Sound intensity

1. HR.p456. If an ear plug decreases the sound level of the sound waves by 20 dB, what is the ratio of the final intensity I_f of the waves to their initial intensity I_i ?

Answer: 0.01

2. BW.p530. Two friends attend a rock concert and bring along a sound meter. With this device, one of them measures a sound level $\beta_1 = 105\ dB$, while the other, who sits 4 rows closer to the stage, measures $\beta_2 = 108\ dB$. If the rows are spaced $0.7\ m$ apart, what is the distance to the stage?

Answer: $6.8\ m;\ \ 9.6\ m$

Sound Resonance – Musical Instruments

3. HR.p459. Assume background noises from the room set up a standing wave in fundamental mode in a cardboard tube $L = 67cm$ with two open ends.

a. What frequency do you hear from the tube?

b. If you jam your year against one end of the tube, what fundamental frequency will you hear?

c. What would be the length of a second open-open tube to give the same frequency as b) ?

Answer: $256\ Hz;\ \ 128\ Hz;\ \ 2L$

Beats

4. BW.16.34. A string of a violin produces 2 beats per second when sounded along with a standard fork of frequency 400 Hz. The beat frequency increases when the string is tightened.

a. What was the frequency of the violin at first?

b. What should be done to tune the violin?

Answer: $402\ Hz$

Doppler Shift

5. HR.p464. Bats navigate and search out prey by emitting, and then detecting reflections of, ultrasonic waves, which are sound waves with frequencies greater than can be heard by a human.
Suppose a bat emits ultrasound at frequency $f_{be} = 82.52\ kHz$ while flying with velocity $\vec{v}_b = 9\frac{m}{s}\hat{\imath}$
As it chases a moth that flies with velocity $\vec{v}_m = 8\frac{m}{s}\hat{\imath}$.

a. What frequency f_{md} does the moth detect?

b. What frequency f_{bd} does the bat detect in the returning echo from the moth?

Answer: $82.8\ kHz;\ \ 83\ kHz$

Doppler Shift and Beats

6. BW16.63. A car traveling at $25\ m/s$ honks its horn as it directly approaches the side of a large building. The horn produces a long sustained note of frequency $f_0 = 230\ Hz$. The sound is reflected off the building back to the car's driver. The sound wave from the original note and that reflected off the building combine to create a beat frequency. What is the beat frequency the driver hears?

Answer: $36\ Hz$