A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

A-level

PHYSICS

Paper 3

Section B Medical physics

7408/3BB

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.

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.**

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

BLANK PAGE

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, on the opposite page, shows the position of a number plate at a distance of $20.5\ \text{m}$ in front of the driver's unaided eye.**

FIGURE 2, on the opposite page, shows the same situation and the position of a corrective lens.

FIGURE 1 and FIGURE 2 are NOT drawn to scale.

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

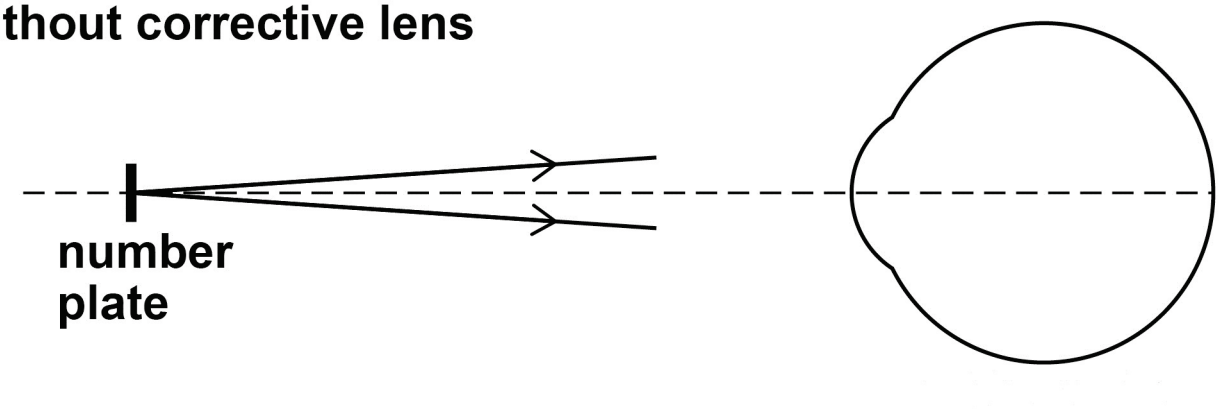
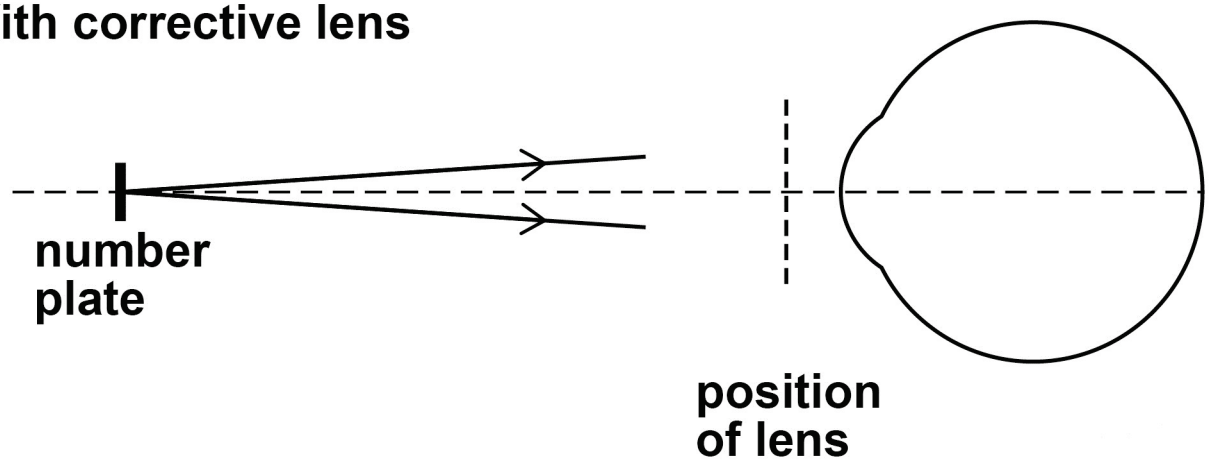


FIGURE 2

With corrective lens



[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 = –2.18D
Power of B = –1.77D
Power of C = +1.95D

Deduce which lens is suitable.
Support your answer with calculations.
[5 marks]

0 2 Three customers, P, Q and R, are sitting in a café listening to music from a loudspeaker.

Customer P is $11\ \text{m}$ 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 $7.0\ \text{m}$ 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 = _____ 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 = _____

BLANK PAGE

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]

[Turn over]

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.

