



Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

# A-level PHYSICS

Paper 3  
Section B Medical physics

Monday 3 June 2019

Afternoon

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.

## 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.

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

## 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.



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**7408/3BB**

**Section B**

Answer **all** questions in this section.

**0 1**

Car drivers must be able to

- read a speedometer from a distance of 50 cm
- read a number plate from a distance of 20.5 m.

A driver has an unaided far point of 55 cm and an unaided near point of 25 cm.

**0 1 . 1**

Identify the driver's eye defect.

Tick (✓) **one** box.

**[1 mark]**

Astigmatism	
Hypermetropia	
Myopia	



0 1 . 2

**Figure 1** shows the position of a number plate at a distance of 20.5 m in front of the driver's unaided eye.

**Figure 2** shows the same situation and the position of a corrective lens.

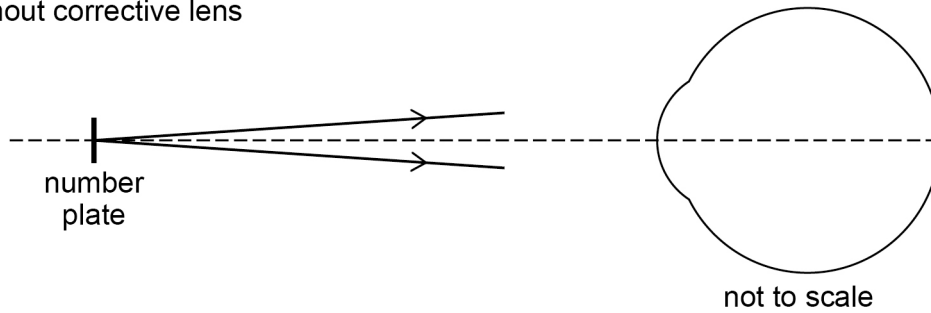
Complete both ray diagrams to show how and where the image of the number plate is formed in each case.

Add a suitable lens to **Figure 2**.

[4 marks]

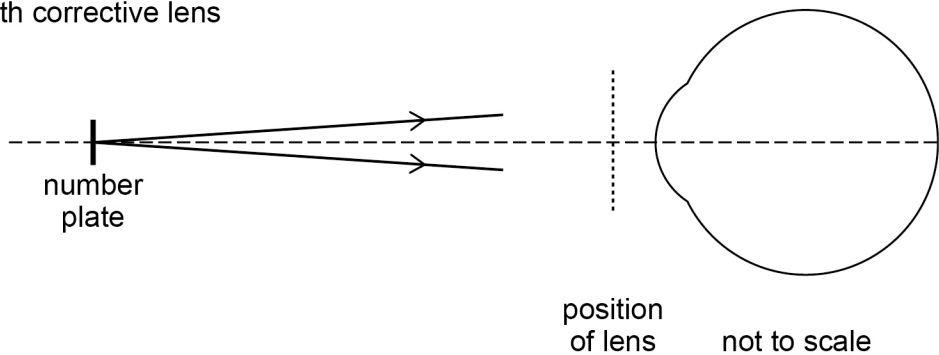
**Figure 1**

Without corrective lens



**Figure 2**

With corrective lens



**Question 1 continues on the next page**

**Turn over ►**



0 1 . 3

An optician considers the use of **three** different lenses, **A**, **B** and **C**, for use by the driver when driving.

Power of **A** =  $-2.18\text{D}$

Power of **B** =  $-1.77\text{D}$

Power of **C** =  $+1.95\text{D}$

Deduce which lens is suitable.  
Support your answer with calculations.

**[5 marks]**

10



**Turn over for the next question**

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0 5

**0 2**

Three customers, **P**, **Q** and **R**, are sitting in a café listening to music from a loudspeaker.

Customer **P** is 11 m from the loudspeaker. At the position of customer **P**, the sound intensity is  $3.4 \times 10^{-8} \text{ W m}^{-2}$ .

**0 2** . **1**

Customer **P** moves to a distance of 7.0 m from the loudspeaker.

Calculate the sound intensity at the new position of customer **P**.  
Assume that the loudspeaker is a point source.

**[2 marks]**sound intensity = \_\_\_\_\_  $\text{W m}^{-2}$ **0 2** . **2**

The sound intensity level is 65 dB at the position of customer **Q** and 42 dB at the position of customer **R**.

