Physics of Music
Physics 341
Assignment 4

1) In the graph of dB versus frequency,

i) What frequencies correspond to -30dB? To -5dB?

What pitches (including names) correspond to these frequencies?

ii)What dB correspond to 1700 Hz? 400Hz? 6500Hz? What pitches correspond to these frequencies? (use the nearest letter name, including ♯ or ♭)

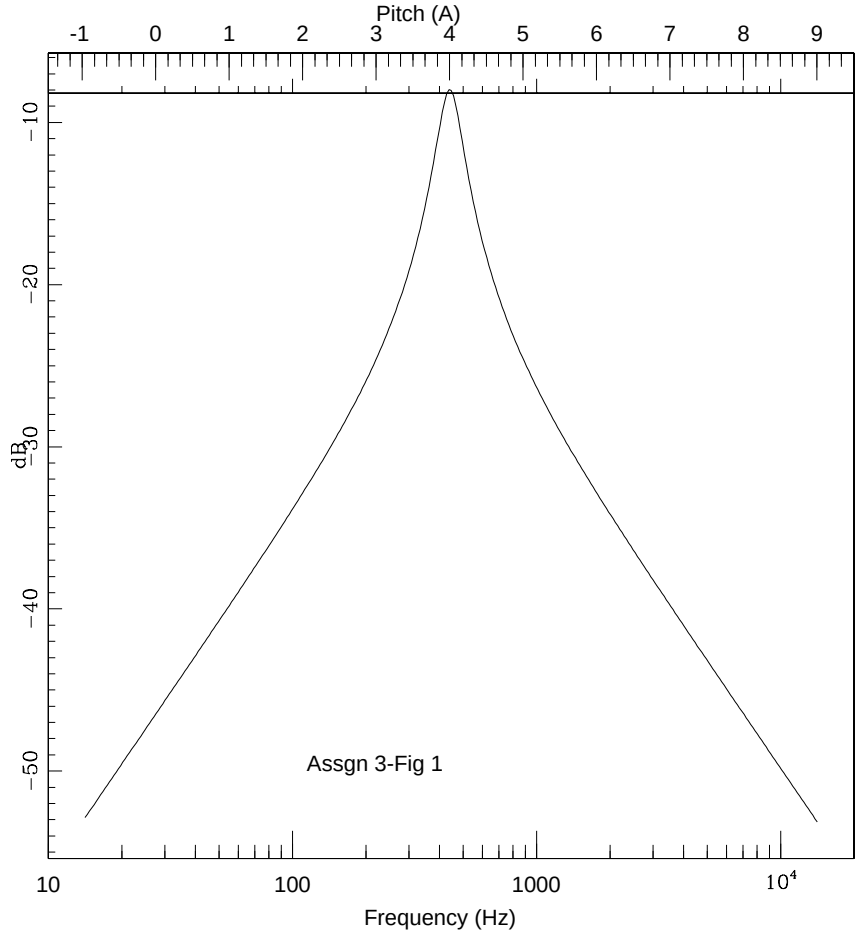

Figure 1

Note that this graph is the graph of the "resonance response" of the energy (not amplitude) of an oscillator to an external driving force which has the same amplitude at each frequency. Note the 6 dB per octave fall off in the energy on either side of the resonant frequency (which occurs at 440 Hz).

2) I want to tune one string 2 Hz below another. How could I do this by listening to the two strings together?

3) The critical band is the range of frequencies around which the vibration on the basilar membrane overlaps (ie, if one has two frequencies, the widths of the region which which each causes to vibrate overlap with each other). This is taken to roughly be a minor third (ie, if two frequencies differ by less than a minor third, their regions of membrane excitation overlap). Consider the series of harmonics of a note. By which harmonic do successive harmonics have overlapping excitations on the basilar membrane?

4) In graph 3, estimate what the highest harmonic which would be needed to make up the complex wave form?

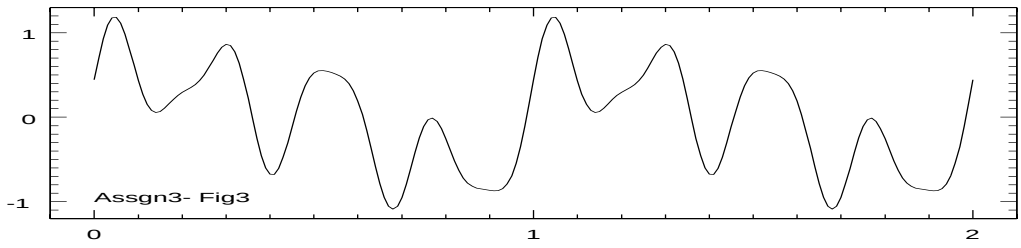

Figure 2

5) 1) In graph 1, add the two waves to get the composite wave.

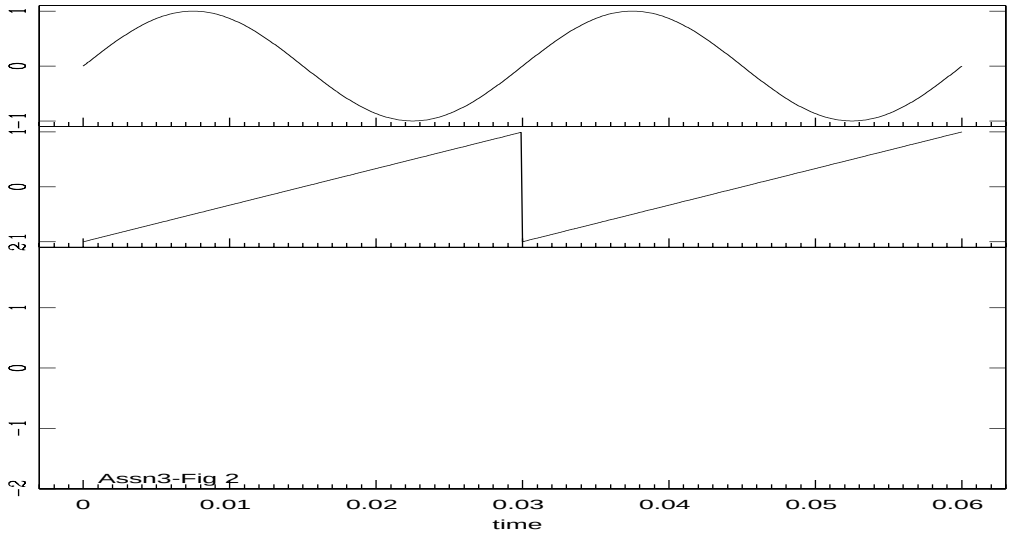

Figure 3

6) A rock concert is going on in Deer Lake Park. Leigh Palmer, at a distance of 1km from the concert measures the intensity of the sound at his house at 80dB. How loud will the sound be 10m from the speakers, where many of the audience will be located?

Assuming the concert lasts for an hour, what intensity should the sound be at 10m from the speakers in order that it comply with the BC Workman's Compensation Board limits on noise in the workplace? What would now be the intensity at Palmer's house?

(Under WCB regulations, the average intensity over 8 hours must be less than 80dB. If all of that exposure takes place in 1 hour, what intensity can the concert be at?)