15.16: a) \( v = \sqrt{F/\mu} = \sqrt{(140.0 \text{ N})(10.0 \text{ m})/(0.800 \text{ kg})} = 41.8 \text{ m/s} \).

b) \( \lambda = v/f = (41.8 \text{ m/s})/(1.20 \text{ Hz}) = 34.9 \text{ m} \).  c) The speed is larger by a factor of \( \sqrt{2} \), and so for the same wavelength, the frequency must be multiplied by \( \sqrt{2} \), or 1.70 Hz.

15.36: a) From Eq. (15.35),

\[
f_i = \frac{1}{2L} \sqrt{\frac{FL}{m}} = \frac{1}{2(0.400 \text{ m})} \sqrt{\frac{(800 \text{ N})(0.400 \text{ m})}{(3.00 \times 10^{-3} \text{ kg})}} = 408 \text{ Hz}.
\]

b) \( \frac{10,000 \text{ Hz}}{408 \text{ Hz}} = 24.5 \), so the 24\( ^{\text{th}} \) harmonic may be heard, but not the 25\( ^{\text{th}} \).

15.46: a) For the fundamental mode, the wavelength is twice the length of the string, and \( v = f\lambda = 2fL = 2(245 \text{ Hz})(0.635 \text{ m}) = 311 \text{ m/s} \).  b) The frequency of the fundamental mode is proportional to the speed and hence to the square root of the tension; \((245 \text{ Hz})\sqrt{1.01} = 246 \text{ Hz} \).  c) The frequency will be the same, 245 Hz. The wavelength will be \( \lambda_{\text{air}} = v_{\text{air}}/f = (344 \text{ m/s})/(245 \text{ Hz}) = 1.40 \text{ m} \), which is larger than the wavelength of standing wave on the string by a factor of the ratio of the speeds.

16.24: Open Pipe:

\[
\lambda_i = 2L = \frac{v}{f_i} = \frac{v}{594 \text{ Hz}}
\]

Closed at one end:

\[
\lambda_i = 4L = \frac{v}{f}
\]

Taking ratios:

\[
\frac{2L}{4L} = \frac{v/594 \text{ Hz}}{v/f} = \frac{594 \text{ Hz}}{2} = 297 \text{ Hz}
\]
16.26: a) \( f_1 = \frac{\lambda}{2L} = \frac{(344 \text{ m/s})}{2(0.450 \text{ m})} = 382 \text{ Hz} \), \( 2f_1 = 764 \text{ Hz} \), \( f_3 = 3f_1 = 1147 \text{ Hz} \), \( f_4 = 4f_1 = 1529 \text{ Hz} \).

b) \( f_1 = \frac{\lambda}{4L} = 191 \text{ Hz} \), \( f_3 = 3f_1 = 573 \text{ Hz} \), \( f_5 = 5f_1 = 956 \text{ Hz} \), \( f_7 = 7f_1 = 1338 \text{ Hz} \). Note that the symbol “\( f_1 \)” denotes different frequencies in the two parts. The frequencies are not always exact multiples of the fundamental, due to rounding.

c) Open: \( \frac{20,000}{f_1} = 52.3 \), so the 52\(^{nd}\) harmonic is heard. Stopped; \( \frac{20,000}{f_1} = 104.7 \), so 103\(^{rd}\) highest harmonic heard.

16.29: a) For a stopped pipe, the wavelength of the fundamental standing wave is \( 4L = 0.56 \text{ m} \), and so the frequency is \( f_1 = (344 \text{ m/s})/(0.56 \text{ m}) = 0.614 \text{ kHz} \). b) The length of the column is half of the original length, and so the frequency of the fundamental mode is twice the result of part (a), or 1.23 kHz.

16.40: a) From Eq. (16.17), with \( v_s = 0, v_L = -15.0 \text{ m/s} \), \( f'_A = 375 \text{ Hz} \).

b) With \( v_s = 35.0 \text{ m/s}, v_L = 15.0 \text{ m/s} \), \( f''_A = 371 \text{ Hz} \).

c) \( f'_A - f''_A = 4 \text{ Hz} \). The difference between the frequencies is known to only one figure.