Calculate the ratio  $\frac{\text{sound intensity at the position of Q}}{\text{sound intensity at the position of R}}$ .

**[2 marks]**

ratio = \_\_\_\_\_



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**0 2 . 3** Customer **Q** perceives the loudness of the sound differently to customer **R**.

Discuss whether the use of intensity level or intensity is more appropriate to compare the perceived loudness.

**[2 marks]**

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**0 2 . 4** Customers **P**, **Q** and **R** move to the same distance from the loudspeaker.

Customer **P** is 80 years old and has hearing loss due to her age.

Customer **Q** is 35 years old and has hearing loss due to working in an extremely noisy environment.

Customer **R** is 35 years old and has no hearing loss.

The hearing defects of **P** and **Q** affect their perception of the music being played.

Describe how their perceptions are different from that of **R**.

**[3 marks]**

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**9**

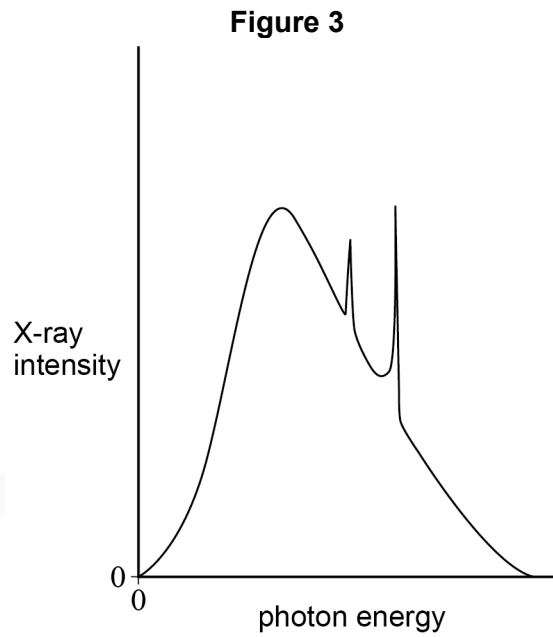
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0 3

**Figure 3** shows the X-ray spectrum produced in a medical X-ray machine at a particular anode potential difference (pd).



0 3 . 1

In an X-ray tube, electrons collide with a tungsten target.

Explain how the continuous spectrum and the characteristic spectra are produced by these electron collisions.

**[4 marks]**

Continuous spectrum \_\_\_\_\_

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Characteristic spectra \_\_\_\_\_

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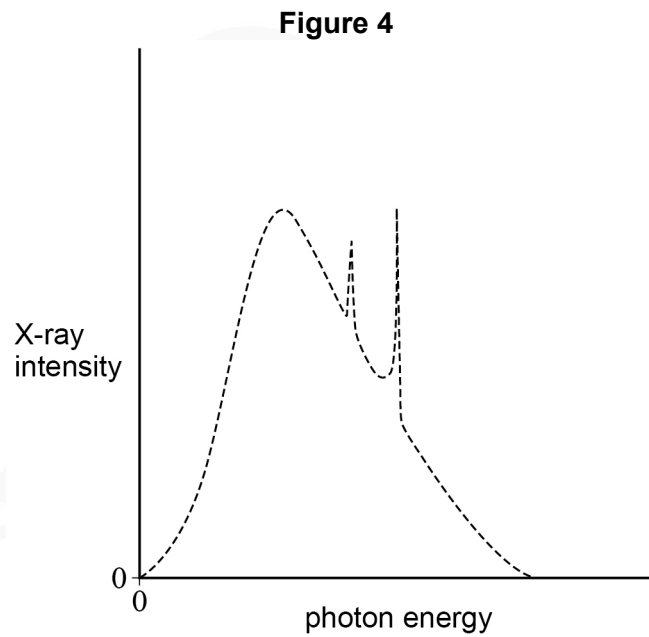


0 3 . 2

The dashed line on **Figure 4** shows the X-ray spectrum for the initial anode pd.

Sketch on **Figure 4** the X-ray spectrum produced when the anode pd is increased.