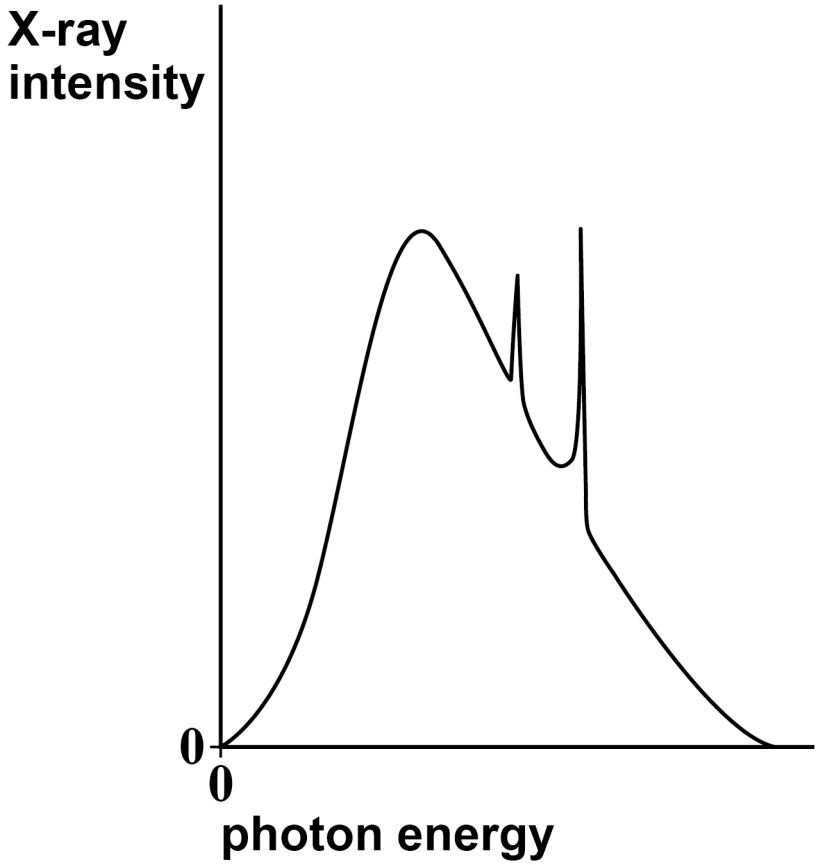
Describe how their perceptions are different from that of R. [3 marks]

[Turn over]

9

0 3 **FIGURE 3 shows the X-ray spectrum produced in a medical X-ray machine at a particular anode potential difference (pd).**

FIGURE 3



BLANK PAGE

[Turn over]

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]

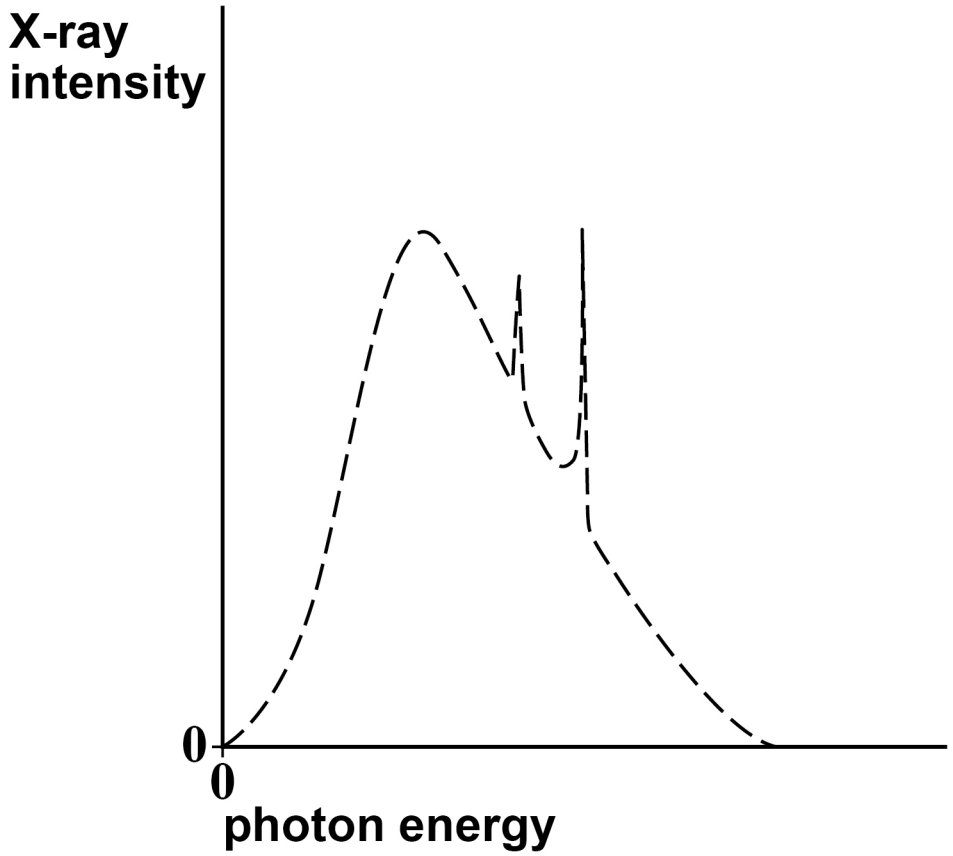
Continuous spectrum _____

Characteristic spectra

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]

