# PhysicsTutor

#### Standing wave on a string combined with sound. Knight, 21.37

# Problem:

- A beautiful note from a violin reaches your ear with wavelength 39.1 cm.
- The room is warm and the speed of sound is 344 m/s.
- If the tension in the string is 150 N, and the linear density of the string is 0.600 g/m, how long is the vibrating section of the violin string?

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- String: wave propagation speed is obtained from mass density (given) and tension force (given)

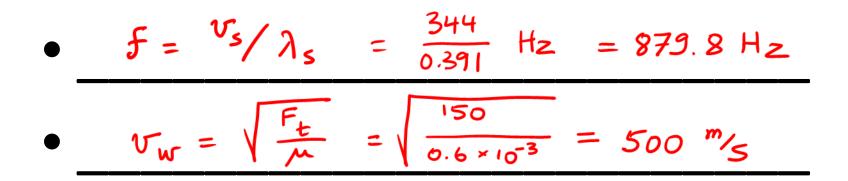
Equations associated with ideas: sound:  $v_s = 344 \text{ Mys} (T > 20^{\circ}\text{C}); v_s = \lambda_s \cdot f$ string:  $v_w = \sqrt{\frac{F_t}{\mu}}; \mu = \frac{M}{L}; v_w = \lambda_s \cdot f$ standing  $\lambda_s \rightarrow \lambda_n = \frac{2L}{n}$  n = 1, 2, 3, ...

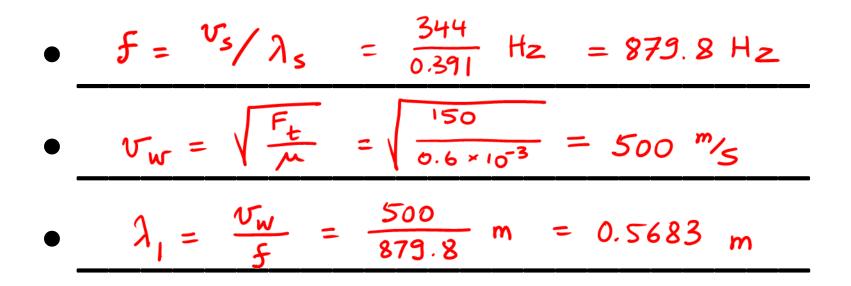
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   and the known wavelength of the sound wave
- We know the propagation speed on the string, and can find the wavelength from the frequency  $\lambda_{i} = \frac{\sqrt{2}}{2} \int_{z}^{z}$

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- We know the propagation speed on the string, and can find the wavelength from the frequency \_\_\_\_\_
- From the standing-wave relation  $\frac{\lambda_1 = \frac{2L}{T}}{\frac{1}{T}}$  we find for n=1 (fundamental) the string length L

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$$\frac{v_w}{w} = \sqrt{\frac{F_{\pm}}{M}} = \sqrt{\frac{150}{0.6 \times 10^{-3}}} = 500 \text{ m/s}$$

$$\frac{\lambda_1}{\lambda_1} = \frac{v_w}{\xi} = \frac{500}{879.8} \text{ m} = 0.5683 \text{ m}$$

$$\lambda_1 = \frac{2L}{L} \quad \therefore \quad L = \frac{\lambda_1}{Z} = 0.284 \text{ m} = 28.4 \text{ cm}$$

-> Frequency is what the longitudinal travelling sound wave and the transverse standing wave have in common. -> The fundamental (n=1) usually dominates.