PHYSICS Problem Set 15.1 Name _____

1. Standing waves can be set up in air columns inside cavities or pipes having either open or closed ends.

   a) The standing wave will always have a (node , antinode) at a ***closed*** end.

   circle one

   b) The standing wave will always have a (node , antinode) at an ***open*** end.

   circle one

2. Make a sketch showing node and antinode locations for the fundamental wave (also called the 1st harmonic) in a pipe 60 cm long that is open at one end and closed at the other end.

3. What portion of the fundamental wave (in # of wavelengths) "fits" in the pipe? _____ λ

4. Calculate the wavelength of the fundamental wave.

5. If the speed of sound in the air column is 340 m/s, calculate the frequency of the fundamental wave.

6. Repeat questions 2–5 for the ***2nd harmonic*** standing wave (also called the 1st overtone).

7. Repeat questions 2–5 for the ***3rd harmonic*** standing wave (also called the 2nd overtone).

8. Complete the following tables regarding standing waves in a pipe:

	ends different (A,N)	ends same (N,N or A,A)
λ_1	4 L	2 L
λ_2	4/3 L	L
λ_3		
λ_4		
λ_n		

	ends different (A,N)	ends same (N,N or A,A)
f_1	f_1	f_1
f_2	$3\,f_1$	$2\,f_1$
f_3		
f_4		
f_n		

1, 2, 3,…n, = harmonic # (1st harmonic = fundamental)

9. Why do identical notes plucked on a banjo and on a guitar have distinctly different sounds?

10. A high-fidelity sound system may have a frequency range that extends beyond the range of human hearing. Of what use is this extended range?

11. Suppose two metal strings both have a fundamental frequency of 512 Hz. One is mounted on a guitar (tied down at both ends) and the other is a stiff piece of metal which is mounted at one end only.

    a) Find the frequencies of the first two overtones for each of the strings.

    b) Will the sounds from these two vibrating objects be identical? *Explain*.

12. An octave spans a frequency range where (f_{higher}) / (f_{lower}) = 2/1. For example, a musical note having a frequency of 440 Hz is one octave higher than a note of 220 Hz. How many octaves are included in the normal frequency range of human hearing?