

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Q1.

A convex lens is placed 0.25 m from an object. The focused image produced is virtual and is 0.60 m from the lens.

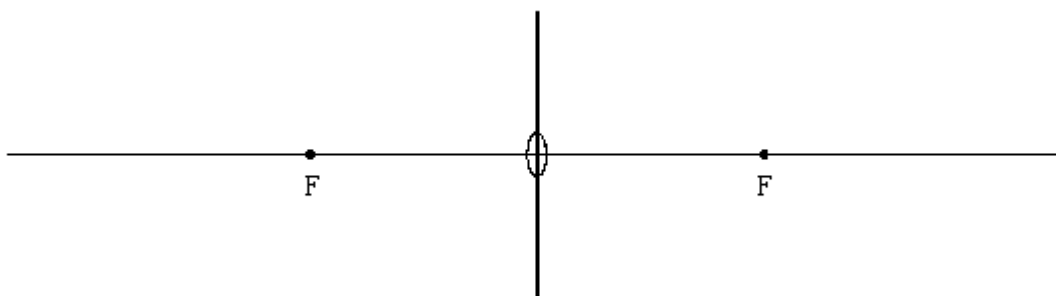
(a) Calculate

(i) the power of the lens,

(ii) the magnification produced.

(3)

(b) Draw a ray diagram to show the formation of the image produced by this lens. The diagram does not have to be to scale, but relevant distances must be marked.



(3)

(c) (i) What defect of vision is this lens used to correct?

(ii) A person has an unaided near point at 0.60 m and an unaided far point at infinity. Calculate the range of vision of the person when using this lens.

Q2.

- (a) The acoustic impedance, Z , of a medium is equal to the product of the medium's density and the speed of sound in that medium. When sound is incident on the boundary between two media of acoustic impedances Z_1 , and Z_2 respectively, some sound is reflected and some transmitted. The ratio of the reflected intensity, I_r , to the incident intensity, I_i , is given by the equation

$$\frac{I_r}{I_i} = \left[\frac{(Z_2 - Z_1)}{(Z_2 + Z_1)} \right]^2$$

speed of sound in air = 330 m s^{-1}
speed of sound in tissue = 1540 m s^{-1}
density of air = 1.3 kg m^{-3}
density of tissue = 1100 kg m^{-3}

- (i) Calculate, giving the appropriate unit, the acoustic impedance of air.

- (ii) Calculate the acoustic impedance of tissue.

- (iii) Show that the ratio $\frac{I_r}{I_i}$ at an air/tissue boundary is approximately 1.

(3)

- (b) Use your answer to part (a)(iii) to explain why a coupling gel is needed between an ultrasound probe and a patient's skin. State and explain what the ideal value of the acoustic impedance would be for such a gel.

(3)

(c) An A-scan is used to find information about the depth and size of organs within a patient's body. Explain

(i) the basic physical principles behind the A-scan,

(ii) how the results are used to find the size of an organ.

(4)

(Total 10 marks)