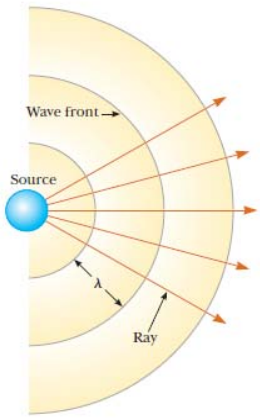
Chapter 14 .Sound

Sound Intensity (a) in S.I. unit $I = \dfrac{\text{Power}}{\text{Area}} = \dfrac{W}{m^2}$

(b) in dB $\beta = 10\log\left(\dfrac{I}{I_0}\right)$

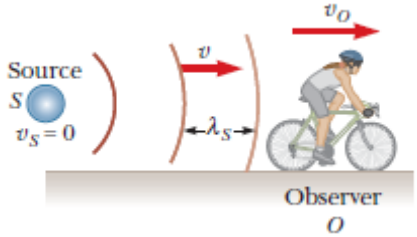


Problem A small source emits sound waves with a power output of 80.0 W. (a) Find the intensity 3.00 m from the source. (b) At what distance would the intensity be one-fourth as much as it is at $r = 3.00$ m? (c) Find the distance at which the sound level is 40.0 dB.

Solution: (a) $0.707 W/m^2$ (b) 6.00 m (c) $2.52\times10^4 m$

17. There is evidence that elephants communicate via infrasound, generating rumbling vocalizations as low as 14 Hz that can travel up to 10 km. The intensity level of these sounds can reach 103 dB, measured a distance of 5.0 m from the source. Determine the intensity level of the infrasound 10 km from the source, assuming the sound energy radiates uniformly in all directions.

Solution: 37 dB



Doppler Effect $f_o = f_s\left(\dfrac{v \pm v_o}{v \mp v_s}\right)$

f_o frequency heard by **o**bserver

f_s frequency of the **s**ource

v speed of sound

v_o speed of observer

v_s speed of source

Moving toward → Higher Frequency

PROBLEM An ambulance travels down a highway at a speed of 75.0 mi/h, its siren emitting sound at a frequency of 4.00×10^2 Hz. What frequency is heard by a passenger in a car traveling at 55.0 mi/h in the opposite direction as the car and ambulance **(a)** *approach* each other and **(b)** pass and *move away* from each other? Take the speed of sound in air to be $v = 345$ m/s.

Solution: (a) 475 Hz (b) 339 Hz

25. Two trains on separate tracks move toward each other. Train 1 has a speed of 130 km/h; train 2, a speed of 90.0 km/h. Train 2 blows its horn, emitting a frequency of 500 Hz. What is the frequency heard by the engineer on train 1?

Solution: 596 Hz