

Physics of Music  
 Physics 341  
 Assignment 2

1) a) Given a pipe with both ends open. Where would you put a piece of gauze in order to damp out the second mode but not the first? (In the damping by the gauze, is it important to look at the pressure or the velocity?)

b) Given a pipe with one end closed, where would you drill a little hole to damp out the first mode but not the second? (again, think about whether such a small hole would introduce damping because of the pressure or the velocity in the mode.)

2) Figure 1 shows the nodes of the first 6 distinct modes of a drum head with their frequencies compared to that of the lowest mode. (The modes are numbered according to frequency, from the lowest frequency to the highest) Where would you lightly rest your finger(s) to damp out the first mode but not the second. Where to damp out the second and first but not the fourth.

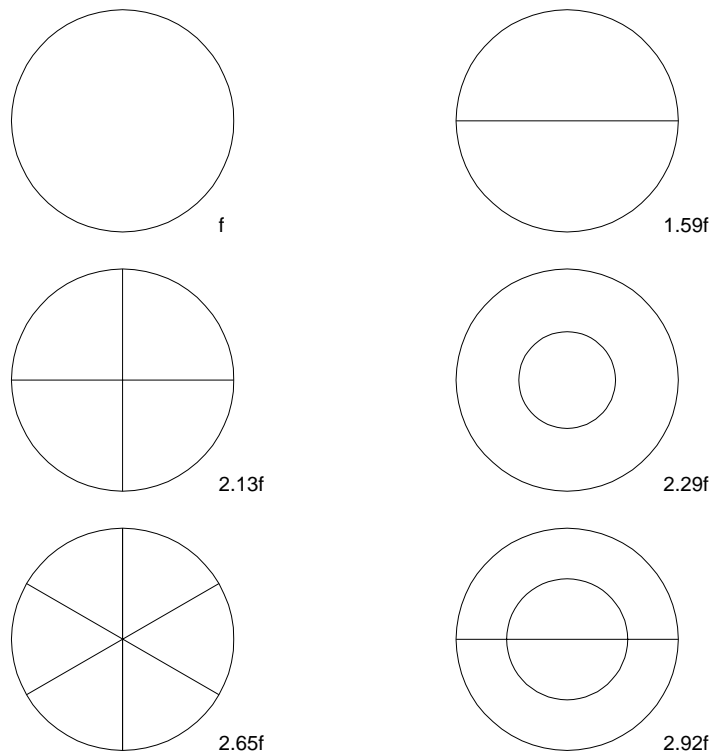


Figure 1

3)a) How many octaves and semitones are the two notes with frequency 450Hz and 2000Hz apart?

b) A soprano sings two notes a perfect fifth apart. What is the difference in frequency between the two notes if the lower one is sung at 440Hz.

5) Which modes of a xylophone bar remain undamped if you held the bar in its middle? Where would you remove material from the bar if you wanted to lower its frequency?

6) The statement has been made (in many undergraduate physics text books) that the Tacoma Narrows bridge fell due to resonance. The bridge, built just south of Seattle in the late '30s fell in a wind storm (40 mph winds), and its amplitude of vibration was over 100 times its amplitude in lower winds (the bridge deck tilted back and forth by over 40 degrees from the horizontal). Do you find this explanation convincing? Why (or why not)? (Hints: What would the  $Q$  of the bridge have to be? What would the frequency of pushing of the wind on the bridge have to be?)

7) A small lump of tape is placed on a guitar string exactly at a point  $1/2$  of the length from the end of the string. What effect would this have on the frequencies of the various modes of the string? (Consider the lowest 4 modes).