SCI220 – Foundations of Musical Acoustics
Cogswell Polytechnical College
Fall 2008

Week 4 – Homework
Problem set due 09/23, lab due 09/25

Exercises

1. A sound pressure level of 160dB means maximum pressure fluctuations of 2800N/m² = 0.28 atm; according to Backus and Hundley, sound levels this high occur inside of a trumpet mouthpiece. if such sound were to fall on your eardrum, how large would be the pressure fluctuations in the inner ear if we ignore the protective mechanisms in the middle ear? How much displacement of the eardrum and of the oval window? (remember: the stapes exerts 1.3 times as much force on the oval window as the eardrum does on the malleus) Do these figures suggest why such a high level of sound is very damaging?
2. If you go to low enough levels, the JND in sound level may become as large as 2dB. Under those conditions, what is the minimum detectable change in intensity, expressed as a percentage?
3. Suppose you change a sine wave's frequency from 180Hz to 400Hz and then again from 400Hz to 700Hz. Which change will be perceived as a greater change in pitch? (Think in terms of octaves).
4. From fig 6.13 of your handout, determine the loudness levels of 20, 30, 60 70, 90, and 100 phons.
5. If you hear three sounds with f = 200, 1000, and 3000Hz, all at the same intensity level SIL = 60dB, which will sound loudest and which least loud? If you hear the same three frequencies, each at the same loudness level LL = 60 phons, which actually has the greatest intensity and which the least?
6. Describe where on the basilar membrane the maximum vibration amplitude occurs when the ear receives a sine wave with f = 6400Hz?
7. What are the approximate critical bandwidths in Hz for center frequencies a) 3KHz, b) 10KHz, and c) 200Hz?
8. Do 100 and 150Hz lie within a single critical band? What about 1000 and 1500Hz? 6000 and 6500Hz?
9. Three sine waves have frequencies 600, 1020, and 1100Hz, and all have level 80dB. What is the loudness in sones when all three are heard together?
10. Three sine waves have frequencies 110, 150, and 370Hz, and all have level 50dB.

What is the loudness in sones when all three are heard together?

Lab Assignment

1. Go to http://www.phys.unsw.edu.au/jw/hearing.html and plot your hearing response. Do this 2 times and compare.
2. Write up a 1-2 page report on our guitar study.

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.