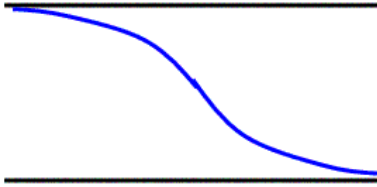An organ pipe (open at both ends) creates its first resonant frequency in a pipe that is 2.60 m long. What is the frequency of the sound wave that is produced if the speed of sound is 340 m/s?

Solution

The fundamental (first harmonic) for an open end pipe needs to be an antinode at both ends, since the air can move at both ends. That's why the smallest wave we can fit in is shown in Figure.

That means the length of the tube is equal to half of a full wavelength:

$$L = \frac{1}{2}\lambda.$$

The frequency of the sound wave is

$$f = \frac{v}{\lambda} = \frac{v}{2L} = \frac{340}{2 \cdot 2.60} = 65.4 \; Hz.$$

Answer: 65.4 Hz.