

Chapter 18

1- A man strikes a long steel rod at one end. Another man, at the other end with his ear close to the rod, hears the sound of the blow twice (one through air and once through the rod), with a 0.1 seconds interval between. How long is the rod? [For the steel, the bulk modulus = 2.1×10^{11} Pa, and the density = 7.0×10^3 kg/m³. Speed of sound in air = 340 m/s]. [36 m]

2- If two successive frequencies of a pipe, closed at one end and filled by air, are 500 Hz and 700 Hz, the length of the pipe is: [speed of sound in air = 340 m/s]. [0.85 m]

3- If the distance from a source of sound increases by 1 meter, the sound level is decreased by 2 dB. Assume the loudspeaker that is emitting this sound emits sound in all directions. The original distance from the sound source is: [3.86 m]

4- An ambulance siren emits a sound of frequency 1.60 kHz. A person running with a speed of 2.50 m/s hears a frequency of 1.70 kHz as the ambulance approaches him from the back. How fast is the ambulance moving? (speed of sound is 340 m/s). [22.4 m/s]

5- The maximum pressure amplitude that the human ear can tolerate in loud sounds is 28 Pa. What is the displacement amplitude for such a sound in air of density 1.21 kg/m³ at a frequency of 5.0×10^3 Hz? [speed of sound in air = 343 m/s]. [2.15 * 10⁻⁶ m]

6- Two sound waves, from two different sources with the same frequency, 660 Hz, travel at a speed of 330 m/s. The sources are in phase. What is the phase difference of the waves at a point that is 5.0 m from one source and 4.0 m from the other? (The waves are traveling in the same direction.) [4 Pi radian]

7- A tube 1.5 m long is closed at one end. A stretched wire is placed near the open end. The wire is 0.33 m long and has a mass of 9.8 g. It is fixed at both ends and vibrates in its fundamental mode. By resonance, it sets the air column in the tube into oscillation at that column's fundamental frequency. Find the tension in the wire. [Speed of sound in air = 343 m/s]. [42 N]

8- A 1.5×10^{-6} W point source emits sound waves isotropically. What is the sound level 2.5 m from the source? [43 dB]

9- A police car is approaching a stationary observer at 34.0 m/s with its siren emitting a frequency of 450 Hz. What is the frequency heard by the observer? [Speed of sound in air = 343 m/s]. [500 Hz]

10- Two small identical speakers are connected (in phase) to the same source. The speakers are 3 m apart and at ear level. An observer stands at X, 4 m in front of one speaker as shown. The sound he hears will be least intense if the wavelength is: [2 m]