[2 marks]



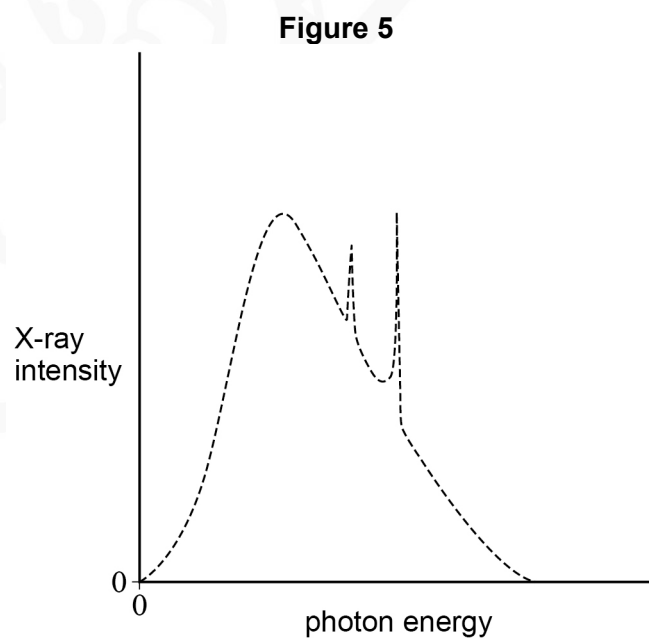
0 3 . 3

In the medical X-ray machine, the X-rays produced with the initial anode pd are now passed through an aluminium filter.

The dashed line on **Figure 5** shows the X-ray spectrum for the initial anode pd.

Sketch on **Figure 5** the X-ray spectrum of the X-rays that emerge from the filter.

[1 mark]



7

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0 4

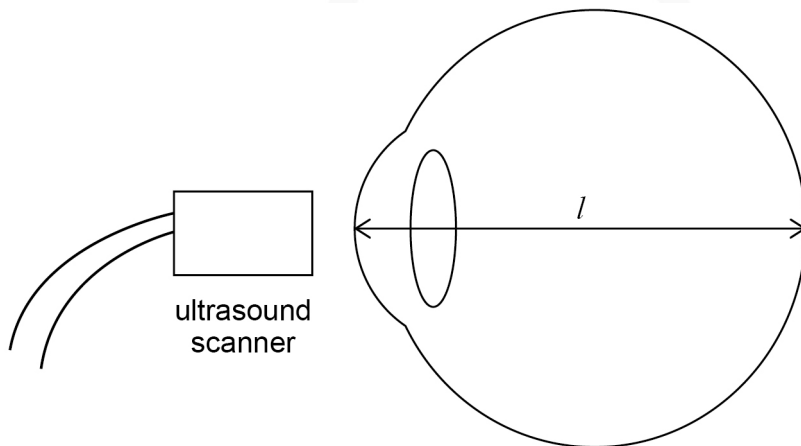
Ultrasound is commonly used in medical procedures.

0 4 . 1

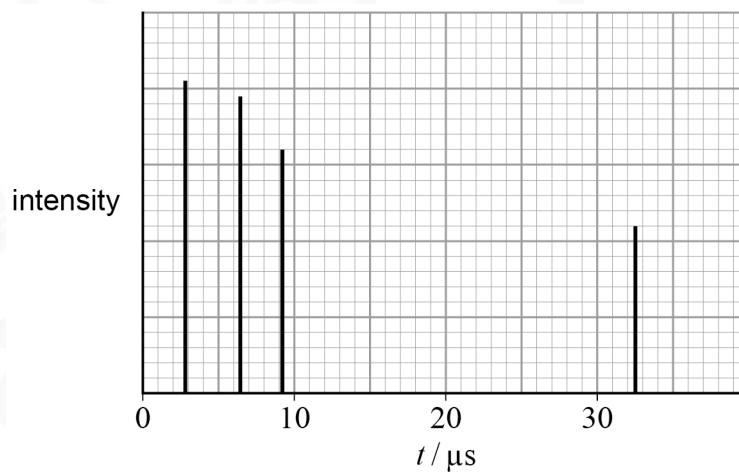
An ultrasound A-scan is used to find the length  $l$  of an eye as shown in **Figure 6**. **Figure 7** shows the simplified A-scan for the eye. A short pulse of ultrasound is transmitted at time  $t = 0$

The average speed of ultrasound in the eye =  $1560 \text{ m s}^{-1}$ .

