Assignment 6
Physics of Music - 2016
Physics 341

1 a)I attended the Marriage of Figaro a few years ago, and found that hearing the bass while he was singing his lower notes was much more difficult than hearing the tenors and the women. Could there be some Physics reason for this? What is it?

b) Why is an (unpowered) megaphone useful (consider the size of the radiating area)? Why do singers tend to sing with their mouths wide open? (It is not for the looks!)

c) Why, when you scream for help, do you open your mouth wide and scream at a high pitch?

2. Figures 1 and 2 are the polar plot of the sound radiation intensity given off by a vibrating diaphram in a wall, at various frequencies. what is the the relative intestity both as a ratio to straight ahead and as dB (relative to straight ahead) of the sound given off at 40 degrees for a frequency of twice the knee frequency? At 70 degrees? What are the relative intensities (compared to straight ahead) of the sound given off at 5 degrees and at 30 degrees for a frequency of eight times the knee frequency.

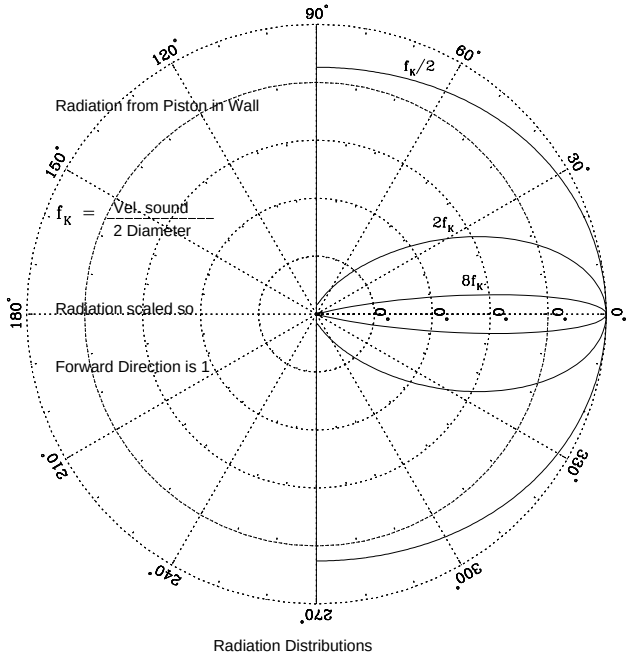

Figure 1

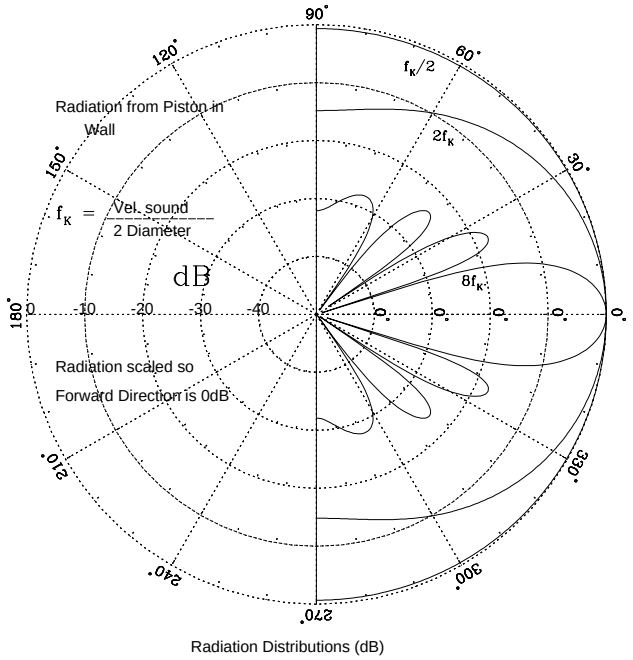

Figure 2

3. Why, when you take off your earphone and lay them on the table, do you suddenly stop hearing the bass, and all you hear is a very tinny high pitched sound?

4. A loudspeaker has a free air (ie outside of any box) resonance of 100 Hz. What would you expect to happen to that resonance if you mounted the speaker in a box enclosure. How would you expect that frequency to depend on the size of the box? Why is it it impossible to get good bass response from a small box?

5. How much louder would a loudspeaker with 4 speaker cones vibrating be than a loudspeaker with just one of those same speakers? What would happen if you miswired one of them so that the motion was out of phase with the other three? How about if you put stacked 20 of them all wired with the same phase? (recall what you know about adding sounds together.)

6. Since people like bass sounds, some loudspeakers are designed so that one can use the sound from inside the box to augment the sound from the speaker at low frequencies. This is done by cutting hole into the box, and either inserting carefully constructed length of tubing into the hole (Bass Reflex loudspeaker). This gives the air in the box a "coke bottle" resonance. What would lengthening or shortening the length of the tube do? What is the phase of the motion of air

in the tube with respect to the air in the front of the speaker i) at frequencies well below resonance, ii) at resonance iii) well above resonance. HOw would the sound from the air in the hole combine with the sound from the front of the speaker in these three cases.