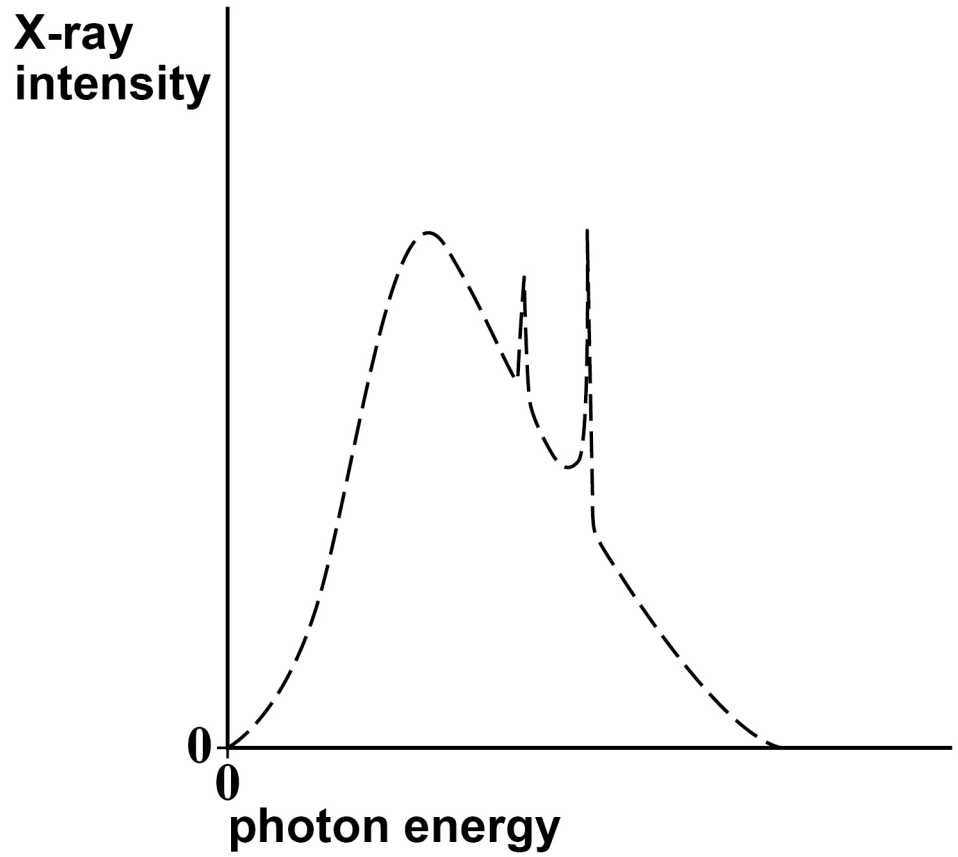
FIGURE 4



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]

FIGURE 5



[Turn over]

7

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, on the opposite page, 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

