

Assignment 5
 Physics of Music - 2001
 Physics 341

1. Figures 1 and 2 are the polar plot of the sound radiation intensity given off by a vibrating diaphragm in a wall, at various frequencies. what is the the relative intensity 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.

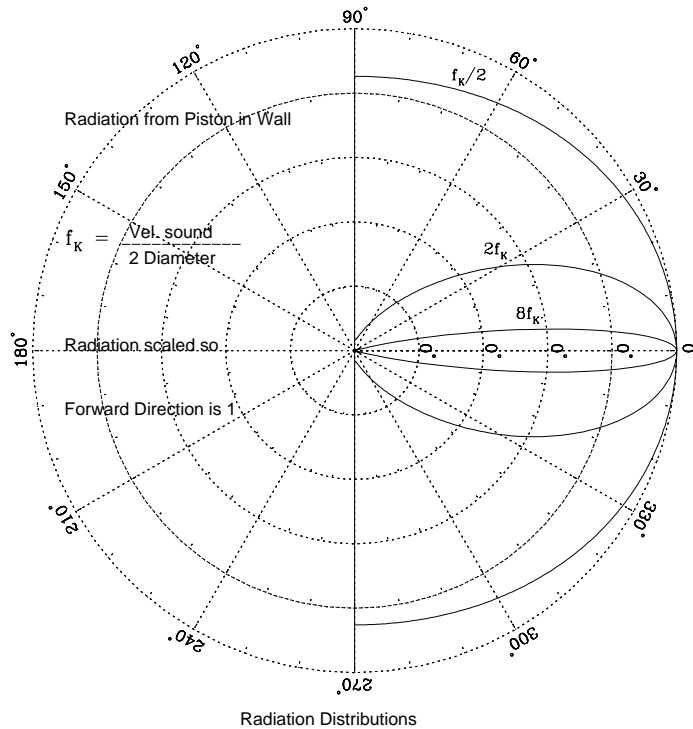


Figure 1

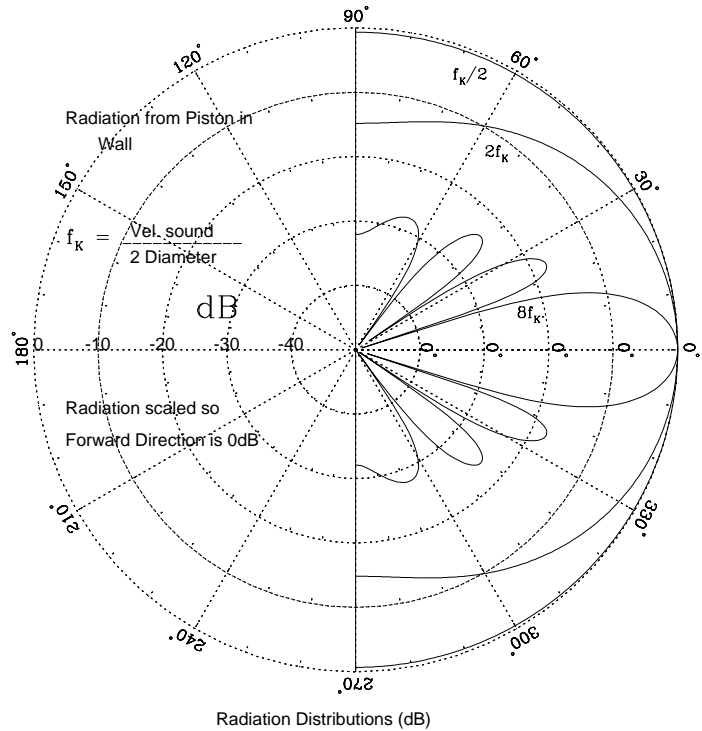


Figure 2

2 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?

3. Two notes, a slightly mistuned perfect Pythagorean fifth apart, are played together. Which harmonics of the two notes will beat? If the lowest note is A440, what would the beat frequency be for the lowest of those beating harmonics if the mistuned perfect Pythagorean fifth is an equal tempered fifth?

4. Two loudspeakers are run so that the cones vibrate with the same velocity and the same frequency of A440. One of the cones is 5cm across, and the other is 10cm. How much difference in loudness (ie intensity of sound) is there between the two speakers? Express in both dB and relative intensities. (Remember both efficiency and size).

5. 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?

6. Figure 3 is the response of a loudspeaker. What is the difference in dB between the maximum and minimum responses of the speaker. What is the difference in intensity?

*From : The Audio Amateur
Issue # 2 1977
David P Hermejer. page 4-9*

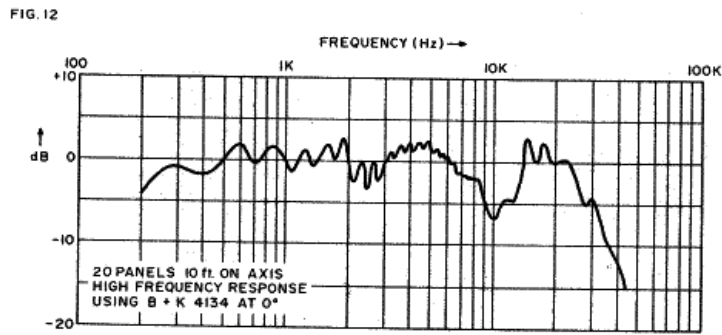


Fig. 12. Twenty panels measured at 10 feet.

Figure 3

7. A sound, where the velocity of the air in the soundwave is the same as the velocity of sound in that air (340 m/sec) has the maximum intensity of 196dB. (the pressure fluctuations are one atmosphere-100,000 pascal). What is the velocity of the air in a sound-wave with an intensity of 100 dB. (Recall that the the velocity is directly proportional to amplitude of the signal and remember the relation between amplitude and dB).