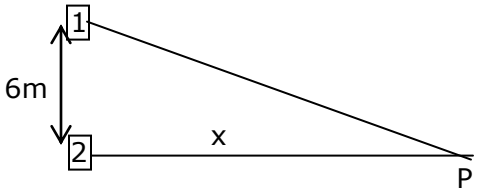
Q- Two speakers are driven by the same oscillator of frequency 200 Hz. They are located horizontally at a distance of 6 meters from each other. Barbara stands in front of one speaker very far away, and walks towards the speaker. How many times will she hear a minimum intensity as she walks from far away towards the speaker and how far is she from the speaker when she hears these minima?



The wavelength is given by

$$\lambda = \frac{c}{n} = \frac{340}{200} = 1.7m$$

Here c is the velocity of sound in air.

At large distance the path difference for the two waves is nearly zero but when she comes near the speaker 2 the path difference is 6 m.

She will hear minimum intensity where the waves interfere destructively and these distances are when the path differences are
Odd multiple of $\lambda/2$

Hence the possible distances x can be calculated as

(1) $\delta_1 = \sqrt{x^2 + 6^2} - x = \frac{\lambda}{2} = 0.85\,\text{m};$

or $x^2 + 6^2 = \left(x + 0.85\right)^2$

Or $x^2 + 6^2 = x^2 + 1.7x + 0.7225$

Gives $x_1 = 20.75$ m

(2) $\delta_2 = \sqrt{x^2 + 6^2} - x = \frac{3\lambda}{2} = 2.55\,\text{m};$

or $x^2 + 6^2 = \left(x + 2.55\right)^2$

Or $x^2 + 6^2 = x^2 + 5.1x + 6.5025$

Gives $x_2 = 5.784$ m

(3) $\delta_3 = \sqrt{x^2 + 6^2} - x = \frac{5\lambda}{2} = 4.25\,\text{m};$

or $x^2 + 6^2 = \left(x + 4.25\right)^2$

Or $x^2 + 6^2 = x^2 + 8.5x + 18.0625$

Gives $x_3 = 2.1103$ m

(4) $\delta_4 = \sqrt{x^2 + 6^2} - x = \frac{7\lambda}{2} = 5.95\,\text{m}.$

or $x^2 + 6^2 = \left(x + 5.95\right)^2$

Or $x^2 + 6^2 = x^2 + 11.9x + 35.4025$

Gives $x_3 = 0.05$.m

For next value the path difference is more than 6 m which is not possible hence only four times the minimum intensity will be heard and the corresponding distances are as above.