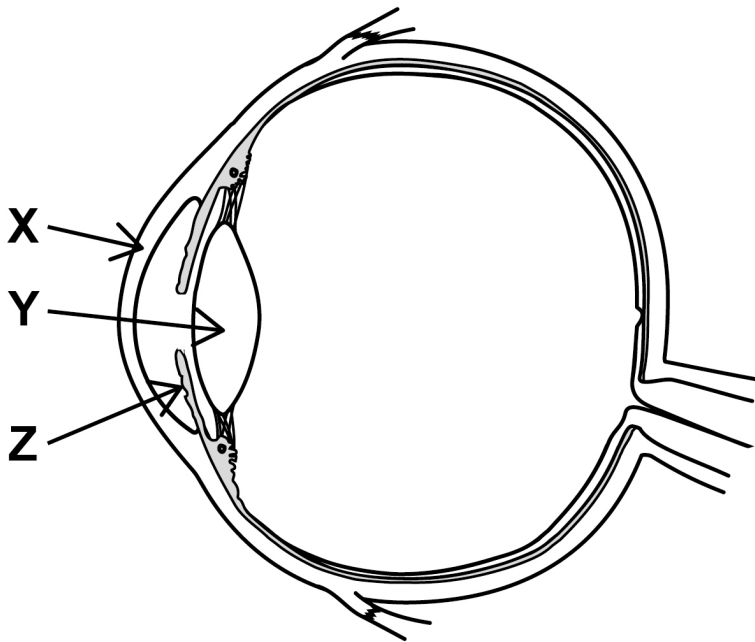
**[Turn over]**



01.3

**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 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

[Turn over]

8



**02.1**

**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]**

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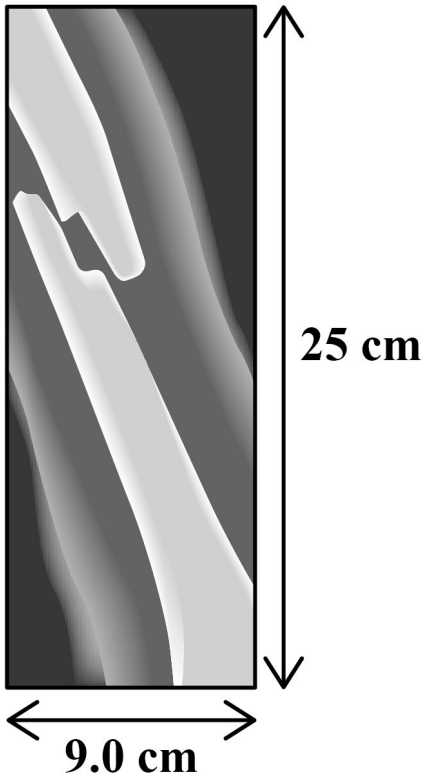
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**[Turn over]**



**FIGURE 2 shows an X-ray of a broken bone.**

**FIGURE 2**



**mean diameter of bone = 0.040 m**

**intensity of incident X-rays =  $0.013 \text{ W m}^{-2}$**

**exposure time of X-ray = 0.80 s**

**linear attenuation coefficient of bone =  $58.3 \text{ m}^{-1}$**



0	2	.	2
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**Calculate an estimate for the X-ray energy that is absorbed by the bone. [5 marks]**

**energy absorbed = \_\_\_\_\_ J**

**[Turn over]**



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**02.3**

**State TWO reasons why the estimate of energy absorption in Question 02.2 may be greater than the actual value. [2 marks]**

**1**

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**2**

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**[Turn over]**



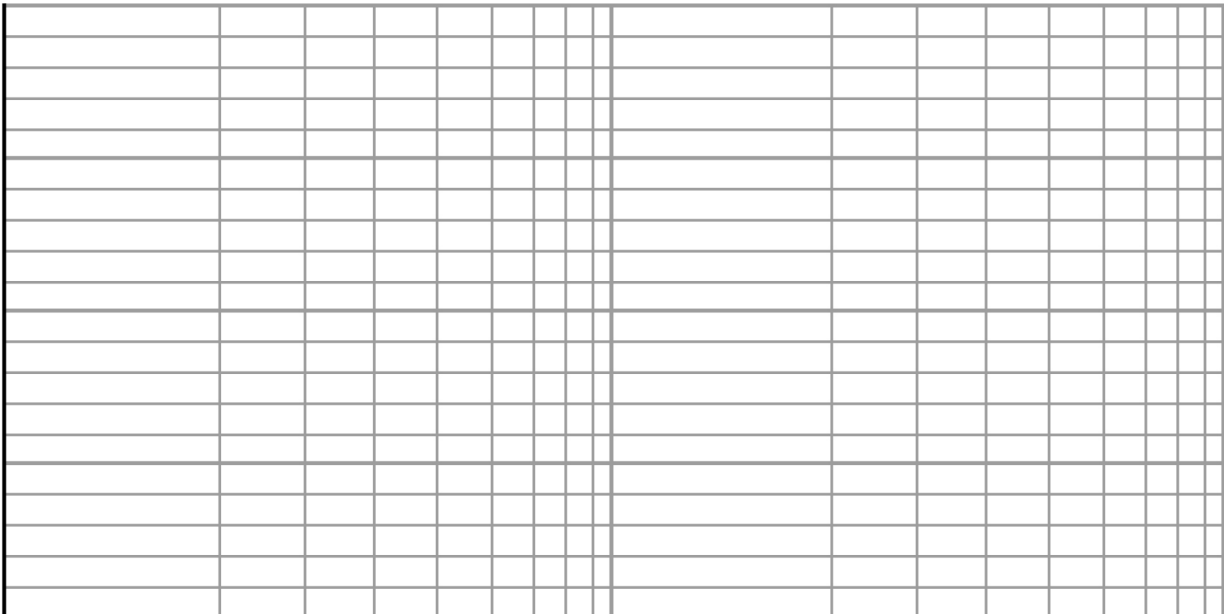
03.1

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**

intensity  
level / dB



frequency / Hz



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

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**[Turn over]**



0	3	.	3
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Calculate the intensity of a sound that produces an intensity level of 30 dB. [2 marks]

intensity = \_\_\_\_\_  $\text{W m}^{-2}$

7





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**[Turn over]**



0	4
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**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]**

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6



0	5	.	1
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**State the purpose of the magnetic field in a magnetic resonance scanner. [1 mark]**

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

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**END OF QUESTIONS**

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3



**Additional page, if required.**

**Write the question numbers in the left-hand margin.**

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**Additional page, if required.**

**Write the question numbers in the left-hand margin.**

[illegible]

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
<b>TOTAL</b>	

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