

- 3 (a) (i) Explain what is meant by *diffraction*.

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[2]

- (ii) A ripple tank experiment is used to observe the diffraction of plane water waves. Sketch on Fig. 3.1 the appearance of the water waves as they pass through the gaps.

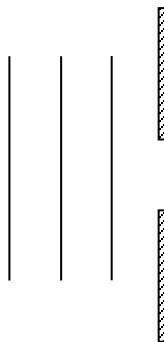


Fig. 3.1

[2]

- (iii) A band is practising in a room along a corridor with the door slightly ajar.

Explain why a student walking along the corridor can hear the band but is unable to see the band.

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[2]

- (b) A student is standing 5.5 m away from a loudspeaker S_1 , which is transmitting with a power output of 20 W.
- (i) Calculate the power intercepted by the student's ear with an effective area of 2.5 cm².

$$\text{power} = \dots \text{W} [2]$$

- (ii) State the assumption you have used in (b)(i).

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..... [1]

- (c) The loudspeaker S_1 is placed at point X. A second loudspeaker S_2 is placed at point Y at a distance of 1.2 m from loudspeaker S_1 as shown in Fig. 3.2. The sound waves from the two loudspeakers have frequency 2.75 kHz and speed 330 m s⁻¹.

The student now stands at point A, a point equidistant from S_1 and S_2 , and hears a sound of maximum intensity.

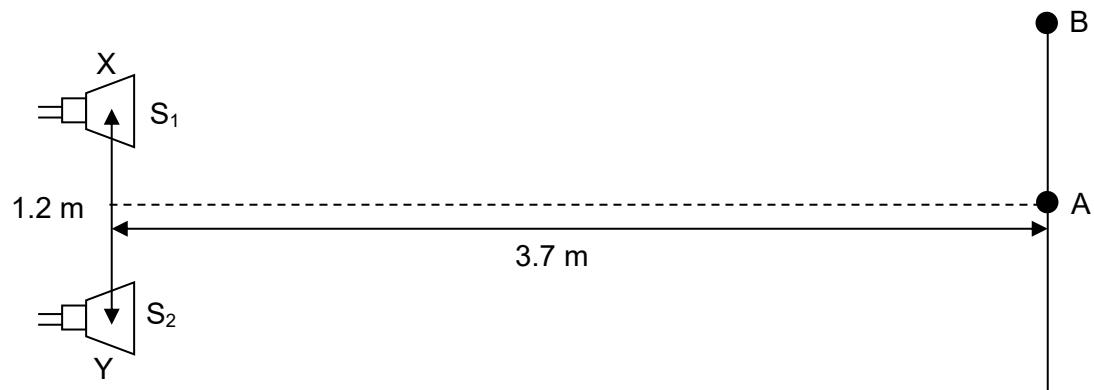


Fig. 3.2

- (i) Show that the wavelength of the sound waves is 0.12 m.

[1]

- (ii) As the student moves from point A to point B, the intensity varies between maximum and minimum values. The distance S_1B is 3.82 m and S_2B is 4.12 m.

Determine the number of maxima between points A and B. Do not include the maxima at point A.

number of maxima = [2]

- (iii) The loudspeakers S_1 and S_2 emit sound waves that arrive at point B with intensity I and $2I$ respectively.

Determine the intensity of the sound at point B in terms of I .

intensity = [3]

- (iv) The two loudspeakers are placed closer together along the line joining X and Y. Without any calculations, state the difference detected by the student as he walks from point B back to point A.

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..... [1]

- (d) The loudspeaker S_1 is now placed facing a wall as shown in Fig. 3.3. A microphone is placed at the wall.

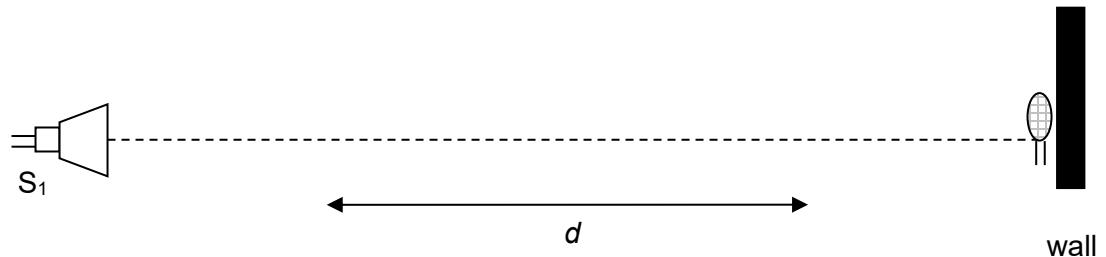


Fig. 3.3

- (i) State and explain whether the microphone detects a maximum or minimum signal.

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..... [3]

- (ii) As the microphone moves through the distance d as shown in Fig. 3.3, it detects 3 positions of minima, with maxima at the ends.

Determine the value of d .

$$d = \dots \text{ m} [2]$$

[Total: 21]

