SAMPLE PROBLEM D

Wave Speed

PROBLEM

A piano string tuned to middle C vibrates with a frequency of 262 Hz. Assuming the speed of sound in air is 343 m/s, find the wavelength of the sound waves produced by the string.

SOLUTION

Given: $v = 343$ m/s $\quad f = 262$ Hz

Unknown: $\lambda = ?$

Use the equation relating speed, wavelength, and frequency for a wave.

$$v = f\lambda$$

$$\lambda = \frac{v}{f} = \frac{343 \text{ m/s}}{262 \text{ Hz}} = \frac{343 \text{ m} \cdot \text{s}^{-1}}{262 \text{ s}^{-1}}$$

$$\boxed{\lambda = 1.31 \text{ m}}$$

PRACTICE D

Wave Speed

1. A piano emits frequencies that range from a low of about 28 Hz to a high of about 4200 Hz. Find the range of wavelengths in air attained by this instrument when the speed of sound in air is 340 m/s.
2. The speed of all electromagnetic waves in empty space is 3.00×10^8 m/s. Calculate the wavelength of electromagnetic waves emitted at the following frequencies:
   a. radio waves at 88.0 MHz
   b. visible light at 6.0×10^8 MHz
   c. X rays at 3.0×10^{12} MHz
3. The red light emitted by a He-Ne laser has a wavelength of 633 nm in air and travels at 3.00×10^8 m/s. Find the frequency of the laser light.
4. A tuning fork produces a sound with a frequency of 256 Hz and a wavelength in air of 1.35 m.
   a. What value does this give for the speed of sound in air?
   b. What would be the wavelength of this same sound in water in which sound travels at 1500 m/s?