Tues, Apr 3

2011-12 PreAP Harmonic Motion 9

1) A **string** is 1.5 m long and produces a note that has a frequency of 150 Hz when plucked. This is H_1, the fundamental.
   A. As a string the $\lambda_{fundamental}$ = __ L.
   B. * So, $\lambda_{fundamental}$ =

   C. Calculate the speed of the wave on the string.

   D. * Give the first 3 possible harmonics on this string.

   E. What part of the sound will be the same in air?
   F. * If the speed of sound in air is 343 m/s, what is the wavelength of the note in the air?

2) An **open pipe** 3 m long produces a 56 Hz sound as its natural frequency (fundamental).
   A. Since it is an open pipe, the $\lambda_{fundamental}$ = __ L.
   B. * Calculate the wavelength of the fundamental.

   C. In a pipe it is actually air that is vibrating, so find the speed of the wave in the pipe (*which is the speed of sound in air*).

   D. Give the first 3 possible harmonics on this pipe.

3) An 40 cm pipe is closed at one end. When struck it naturally produces a 206 Hz sound (*its natural frequency, the fundamental*).
   A. Since it is an closed pipe, the $\lambda_{fundamental}$ = __ L.
   B. * So, $\lambda_{fundamental}$ =

   C. Calculate the speed of sound of the air in the pipe.

   D. * Give the first 3 <u>possible</u> harmonics on this pipe.

   All of the above are pretty simple if you remember that for a string or open pipe $\lambda_{fundamental}$ = 2L and for a closed pipe $\lambda_{fundamental}$ = 4L. And each of the three above examples work with the fundamentals only. Here's how you deal with other examples, easily.

4) * A **closed pipe** is 20 cm long. The third harmonic on the pipe is 1275 Hz. Calculate the velocity of air in the pipe.
   A. You need the wavelength and frequency of one particular harmonic on the pipe. So, calculate the frequency and wavelength of the fundamental.

   B. You can now use the wave equation to calculate the wave speed.

5) If the speed of sound in air is 336 m/s. An open pipe makes a fourth harmonic of 480 Hz. What is the length of the pipe?
   A. Calculate the frequency of the fundamental.

   B. Calculate the wavelength of the fundamental.

   C. Knowing that $\lambda_{fundamental\ for\ an\ open\ pipe}$ = ___ L, calculate the length of the pipe.

* 1) B: 3m; D: f_1 = 150 Hz; f_2 = 300 Hz, etc. F: 2.9 m/s; Q2) B: 6 m; D: all harmonics possible, so just multiply f_1 by 1,2,3 Q3) B: 1.6 m; D: only odd harmonics this time (close pipe). Q4) A: $\lambda_1 = 4(.2) = 0.8$ m; $f_1 = 1275/3 = 425$ Hz B: v = 340 m/s