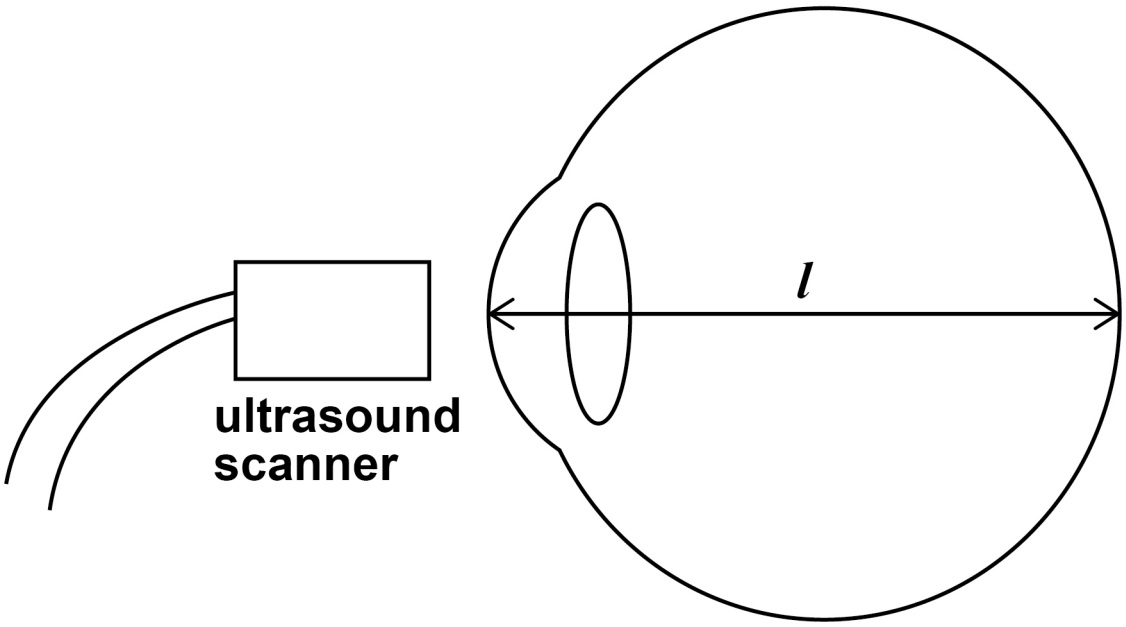
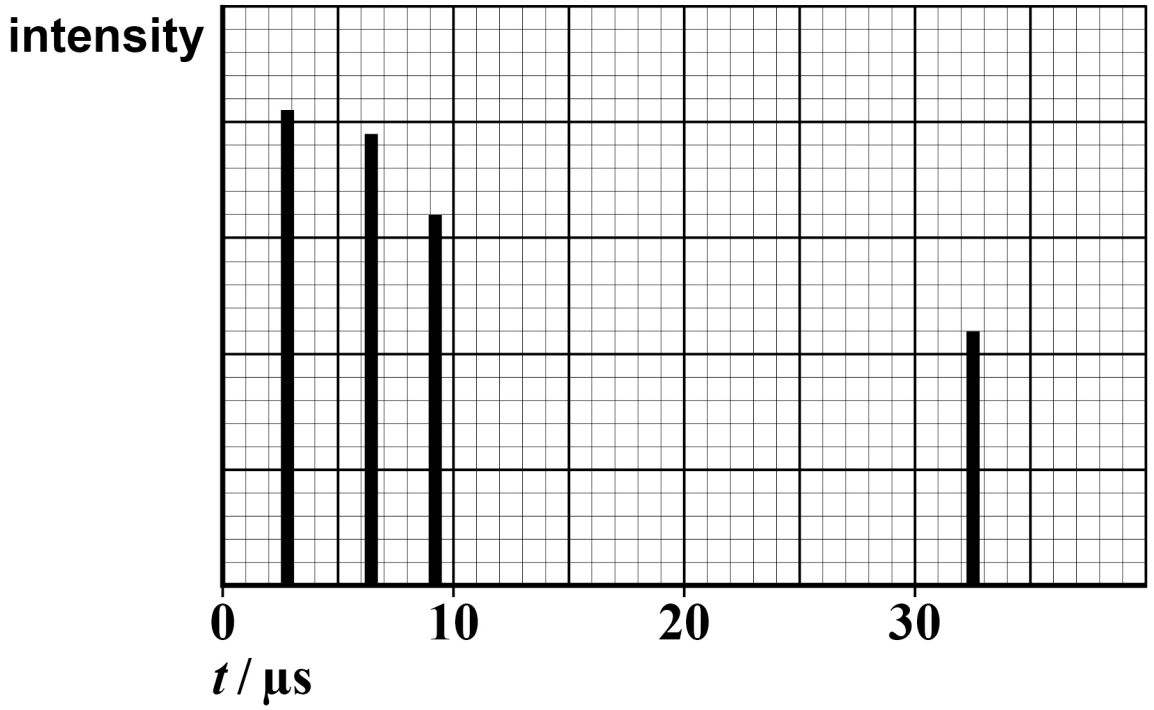


FIGURE 7



Calculate *l*. [3 marks]

l **=** _____ **m**

0 4 . 2 **Amniocentesis is a procedure where a tube is inserted into a uterus to remove some cells and fluid from around a foetus. For the procedure to be carried out safely the positions of the needle, foetus and placenta must be determined accurately.**

Discuss whether an A-scan or a B-scan should be used for amniocentesis.

In your answer, you should:

- **outline the differences between an A-scan and a B-scan**
- **describe the advantages and disadvantages of each type of scan**
- **explain why your chosen scan should be used for this procedure.**

[6 marks]

END OF QUESTIONS

9

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.

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.

BLANK PAGE

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