Chapter 14 Problem 68 †

Given
$f = 22\ Hz$
$v = 343\ m/s$

Solution
a) Find the length of pipe needed for a standing wave with frequency of 22 Hz when the pipe has one open end.

When the pipe has one closed end and one open end, the fundamental wavelength is 4 times the length of the pipe.

$$\lambda = 4L \tag{1}$$

The relationship between wavelength and frequency is

$$v = f\lambda \tag{2}$$

Combining Equations 1 and 2 and solving for length gives

$$L = \frac{\lambda}{4} = \frac{v}{4f}$$

Substituting in the appropriate values gives

$$L = \frac{(343\ m/s)}{4(22\ Hz)} = 3.90\ m$$

b) Find the length of pipe needed for a standing wave with frequency of $22Hz$ when the pipe has two open ends.

The wavelength of the fundamental for a pipe with two open ends is two times the wavelength. Following the same development as above the length will be

$$L = \frac{\lambda}{2} = \frac{v}{2f} = \frac{(343\ m/s)}{2(22\ Hz)} = 7.80\ m$$

†Problem from Essential University Physics, Wolfson