Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

A-level PHYSICS

Paper 3BB – Medical Physics

Specimen materials (set 2)

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
- a ruler
- a scientific calculator
- a Data and Formulae booklet.

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.
- 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 calculator where appropriate.
- A Data and Formulae Booklet is provided as a loose insert.

For examiner's use	
Question	Mark
1	
2	
3	
4	
TOTAL	

Section B

Answer **all** questions in this section.

0 1 . 1 A converging (convex) lens is placed $0.25\ \text{m}$ from an object. The focused image produced is virtual and formed $0.64\ \text{m}$ from the lens.

Calculate the power of the lens. Give a suitable unit for your answer.

[3 marks]

power = _____ unit = _____

0 1 . 2 Calculate the magnification produced.

[1 mark]

magnification = _____

0 1 . 3 State the defect of vision that this lens can correct.

[1 mark]

_____

_____

0 1 . 4 A defective eye is found to suffer from astigmatism.

Discuss the cause, effect and correction of astigmatism.

[3 marks]

0 1 . 5 Give **two** values needed for the manufacture of a lens suitable for the correction of astigmatism.

[2 marks]

1

2

10

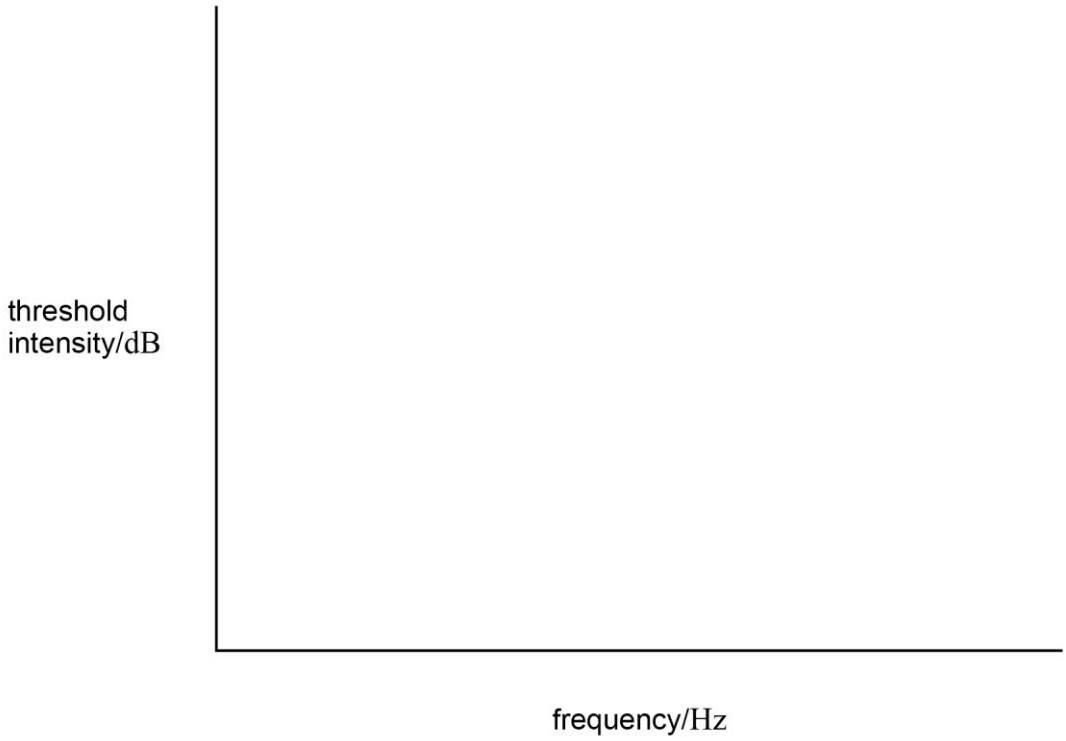
Turn over for the next question

0 2 . 1 Define the threshold of hearing.

[2 marks]

0 2 . 2 Sketch a graph to show how the threshold intensity, measured in dB, varies with frequency for a young person with normal hearing.
Include scales on both axes.

[4 marks]



0 2 . 3 A sound of intensity 46 $\mathrm{mW\ m^{-2}}$ is incident on a soundmeter set to the dB scale.
Calculate the reading on the meter.

[2 marks]

reading = _____ dB

8

0 3 . 1 Discuss the design of the anode of a modern X-ray tube.

In your answer you should consider features that:

- limit the anode temperature reached when the tube is operating
- allow a sharp image to be produced.

[6 marks]

0 3 . 2 In an X-ray tube, electrons are accelerated from rest through a pd of $82.5\ \text{kV}$ before they reach the anode.

Calculate the kinetic energy of an electron as it reaches the anode.
Give your answer to an appropriate number of significant figures.

[2 marks]

kinetic energy = _____ J

0 3 . 3 An electron transfers $75\ \text{keV}$ of energy to produce a single X-ray photon.

Calculate the wavelength of this photon.

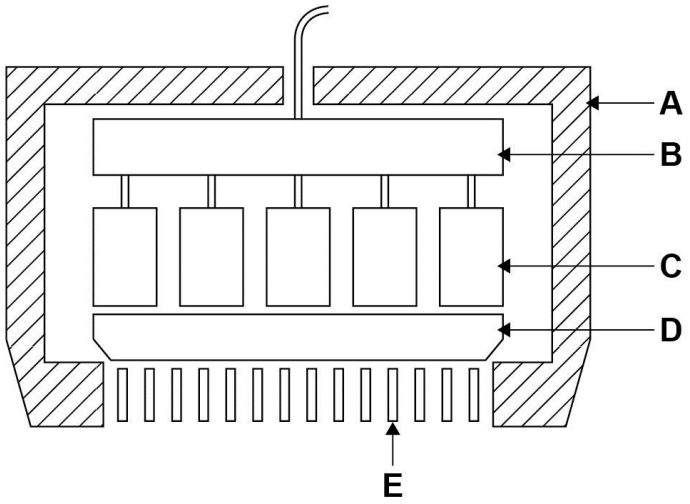
[3 marks]

wavelength = _____ m

11

0 4 . 1 **Figure 1** shows the main components of a gamma camera.

Figure 1



Explain briefly the operation of the camera referring to the parts labelled A to E.

[4 marks]

Question 4 continues on the next page

0 4 . 2 Describe how the image obtained using the gamma camera differs from that obtained using diagnostic X-rays and why this difference can be an advantage in medical diagnosis.

[2 marks]

6

END OF QUESTIONS