Name_____ Units? Units?

Nov. 24, 2003

Phys 2010, Section 3
Quiz #5 — Fall 2003

1. A simple pendulum has a period of 5.00 s for small oscillations (on Earth!).

What is the length of the pendulum?

Use $T = 2\pi\sqrt{\frac{L}{g}}$ (period of simple pendulum). Then:

$T^2 = 4\pi^2 \frac{L}{g}$

$L = \frac{T^2 g}{4\pi^2} = \frac{(5.00\,s)^2 (9.80\,m/s^2)}{4\pi^2} = \boxed{6.21\,m}$

2. A sound wave of frequency 440 Hz is played together with a similar sound wave of unknown frequency. When this happens, one hears pulses of sound at a rate of 2.00 per second.

What are the *possibilities* for the frequency of the second sound wave?

The beat frequency is 2.00 beat/sec; this is the absolute value of the difference of $f_1 = 440$ Hz and f_2: $2.00\ Hz = |440\ Hz - f_2|$

so that f_2 is either $\boxed{438\ Hz \text{ or } 442\ Hz.}$

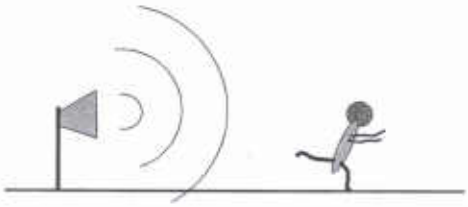
3.a) What is the frequency of a sound wave which has a wavelength of 2.00 cm? Using $\lambda f = v$ with $v = 343\ \frac{m}{s}$ for sound wave in air,

$$f = \frac{v}{\lambda} = \frac{343\ \frac{m}{s}}{2.00\times10^{-2}\ m} = 1.72\times10^{4}\ Hz$$

b) What is the intensity level of a sound wave whose intensity is $1.0 \times 10^{-10}\ \frac{W}{m^2}$?

$$\beta = 10\log_{10}\left(\frac{10^{-10}\ W/m^2}{10^{-12}\ W/m^2}\right) = 10\log_{10}(10^2) = (10)(2) = \boxed{20\ dB}$$

4. You are running away from a source of sound of frequency 480 Hz coming from a stationary source. While doing so, you hear a frequency of 450 Hz.



How fast are you running? (Use $343\frac{m}{s}$ for the speed of sound. Hint: You may want to set $\frac{v_o}{v}$ equal to x and then later solve for v_o.)

Here $V_s = 0$ and V_o is unknown; $f_s = 480$ Hz and $f_o = 450$ Hz. Choosing the proper sign in the Doppler formula, we have:

$$f_o = \left(\frac{1 - V_o/V}{1}\right) f_s = (1-x) f_s, \text{ where } x = V_o/V. \text{ Then:}$$

$$(450\ Hz) = (1-x)(480\ Hz) \rightarrow (1-x) = \frac{450}{480} = 0.938$$

$$\Rightarrow x = 1 - 0.938 = 6.25\times10^{-2} = V_o/V$$

$$\text{So } V_o = (6.25\times10^{-2})\left(343\ \tfrac{m}{s}\right) = \boxed{21.4\ \tfrac{m}{s}}$$

You must show all your work and include the right units with your answers!

Use $343\ \frac{m}{s}$ for speed of sound.

$$f = \frac{\omega}{2\pi} \quad T = \frac{1}{f} \quad \omega = \sqrt{\frac{k}{m}} \quad T = 2\pi\sqrt{\frac{m}{k}} \quad v_{max} = \omega A \quad a_{max} = \omega^2 A$$

$$E_{tot} = \tfrac{1}{2}kx^2 + \tfrac{1}{2}mv^2 = \tfrac{1}{2}kA^2 = \tfrac{1}{2}mv_{max}^2 \quad T = 2\pi\sqrt{\frac{L}{g}} \quad \omega = \sqrt{\frac{MgL}{I}}$$

$$g = 9.80\tfrac{m}{s^2} \quad \lambda f = v \quad v = \sqrt{\frac{F}{\mu}} \quad \mu = \frac{m}{L} \quad I = \frac{P}{4\pi r^2} \quad f_{beat} = |f_1 - f_2|$$

$$\beta = 10\log_{10}\left(\frac{I}{I_0}\right) \quad I_0 = 1\times10^{-12}\ \tfrac{W}{m^2} \quad f_o = \left(\frac{1 \pm \frac{v_o}{v}}{1 \mp \frac{v_s}{v}}\right) f_s = \left(\frac{v \pm v_o}{v \mp v_s}\right) f_s$$