21.39. **Model:** The standing wave on a guitar string, vibrating at its fundamental frequency, has a wavelength λ equal to twice the length L.

Solve: The wave speed on the stretched string is

$$v_{\text{string}} = \sqrt{\frac{T_S}{\mu}} = \sqrt{\frac{200 \text{ N}}{0.001 \text{ kg / m}}} = 447.2 \text{ m / s}$$

The wavelength of the wave on the string is $\lambda = 2L = 2(0.80 \text{ m}) = 1.60 \text{ m}$. Thus, the frequency of the wave is

$$f = \frac{v_{\text{string}}}{\lambda} = \frac{447.2 \text{ m / s}}{1.60 \text{ m}} = 279.5 \text{ Hz}$$

The wave created by the guitar string travels as a sound wave with a speed of 343 m/s in air. Thus, the wavelength of the sound wave that reaches your ear is

$$\lambda_{\text{air}} = \frac{v_{\text{sound}}}{f} = \frac{343 \text{ m / s}}{279.5 \text{ Hz}} = 1.23 \text{ m}$$