88. A thinner string will sound higher frequency. Since \( v = \sqrt{\frac{F_t}{\mu}} \), a thinner string will have a small \( \mu \). Thus the speed is higher, as is frequency, because \( v = \lambda f \).

89. (a) \( L = \frac{\lambda_1}{2} \), \( \lambda_1 = 2L = 2(3.0 \text{ m}) = 6.0 \text{ m} \).
(b) \( L = 1.5 \lambda_3 \), \( \lambda_3 = \frac{L}{1.5} = \frac{3.0 \text{ m}}{1.5} = 2.0 \text{ m} \).

90. (a) \( f_2 = 2f_1 = 2(100 \text{ Hz}) = 200 \text{ Hz} \).
(b) \( f_3 = 3f_1 = 3(100 \text{ Hz}) = 300 \text{ Hz} \).

91. \( f_3 = 3f_1 \), \( f_1 = \frac{f_3}{3} = \frac{450 \text{ Hz}}{3} = 150 \text{ Hz} \).

92. (a) \( f_1 = \frac{v}{2L} = \frac{12 \text{ m/s}}{2(4.0 \text{ m})} = 1.5 \text{ Hz} \). So the answer is [yes]. 15 Hz is the 10th harmonic.
(b) [No]. 20 Hz is not a harmonic.

93. \( f = \frac{v}{\lambda} = \frac{250 \text{ m/s}}{0.80 \text{ m}} = 312.5 \text{ Hz} \). \( f_1 = \frac{v}{2L} = \frac{250 \text{ m/s}}{2(2.0 \text{ m})} = 62.5 \text{ Hz} \).

So \( n = \frac{f}{f_1} = \frac{312.5 \text{ Hz}}{62.5 \text{ Hz}} = 5 \).

94. (a) \( v = \sqrt{\frac{F_t}{\mu}} \), \( \frac{v}{v_1} = \sqrt{\frac{F_{t2}}{F_{t1}}} = \sqrt{\frac{2}{1}} = \sqrt{2} \). So the speed increases by \( \sqrt{2} \).
(b) \( v = \sqrt{\frac{9.00 \text{ N}}{0.125 \text{ kg/m}}} = 8.49 \text{ m/s} \).

(b) \( f_n = \frac{mv}{2L} = \frac{8.49 \text{ m/s}}{2(10.0 \text{ m})} = (0.425)n \text{ Hz}. n = 1, 2, 3, \ldots \).

95. \( v = \sqrt{\frac{F_t}{\mu}} = \sqrt{\frac{40 \text{ N}}{2.5 \times 10^{-2} \text{ kg/m}}} = 40 \text{ m/s} \).
\( f_n = \frac{mv}{2L} = \frac{40 \text{ m/s}}{2(2.0 \text{ m})} = 10n \text{ Hz} \).

So the frequencies of the first four harmonics are \( 10 \text{ Hz}, 20 \text{ Hz}, 30 \text{ Hz}, \) and \( 40 \text{ Hz} \).