Answer on Question #69358 – Physics – Mechanics | Relativity

Two loudspeakers are placed 3.00 m apart, as shown in the figure below. They emit 494-Hz sounds, in phase. A microphone is placed 3.20 m distant from a point midway between the two speakers, where an intensity maximum is recorded.

A) How far must the microphone be moved to the right to find the first intensity minimum?
B) Suppose the speakers are reconnected so that the 494-Hz sounds they emit are exactly out of phase. At what positions are the intensity maximum and minimum now?

Solution.

Let us suppose the speed of sound to be $c = 343\ m/s$. Let $2L = 3.00\ m, d = 3.20\ m, \nu = 494\ Hz$.

A) Minimum will be reached when difference of wave`s propagation distances (s_l for the left speaker and s_r for the right speaker) will be $\lambda/2$, where λ is the wavelength

$$\lambda = \frac{c}{\nu} \approx 0.69\ m.$$

So we have to find x:

$$\begin{cases} s_l - s_r = \lambda/2 \\ s_l = \sqrt{(L+x)^2 + d^2} \\ s_r = \sqrt{(L-x)^2 + d^2} \end{cases}$$

The final result is $x \approx 0.41\ m$

B) Now we have *fictive* difference of wave`s propagation distances $\lambda/2$ in the point that is in 3.20 m distant from a point midway between the two speakers. So this point corresponds to the minimum now. To calculate the point of maximum intensity we need to calculate the same equation as in A), but the distances will be fictive in the sense that they correspond to the phases of the waves.

Answer: A) $0.41\ m$, B) New minimum is old maximum, new maximum is old minimum.