Physics 200 Name(s): _____

String Instrument Activity

1. Get a laptop and open the Audacity app.
2. Set up an "electric guitar," and tune the open string to over 300 Hz. Higher frequencies are easier for a laptop microphone to pick up.
    a. To check the frequency, record the sound in Audacity. Click and drag to select a large, undistorted-looking segment of the waveform. Then click on the *effect* menu, and select *change pitch.* The frequency labeled "from" should be the string's fundamental frequency (the one you hear).
    b. Another way to check the frequency in Audacity is to select the waveform and click on *analyze*, followed by *plot spectrum*. This will give you a graph of the different harmonics that are represented by the complex wave. The first peak on the left should be the fundamental frequency.
3. Find the following for your open string:

    Fundamental Frequency (Hz) = _____

    Vibrating String Length (m) = _____

    Wave Speed Along String (m/s) = _____

4. String instruments' pitches are usually manipulated by changing the lengths of the vibrating portions of the strings. The musician usually presses the string against the fretboard or fingerboard, thus shortening the vibrating length of string and changing its frequency. Calculate the position at which you should press down your string in order to increase the frequency to 1.6 times the original frequency. Perform your calculation, try it and measure the new frequency. Then fill in the data.

    Fundamental Frequency x 1.6 (Hz) = _____

    Calculated Vibrating string length (m) = _____

    Actual Measured Frequency (Hz) = _____

5. If your calculations and your finger pressing were perfect, you should have still had some error in the frequency that was produced. In other words, the frequency that you played should not have been exactly 1.6 times the open string frequency. Why?

6. Another way to change the pitch of a string instrument is to cancel some of the harmonics. You can do this by pressing the string lightly at a position that corresponds to the node of one harmonic. This will stop any vibrations (harmonics) that do not have a node at that position. But the harmonics that do have a node at that position can still be heard.

    Demonstrate to Mr. Stapleton that you can…

    _____ triple the frequency of a string by "playing the 3rd harmonic" in two different ways (with your finger in one of two different locations).

    _____ quadruple the frequency of the open string by "playing the 4th harmonic" in two different ways.

    _____ play the 2nd harmonic and explain how the sound that is heard is different from playing the same frequency with the string pressed against the fingerboard.