

Physics 225

Homework Assignment 5

Due 14 February 2008 (note)

1 Impedance and swimming pools

Water has a density of 1000 kg/m^3 and a speed of sound of 1400 m/s . Air has a density of 1.2 kg/m^3 and a sound speed of 344 m/s .

1. By how many decibels is a sound attenuated, when it goes from the air into the water?

2. Assuming that the sound gets attenuated by the same amount AGAIN as it goes from the water into the air bubble inside a swimmer's ear, will a swimmer at the bottom of a pool be able to hear loud conversation (70 dB) occurring outside the pool?

2 Ear as a resonator

The meatus (ear canal) of your ear is an approximately cylindrical tube about 2.5 cm deep, open at one end and closed (by the eardrum) at the other. What are its first two resonant frequencies?

Suppose two sounds are produced near your head, of equal loudness. One has a frequency of 1000 Hertz , one has a frequency of 3500 Hertz . Explain (based on your answer to the first part, and based on how resonances in tubes work) why the pressure on your eardrum will be larger for the 3500 Hertz sound than for the 1000 Hertz sound. (Because of this effect, the ear is extra-sensitive to a range of frequencies around 3500 Hertz .)

