

Workshop module 4 - Physics 123, Fall 2013

1. Two successive harmonics of a vibrating string (fixed ends) are 240 Hz and 320 Hz. What is the frequency of the fundamental for this string?
2. Three successive resonance frequencies in an organ pipe are 1310, 1834, and 2358 Hz, respectively. Is the pipe closed at one end or open at both ends? What is the fundamental frequency of the pipe? What is the length of the pipe?
3. A violinist is tuning the A string on her violin by listening for beats when this note is played simultaneously with a tuning fork of frequency 440 Hz. She hears a beat frequency of 4 Hz. She notices that, when she increases the tension in the string slightly, the beat frequency decreases. What was the frequency of the mistuned A string?
4. The famous rock star, Axle Ross, walks in a straight line between two speakers that are driven by the same amplifier. The speakers are separated by 10 meters. Each speaker emits a sound with a frequency of 300 Hz. The speed of sound in air is 340 m/s. At what positions, relative to the location of one of the speakers, will Axle find minima in the intensity of the sound (corresponding to destructive interference)?
5. During our discussion of the special theory of relativity in lecture, we covered the optical Doppler effect relating the light frequencies emitted and detected by moving sources and detectors. Spend a few minutes seeing if you can derive similar relationships for (non-relativistic) sound waves. In this case time dilation is not a factor as it was in relativity. After playing with this for a while, scan through Giancoli Section 16-7 (p. 439) and compare what he says with what you were thinking.

Some say if Dante were alive now, he would describe hell in terms of taking a university course in physics. The vision brought to mind by some of the comments I've heard is that of the devil standing over the pit of hell gleefully dropping young, innocent, and hardworking students into the abyss. Let us suppose that air friction cannot be ignored. A student accelerates downward until the force due to air friction is equal (and opposite in direction) to that due to gravity. At that point, the student has reached a "terminal" (pardon the pun) velocity and continues downward without accelerating any further. After reaching terminal velocity, a falling student screams at a frequency of 855 Hz. The grinning devil hears the scream and judges it to be at 835 Hz. What is the terminal velocity of the student?

6. 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. What is the beat frequency heard by the driver?
7. When a pin of mass 0.1 g is dropped from a height of 1 m, 0.05% of its energy is converted into a sound pulse with a duration of 0.1 s. Estimate the range at which the dropped pin can be heard if the minimum audible intensity is 10^{-11} W/m².