NAME: _____, Sect. #_____

Physics 109 **Homework #5** due Monday Oct. 15, 2001

Formulae: in air v= 340m/s. Open: $f_1 = v/2L$; $f_n = nf_1$; Closed: $f_1 = v/4L$

Exercises on pipes:

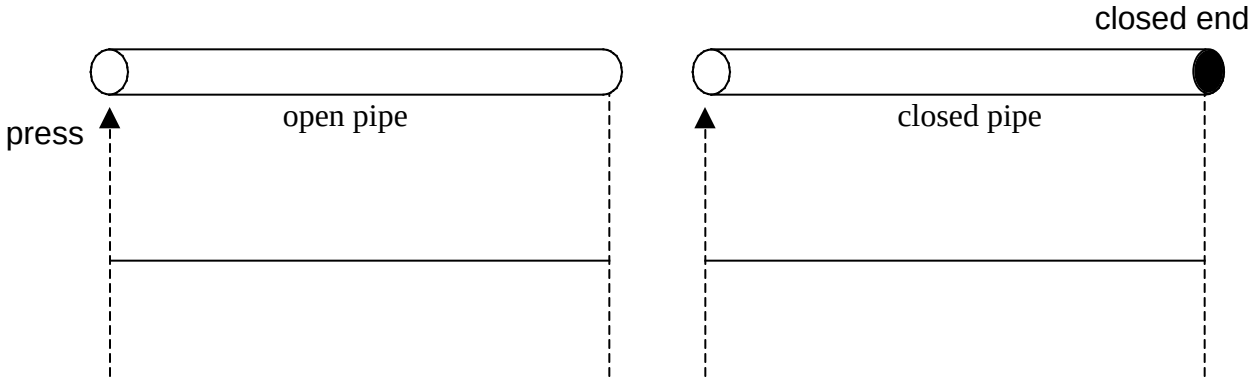
1. **(a)** Find the fundamental frequency and the frequencies of the first two overtones of an open pipe of **60 cm** length.

_____ **Hz,** _____ **Hz,** _____**Hz.**

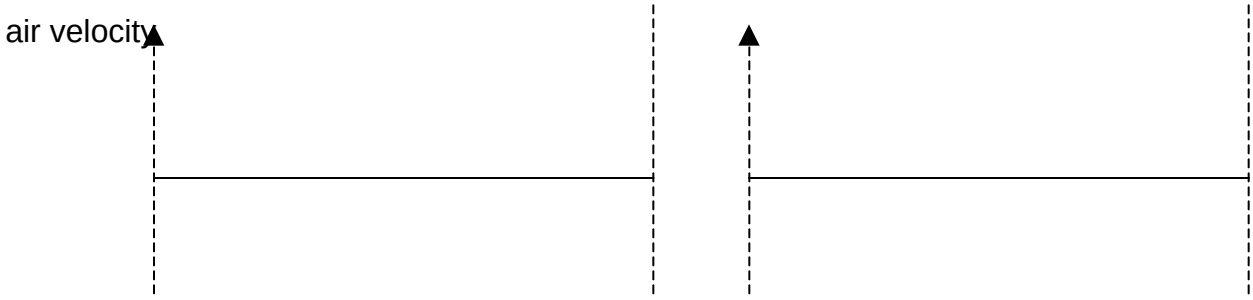
(b) if the same pipe is closed at one end, what are the corresponding frequencies?

_____ **Hz,** _____ **Hz,** _____**Hz.**

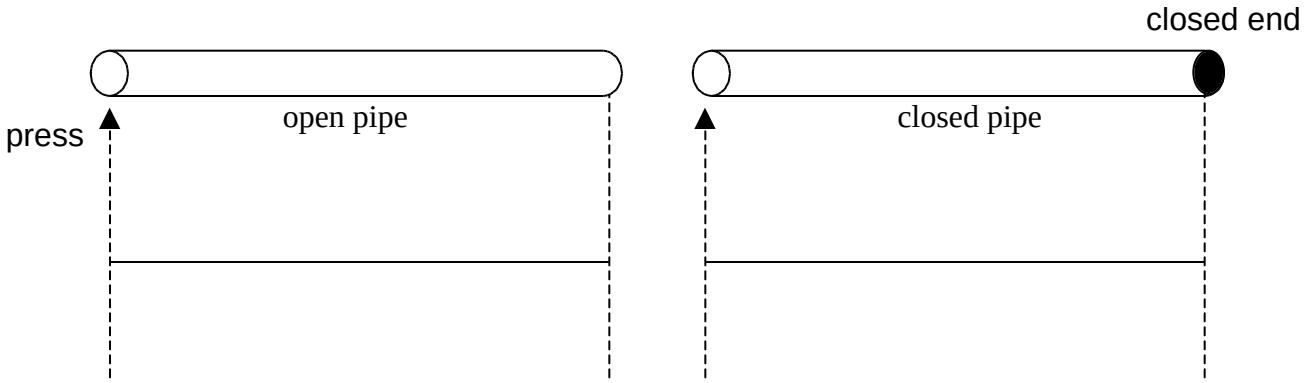
2. (a) Make a graph of the **pressure** at different instances in an open pipe (left) and in a closed pipe (right) oscillating in the fundamental mode.
(hint: first mark the pressure nodes by letter **N** - then draw the curves)



make a corresponding graph or the air **velocity** distribution in the pipe.
(remember slinky demo - where does it move most, where does it not move at all?)



(b) make corresponding **pressure** graphs for the **next higher mode**.



3. Between room temperature (20^{O} C) and body temperature (37^{O} C) the speed of sound increases by 10 m/s. A flute has a frequency of 260 Hz when it is cold. Find the frequency when the flute is warmed to body temperature by the flutist's breath (hint: use proportions to relate frequencies to speed of sound - what is the ratio of speed of sound at the two temperatures? What is the frequency ratio?)

f = _____

Exercises on Fourier Analysis

NOTE: we can usually <u>not</u> figure out the amplitudes of the overtones, but can only find out which are present and what their frequencies are. Thus when you are asked to draw a Fourier spectrum the position of the Fourier components should be in the right place, but the intensity is arbitrary.

4 a) What might the Fourier spectrum of a closed pipe with fundamental frequency 300 Hz look like?

(b) What is the spectrum when the <u>same</u> pipe is open at both ends?

5. What might the Fourier spectrum of a 500 Hz violin string look like when it is plucked 1/3 the length from one end?