Exam #1

This exam should only take you about 2 hours to complete. You are to complete the exam without the help or consultation of any of your fellow students or any other person. By signing your name and handing in this exam paper you are asserting that this is your own work; if it is determined subsequently that this is untrue then applicable University or Rochester Academic Honesty policies will be enforced. However you may consult class notes, the textbook, the Internet, or other written sources of material in completing the exam. Hand in all exams by 2:00 PM Friday October 11 to Hopeman 334, (Sarah Smith’s Office).

1. Write down a function for a sine wave with a period of 4 milliseconds and that has a value of 1.5 at t = 3 milliseconds.

2. If you look at the staircase in the new Rettner Hall you will see that it is partially supported by a long steel cable, kind of like an oversized guitar string. Assume that the main cable holding up the staircase has a linear mass density of 5 kg/meter and is under a tension of 75,000 Nt. If the cable is 10 meters long what is the speed of a bending wave on this cable? Then, what is the fundamental frequency for its lowest bending mode of oscillation?
3. A trend in bass guitar design is to make the strings longer. Rather than 34” which is standard many basses have strings of length 35” or even as long as 37”. Assume that you use the same gauge strings and tune the bass guitar to the same pitches. Is the tension in the strings higher or lower? If you go from 34” to 35” by what percentage does the string tension change? Support your answers with a few simple equations.

4. Explain how the equal temperament scale is constructed and how it solved the problem of the Phythagorean comma. Discuss the main compromises in the equal temperament tuning system.
5. If one plucks a guitar string close to the bridge (near the end of the string) the sound is “brighter”. What does brighter mean in terms of the frequency content of the signal? Why is the sound brighter when you pluck the string closer to its end?

6. You are trying to build a contrabass flute with a lowest note at 32.7 Hz, this is C1, the lowest C on a piano. Find how long the pipe needs to be.
7. Find the lowest frequency acoustic resonance in a bathroom with dimensions 2.5 meters wide, 3 meters long and 2.5 meters high. Assume that the speed of sound is 340 m/sec. After computing the resonant frequency can you comment on why everyone’s singing sounds so much better in the shower.

8. What is reverberation time for a room? Explain the definition of T_{60}. 