SCI220 – Foundations of Musical Acoustics
Cogswell Polytechnical College
Fall 2008

Week 1 – Homework
Problem set due 09/02, lab due 09/04

Exercises

1. How far does sound travel during 0.002 second if the temperature is 20°C?
2. How long does it take for sound to arrive at the back of an auditorium if the temperature is 30°C and the stage is 35m away?
3. Suppose a sound wave has pressure amplitude 0.3 N/m². What is this amplitude expressed as a number of atmospheres? What are the maximum and minimum pressures in (atm) in the presence of this wave?
4. Imagine for a moment that treble sounds could travel at 400m/s, but bass sounds at only 300m/s. If sound actually behaved this way, and you were listening to a brass band from a distance of 120m, how much delay would you hear between trumpet and tuba notes when they begin a chord together?
5. Suppose a particular sound wave momentarily creates an extra pressure of 10^{-4} atm upon a microphone diaphragm that has the area of 1cm². What total force in newtons does this make on the diaphragm?
6. If the frequency of a middle-C sound wave is 262 Hz, what is the period of each vibration?
7. Suppose you measured both frequency and wavelength of a sound wave to be 175 Hz and 2m, respectively. What speed of sound does that imply? Give two different reasons for why the answer may not be 344 m/s?
8. If a violin string vibrates at 1720 Hz, what is the wavelength of the sound produced in the surrounding air? (Assume T = 20°C)
9. If a steady force of 2N applied to a certain string stretches it to 0.2m, what is the stiffness, K? If a mass of 0.1kg is hung on this spring, what will be its natural frequency of oscillation?
10. If the microphone from exercise 5 moved 10^{-5} m under the influence of that 10^{-3} N force, how much work did the force do?
11. (Extra credit) A) Calculate the pulse repetition rates corresponding to an interpulse time of T = 2.0, 0.2, 0.02, 0.002 seconds. B) Classify each of your results into the way each pulse sequence is perceived (buzz, tone, individual

pulses).

Lab Assignment

1. Find a large building from which you can stand 30 or 40m away and hear a good echo when you clap your hands. Find a clapping rate for which each echo splits the time between two consecutive claps in half. Use your wristwatch to find how long does it take for 10 or 20 such claps.
   Explain why this is more accurate than just measuring the time fro one clap to the next. Remember the formula $v = d/t$. Compute the speed of sound using your distance and time data and see whether your answer lies close to 344m/s.
2. Using the Pure data (Pd) patch given, observe the signals of four different sound sources. Make as wide a variety of sounds as you can. Describe each wave in terms of amplitude, frequencies, and waveform complexity.

Note: group work is acceptable and recommended, if and only if, you write your own homework to submit. Remember to show your work on the problem sets and submit all of your data for the lab.