[4]

4 **Fig. 4.1** shows two similar small loudspeakers driven in phase from a common audio-frequency source.

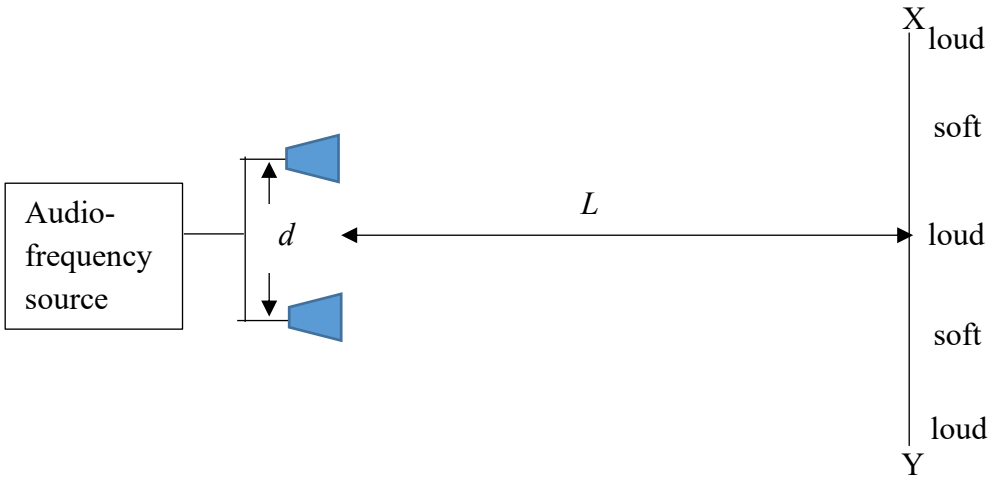

Fig. 4.1

The distance *L* is much larger than the distance *d*. When a student walks with a constant speed from X to Y, the intensity of the note he hears is alternately loud and soft at equally spaced intervals.

(a) **(i)** Explain the origin of the loud and soft regions.

……

……

……

…… [2]

(ii) The distance between the two loudspeakers is 75 cm while *L* is 10.0 m. The sound has a wavelength of 4.8 cm. Calculate the distance between adjacent loud and soft regions.

[2]

(iii) While walking from X to Y, the student notices that the intensity of the maxima is not the same. It gets stronger when he walks from X towards the midpoint and then becomes weaker again as he walks towards Y. Explain his observations.

……

……

……

…… [2]

(b) **(i)** When a recording is played through one of the loudspeakers, it is desirable that the speaker should have a diameter d smaller than the wavelength. State the reason why.

……

…….[1]

(ii) Estimate the maximum diameter of the speaker that would ensure adequate spreading of sound waves from a recording of a piano. Explain your reasoning. [Speed of sound in air = 340 m s^{-1}, the notes of a piano range from 34 Hz to 3.4 kHz.]

Maximum diameter = …… m [3]