

Name _____ Date _____

Partners _____

Vibrating Strips: Mechanics Lab #3

M.L. West

Objective: To investigate the oscillations of a complex system and use them to investigate the phenomenon of resonance and the natural frequencies of various modes of oscillation.

Define resonance:

Procedure:

1. Measure the length of each of the metal strips from the shaft end to the free end of the strip. Record these values in your team spreadsheet.
2. Plug the holder for the metal strips into the top driving shaft of the mechanical driver. Connect the function generator to the mechanical driver. Set the function generator to a sine curve. Start with the amplitude fairly low.
3. Spread the metal strips so that they make roughly equal angles with each other.
4. Unlock the driver, and turn on the power to the function generator. Begin with a frequency of about 5 Hz. The driver should be vibrating with an amplitude of about 1 mm. Gradually raise the frequency of the generator while observing the strips for resonance. When you find a resonance record the frequency for the fundamental (first harmonic). Change the frequency a little, then find the resonant frequency again for two more trials. Do this for each of the six strips.
5. The frequency for the second harmonic (higher than the fundamental) for each strip is harder to locate. Increase the amplitude setting. Starting at frequency = 100 Hz, find the natural frequencies for the second mode for each strip. The amplitudes are small, particularly for the short strips, so you may need to find them by gently touching the strip and concentrating on your fingertip rather than on your eyes, or using salt or coffee powder as an indicator.
6. Find the frequencies for the third harmonics, if you can.

Analysis:

Calculate averages and standard deviations of frequency trials.

Plot graphs of frequency vs, strip length for the fundamental and for the higher harmonics. Fit the data to find the frequency as a function of strip length for each harmonic. Put the equations on the board to compare.

Think about experimental error and probable exponents, since nature prefers small integers, it seems.

For each strip calculate the ratio of f_2/f_1 , and also f_3/f_1 .

Plot the ratios vs. strip length. Discuss.

Report: Write a **team report** of your experience and all sign it.

Include a list of equipment, a sketch of the setup, Excel spreadsheet with appropriate full size graphs, a sample of each calculation, experimental errors, estimate of errors at each step, and application of these methods to other situations.