

A Very Sound Worksheet

1. Please draw the wave pattern for the 3rd, 4th, and 5th harmonics of a guitar string, and write the relationship between λ and L for the 2nd through 5th harmonics. Please indicate node (n) and antinode (a) positions and fill in the “Overtone” column.

Overtone	Harmonic	Relationship between λ and L
	1st	$\lambda = 2L$ or $L = \lambda / 2$
	2nd	
	3rd	
	4th	
	5th	

2. The speed of sound in air is about 343 m/s while the speed of light in air is about 3.00×10^8 m/s. What is the ratio of the speed of light in air to the speed of sound in air?

3. During a thunderstorm, you can tell how far away the lightning is by timing the number of seconds between the flash of the lightning, and the boom of the thunder. If you see a flash, then hear the boom 10 seconds later, how far away is the lightning? Draw a picture and solve. (hints: are thunder and lightning created at the same time? how long does it take the light to reach you, how long does it take the sound to reach you?)

4. The speed of sound in air is accepted to be directly proportional to the temperature of the air. Sound waves have a velocity of 331 m/s at 0°C and 343 m/s at 20°C. Make a graph to represent these data points and write an equation describing the speed of sound at any KELVIN temperature. On what area of the graph might this equation no longer be valid? Why?

5. Identify and label the first 5 harmonics on the sound spectrum below. List the corresponding frequencies here:

6. Assuming the speed of sound is 343 m/s, determine the wavelengths of the first 5 harmonics, and the length of the flute.

7. Draw on the blank flute diagrams below, the first 5 harmonics:

1st		4th	
2nd		5th	
3rd			

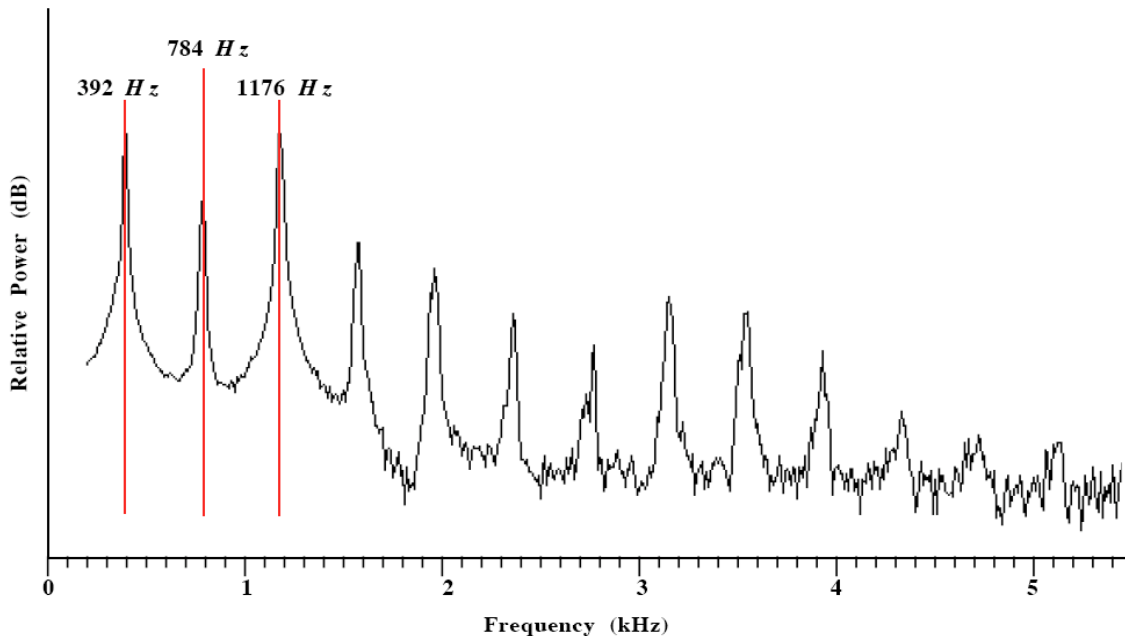


Figure 3.1: The “sound spectrum” of a flute shows the frequencies present when the G_4 note is played. The first designated peak is the desired frequency of 392 Hz (the “fundamental frequency”). The next two designated peaks are the first and second “overtones.” Since these and all higher overtones are integer multiples of the fundamental frequency, they are “harmonic.” (Used with permission. This and other sound spectra can be found at <http://www.phys.unsw.edu.au/music/flute/modernB/G4.html>)