**Figure 6**



**Figure 7**



Calculate  $l$ .

[3 marks]

$l =$  \_\_\_\_\_ m





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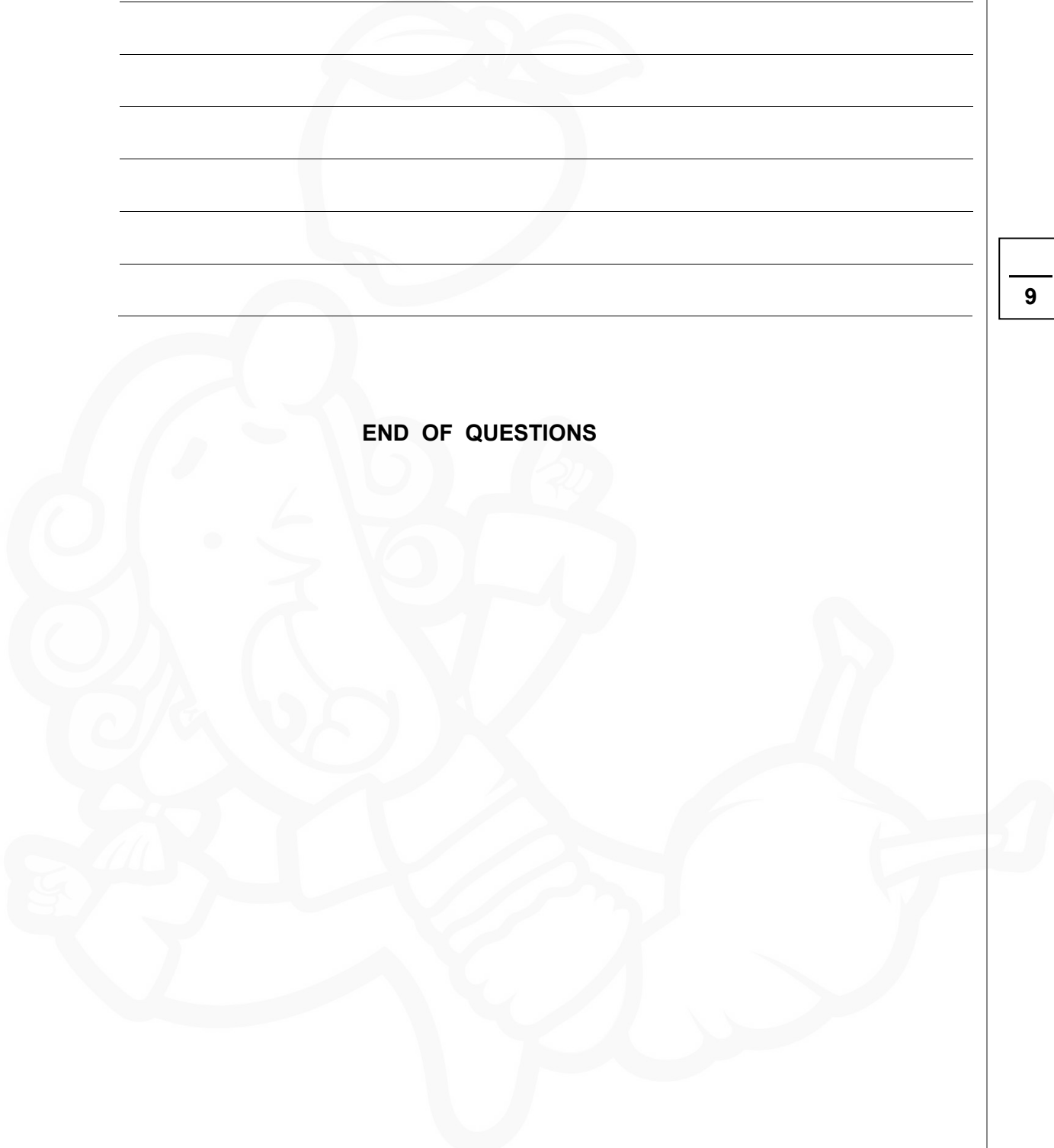
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**END OF QUESTIONS**



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