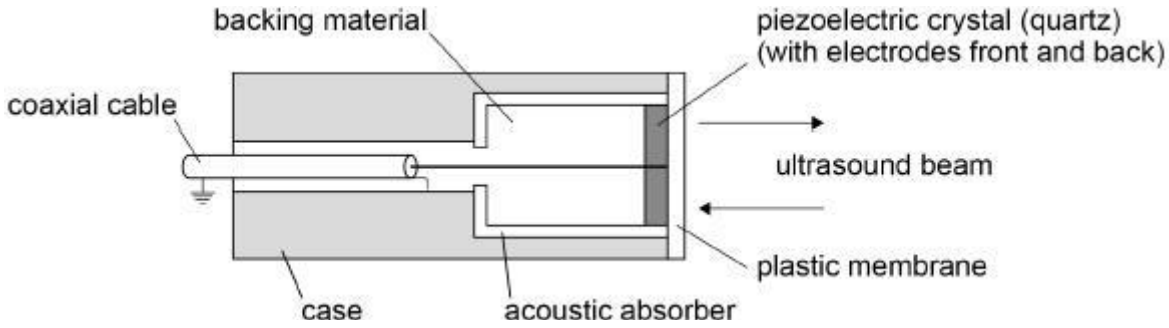
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

The diagram shows an ultrasound transducer used to perform medical scans.



(a) Explain how the transducer in the diagram above operates in medical diagnosis.

In your answer you should explain how

- an ultrasound pulse is produced by the transducer
- the reflected ultrasound pulse is detected by the transducer
- the transducer can both transmit a pulse and receive the reflected pulse.

(6)

(b) Ultrasound of frequency 1.0 MHz is used to scan a person's liver.

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Estimate the resolution of the scan.

speed of sound in liver tissue = 1600 m s^{-1}

resolution = _____ mm

(1)

(c) Ultrasound travels from a transducer through the chest wall to an air pocket inside the lung. From the air pocket, the ultrasound is then incident on lung tissue.

Calculate the percentage of the incident ultrasound intensity that is transmitted into the lung tissue.

speed of sound in lung tissue = 1580 m s^{-1}

density of lung tissue = 1075 kg m^{-3}

speed of sound in air = 330 m s^{-1}

density of air = 1.3 kg m^{-3}

percentage = _____ %

(4)

(d) Discuss whether an ultrasound scan would be suitable to investigate a tumour inside a lung.

_____

_____

_____

_____

_____

_____

(2)

(Total 13 marks)

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Q2.

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.

(a) Identify the driver's eye defect.
Tick (✔) **one** box.

Astigmatism	
Hypermetropia	
Myopia	

(1)

(b) **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**.

Figure 1

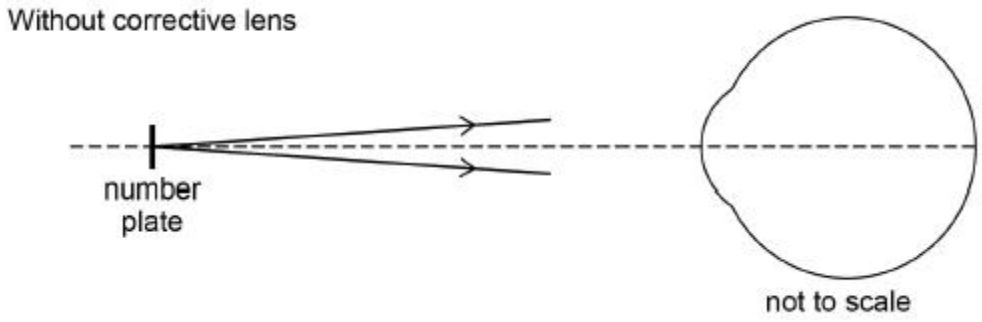
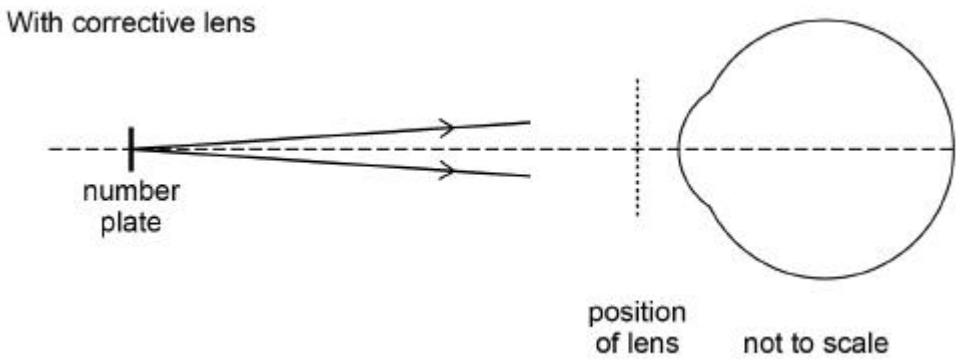


Figure 2



(4)

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

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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)
(Total 10 marks)

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