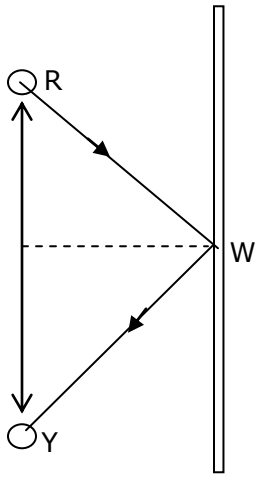
Q- Your friend Ram wants to talk to you. You both are 12 meters apart. A long wall is located 8 meters to the side of both. When Ram talks, you hears the sound coming directly from Ram, and the sound that reflects off the wall. What is the lowest frequency that Ram should talk so that when the two waves reach you they are in phase? Take the speed of sound to be 340 m/sec.

Angle of reflection is same as angle of incidence.
The path RW and WY can be calculated by using Pythagoras theorem as



$$\text{RW} = \text{WY} = \sqrt{\left(\frac{12}{2}\right)^2 + 8^2} = 10.0 \text{ m.}$$

Hence path RWY = 2*10.0 = 20.0 m

As the sound is reflected by wall, may be considered as denser medium, a phase difference π or a path difference λ is introduced hence the total path difference between the waves will be

$$\delta = 20 \pm \frac{\lambda}{2} - 12 = 8 \pm \frac{\lambda}{2} \text{m.}$$

For the two waves to be in same phase this path difference must be $m\lambda$. Here m is an integer.

Hence $8 \pm \frac{\lambda}{2} = m\lambda$

Or $\lambda = \frac{8}{m \pm 0.5}$

And the frequency of the wave will be

$$\nu = \frac{c}{\lambda} = \frac{340(m \pm 0.5)}{8}$$

The lowest frequency will be for m = 1 and with negative sing

$$\nu_{\min} = \frac{340(0.5)}{8} = 21.25 \text{ Hz.}$$