Name: _____

Other group members: _____

Tutorial #8

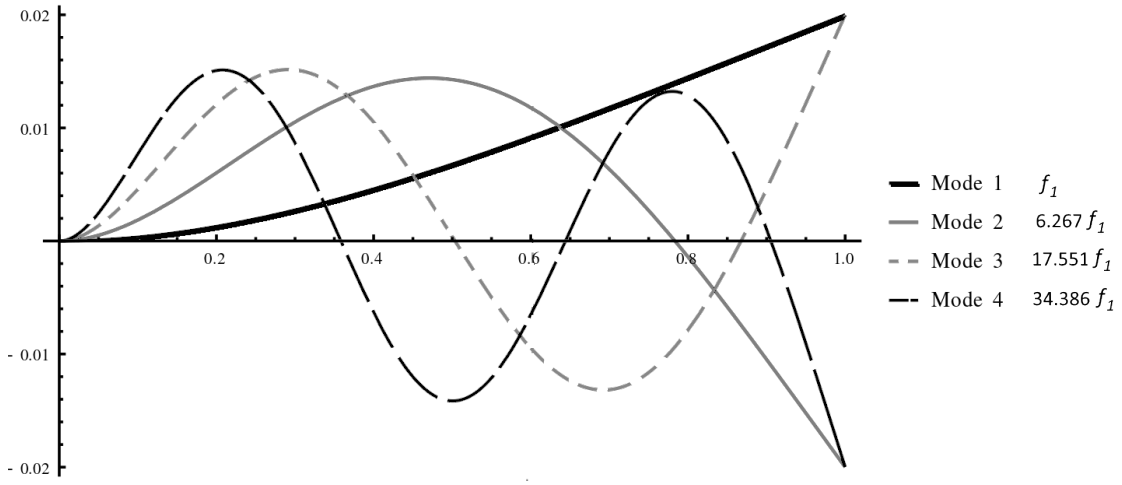
PHYS 1240: Sound and Music

Monday, July 29, 2019

Instructions: Work in groups of 3 or 4 to answer the following questions. Write your solutions on this copy of the tutorial—each person should have their own copy, but make sure you agree on everything as a group. When you're finished, keep this copy of your tutorial for reference—no need to turn it in (grades are based on participation, not accuracy).

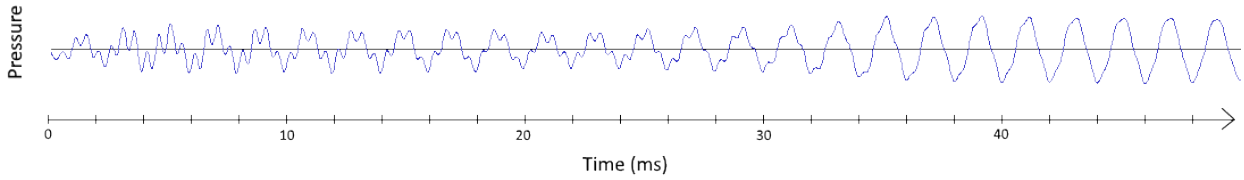
1. Consider a tuning fork which is tuned to the musical note A_5 (880 Hz). We can model this system as two beams each clamped at one end and free at the other, each one of which is shown in the diagram below.

   (a) What are the frequencies of the second, third, and fourth modes (in kHz)?



(b) If you hang the tuning fork from a string attached to the center of both beams (at 0.5 on the x-axis of the diagram below) and strike it, what frequency will you hear? Why?

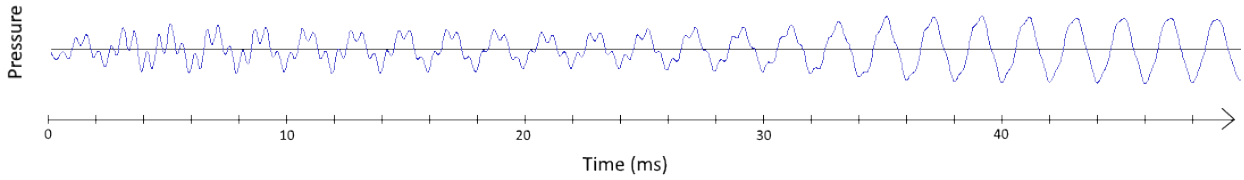
(c) Where should you strike the tuning fork to most effectively sound the 4th mode? (Express your answer as a percentage, e.g. 40% of the way from the base.) If you do this, how likely is it that you will hear this mode?



2. The plot above shows the plot of pressure versus time for a sound produced by an instrument hit by a mallet.

(a) Measure the fundamental frequency of this sound. (*Hint*: You will first need to measure the period—which periodic part of the wave is longest?)

(b) You should also notice a second, smaller period corresponding to the next-highest mode. Find the frequency of this mode.



(c) In the space below, draw three frequency spectra (plots of amplitude versus frequency) corresponding to this sound wave. The first spectrum should be for the beginning of the sound (at around 0–10 ms), the second should be in the middle (around 25 ms), and the third should be at the end (around 50 ms). Be sure to label the x-axis with the frequencies you found in parts (a) and (b).

(d) What phenomenon is responsible for the changes in the sound's spectrum over time?

(e) Based on the spectra you drew, what instrument is likely being played in this plot? Why?

3. If the amplitude of a certain wave decreases to half its value in 0.2 seconds, how many decibels has it decreased in this time? If it continues to decay at this same rate, what is the 60-dB damping time (the time it takes for the sound wave to decrease 60 dB, a standard measure for how long we hear the sound last)?