

- 6 (a) Distinguish between longitudinal and transverse waves.

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[2]

- (b) Sound travels by means of *longitudinal waves* in air and solids. A progressive sound wave of wavelength λ and frequency f passes through a solid from left to right.

In Fig 6.1, the dots on line X represents the equilibrium positions of the atoms in the solid and dots on line Y represents the positions of the same atoms at a time $t = t_0$.

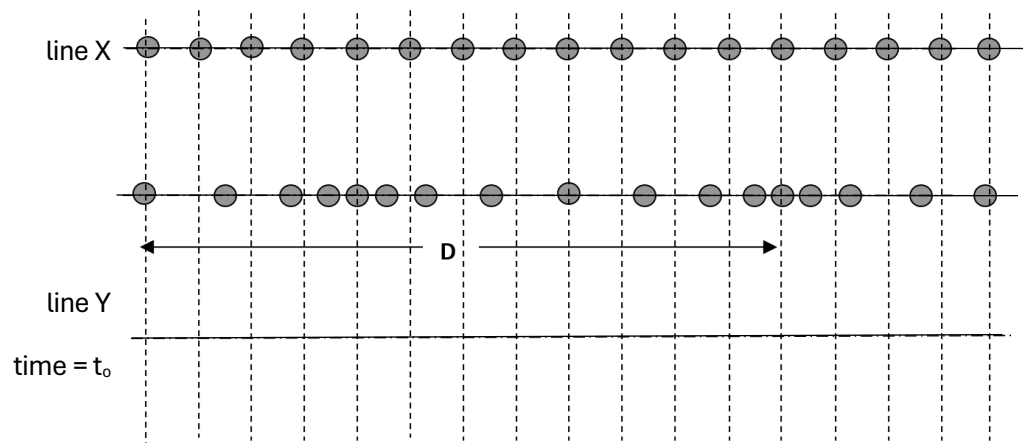


Fig. 6.1

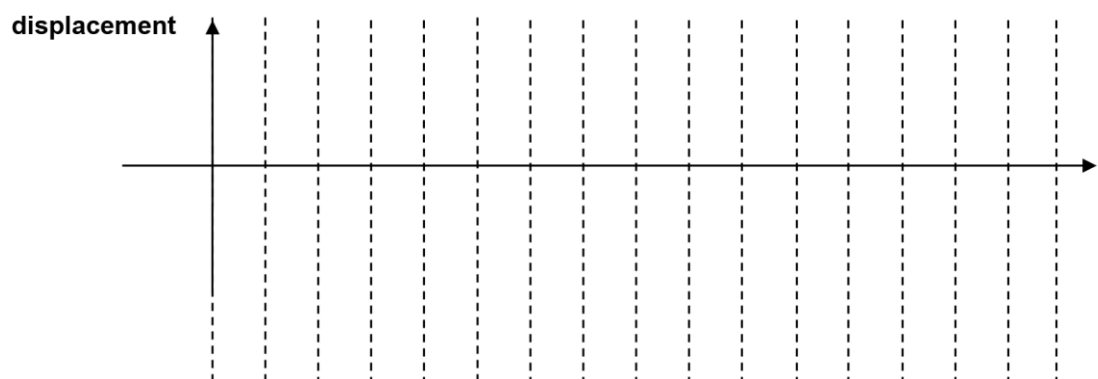


Fig. 6.2

- (i) Explain why longitudinal waves cannot be polarised.

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..... [1]

- (ii) State what the distance D in Fig. 6.1 represent.

..... [1]

- (iii) Taking displacement to the right of equilibrium position as positive, sketch on Fig 6.2, a graph of displacement against distance at time t_0 for Line Y. Label this graph Y. [2]

- (iv) Sketch on the same axis given on Fig. 6.2, a graph of displacement against position of the atoms at time $= t_0 + T/4$, where T is the period of the wave. Label this graph Z. [2]

- (v) Hence, in Fig. 6.1, show the actual position of the particles at time $= t_0 + T/4$ on the line Z. [2]

Question 6 continues on next page

- (c) Fig. 6.3 shows an arrangement used to determine the wavelength λ of monochromatic light emitted by a laser.



Fig. 6.3 (not to scale)

S_1 and S_2 are slits at right angles to the plane of the diagram. When illuminated by light from a laser, an interference pattern is formed on the screen from which measurements can be taken to determine λ .

The distance x between neighbouring bright images in the interference pattern is given by

$$x = \frac{\lambda D}{a}$$

- (i) Draw and annotate on Fig. 6.3 the distances represented by the symbols D and a . [2]
- (ii) The wavelength of the light used is known to be 620 nm and D is 2.0 m. Given that 2 mm is the minimum fringe spacing which can be seen, determine the value of a which provides this minimum fringe spacing.

$a = \dots\dots\dots$ mm [3]

- (d) A parallel beam of monochromatic light of wavelength λ falls at normal incidence on a narrow slit S of width $13\text{ }\mu\text{m}$, as shown in Fig. 6.4.

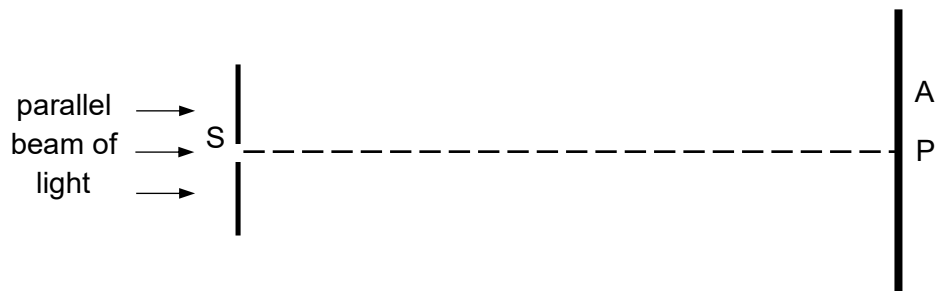


Fig. 6.4

- (i) The intensity pattern of the light observed on the screen 2.8 m from the slit S is as shown in Fig. 6.5.

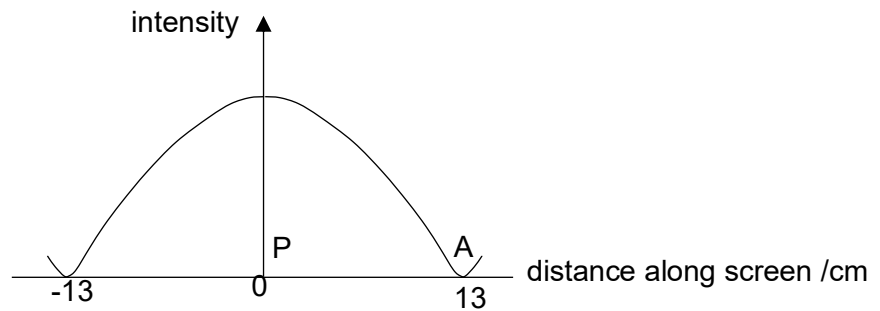


Fig. 6.5

Describe how the intensity pattern will change if the width of the slit S is reduced.

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[2]

- (ii) Use Fig. 6.5 to determine the wavelength λ of the parallel beam of monochromatic light.

$\lambda = \dots\dots\dots$ m [3]

[Total: 20]