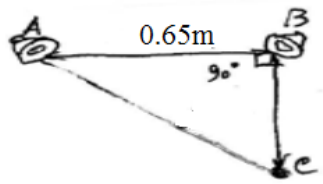
Answer on Question #49810- Physics-Acoustics

There are speakers that are separated by .650m and are playing a note having a frequency of 676 hz. If your lounge chair is located in a line directly in front of one of the speakers, how far from that speaker should it be for you to be located at the first maximum intensity. The speed of sound in the room is 343 m/s.

Solution



ABC is right triangle:

$$AB^2 + BC^2 = AC^2.$$

The difference in the travel distances for waves is path difference:

$$\Delta d = AC - BC.$$

For constructive interference

$$\Delta d = n\lambda.$$

$$\lambda = \frac{v}{f}.$$

The first maximum intensity will be at

$$\Delta d = 1 \cdot \lambda = \frac{v}{f} = \frac{343\,\frac{\text{m}}{\text{s}}}{676\ \text{Hz}} = 0.507\ m.$$

So,

$$AB^2 + BC^2 = (BC + \lambda)^2 \rightarrow AB^2 + BC^2 = BC^2 + 2BC\lambda + \lambda^2.$$

$$BC = \frac{AB^2 - \lambda^2}{2\lambda} = \frac{0.650^2 - 0.507^2}{2 \cdot 0.507} = 0.163\ m.$$

Answer: $0.163\ m$.