Practice Problems— Intensity, Harmonics, Sound

1. A pendulum's length is doubled. By how much does the period change?

2. The spring constant is tripled while the mass is increased by six times. How much does the period change?

3. What is sound and how is it transmitted?

4. What is the Doppler effect?

5. A. What is the intensity of a 0.50 W sound 8.0 m away?

   B. What is the intensity 16.0 m away?

6. A sound source has a power rating of 2.0 W.
   A. What is the intensity 10 m away?

   B. How many decibels is that?

7. If the intensity increases by a factor of 10, the decibel change is?

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8. A. Calculate the wavelengths for the first three harmonics of a string that is 80 cm long.

   B. If the frequency of the second harmonic is 62 Hz, what is the wavespeed of the string?

9. A. Calculate the wavelengths for the first three harmonics of a pipe closed at one end that is 120 cm long.

   B. What is the wavelength of the fundamental?

10. What is the frequency of the second harmonic for an open pipe that is 24 cm long. (*Use* $V_{sound} = 333$ *m/s*.)

11. How long is a closed pipe with a natural frequency of 350 Hz? Use the same speed of sound.

12. A 40 cm long open pipe produces its first harmonic at 428 Hz. What is the speed of sound for the room, that day?

Practice Problems— Intensity, Harmonics, Sound

1. A pendulum's length is doubled. By how much does the period change?

$T_1 = 2\pi\sqrt{\frac{\ell}{g}}$ $T_2 = 2\pi\sqrt{\frac{2\ell}{g}}$ $T_2 = \sqrt{2}\,T_1$

2. The spring constant is tripled with the mass is increased by six times. How much does the period change?

$T_1 = 2\pi\sqrt{\frac{m}{k}}$ $T_2 = 2\pi\sqrt{\frac{6m}{3k}} = \sqrt{2}\,T_1$ $f = \frac{1}{T_2}$

3. What is sound and how is it transmitted?

longitudinal wave: pressure waves moving thru the air.

4. What is the Doppler effect? *when a sound goes by you hear the pitch drop.*

5. A. What is the intensity of a 0.50 W sound 8.0 m away?

$I = \frac{.5}{4\pi(8)^2} = 6.22\times10^{-4}\ \frac{W}{m^2}$

$10\times10^{-4} = 1\times10^{-3}$ around 85 dB

B. What is the intensity 16.0 m away?

$= \frac{.5}{4\pi(16)^2} = 1.55\times10^{-4}\ \frac{W}{m^2}$ double r = $\frac{1}{4}$ I

6. A sound source has a power rating of 2.0 W.

A. What is the intensity 10 m away?

$I = \frac{2}{4(\pi)10^2} = 1.6\times10^{-3}\ \frac{W}{m^2}$

B. How many decibels is that? 90 dB

7. If the intensity increases by a factor of 10, the decibel change is? + 10 dB
which we hear as twice as loud.

8. A. Calculate the wavelengths for the first three harmonics of a string that is 80 cm long.

80cm [ )))]

$\lambda_{H_1} = 2L = 1.6m$ or 160cm

$\lambda_{H_2} = 80cm = .8m$

$\lambda_{H3} = \frac{2}{3}L = \frac{2(80)}{3} = .53m$

B. If the frequency of the second harmonic is 62 Hz, what is the wavespeed of the string?

$v = f\lambda = 62(.8) =$

9. A. Calculate the wavelengths for the first three harmonics of a pipe closed at one end that is 120 cm long.

$\lambda = \frac{4L}{n}$ $H_1 = \frac{4(1.2)}{1} = 4.8m$ $H_2 = \frac{4(1.2)}{2}$

$H_3 = \frac{4(1.2)}{3} = 1.6m$ $H_5 = \frac{4(1.2)}{5}$

B. What is the wavelength of the fundamental?

4.8 m → not. freq → H_1

10. What is the frequency of the second harmonic for an open pipe that is 24 cm long. (*Use V_{sound} = 333 m/s.*)

$f = \frac{nV}{2L} = \frac{2(333)}{2(.24)} =$

11. How long is a closed pipe with a natural frequency of 350 Hz? Use the same speed of sound.

$f = \frac{nV}{4L}$ $350 = \frac{1(333)}{4(L)}$

$n = 1$ $L =$ $L = \frac{1}{4}\frac{333}{350} = .238m$

12. A 40 cm long open pipe produces its first harmonic at 428 Hz. What is the speed of sound for the room, that day?

$f = \frac{nV}{2L}$ $v = \frac{2Lf}{n} = 2(.4)(428)$

$= 342\ m/s$