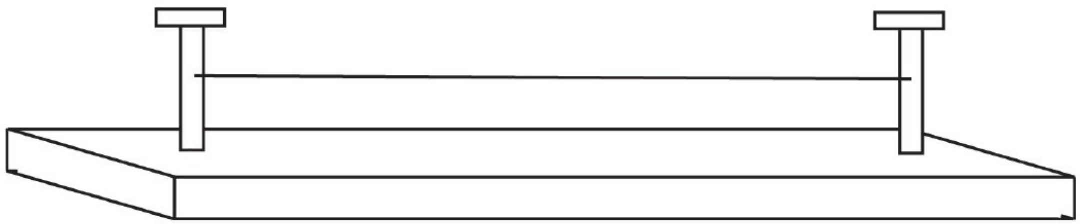
# Worksheet: Speakers and Microphone

Name: ________________________________________ Group name: ______________________

1. **Electric guitar**: Stretch the steel guitar string between the two pegs. The tension in the string is controlled by rotating one peg. For the pickup, use the micropone/amplifier setup. You will need to tape the microphone to the base to prevent it from being attracted to the string. Pluck the string and move the pickup around to find where the sound is loudest.



   (a) Pluck the string, that is pull string vertically upward and release. Observe the shape of the area taken up by the string as it vibrates. Make a drawing this showing how the “amplitude” of the strings motion changes along its length. showing the two ends of the string and the extent of the vibrations. Indicate the distance (cm) between the end pegs holding the string. (Hint: the amplitude of vibrations is zero at the ends where the string is fixed.)

   (b) Where is the amplitude a maximum? ________________________________________

   (c) You should have drawn half of a sinusoidal cycle. If the distance between the pegs is L, what is the wavelength of the cycle?

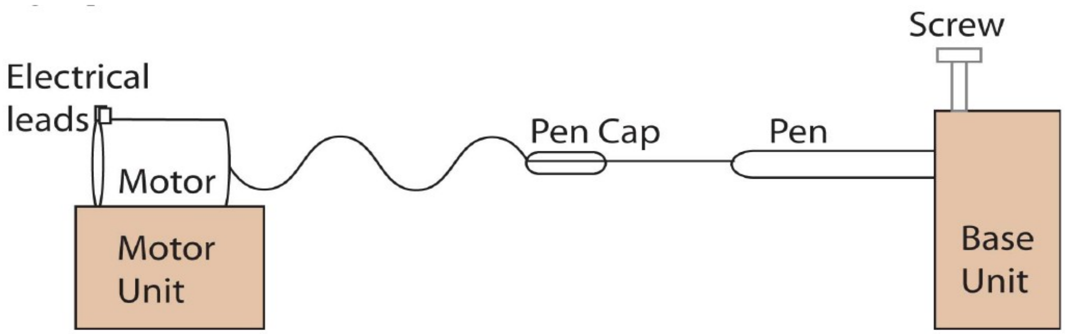
   (d) Move the pickup along the string. Where is the sound the loudest?

(e) What three variables can change the pitch of a note from your guitar?

A. ________________________ B. _____________________ C. ________________________

Use the guitar model to check your answers.

2. **Standing-wave apparatus**. Set up as shown below. Power the standing wave apparatus with the battery board. Use 3 V and a switch. Slip the bottom of the pen into the base unit and tighten the screw. Clamp the motor mount to the table so you can stretch the base unit away from it. Have one group member close the switch, and another move the base unit.




(a) Estimate the frequency by timing 10 or more cycles.

f = ________________ ____

(b) Adjust the length of the string by moving the pen to locate the fundamental mode – the same one you observed in question 1. What are the approximate wavelength?

λ = _______________ ____.

(c) Estimate the speed of propagation along the string: (see prelab) c = _______________ ____

(d) Observe the amplitude of the oscillations as you move the pen back and forth. Draw a rough plot of amplitude vs. length of the string.

(e) Notice that the amplitude of the wave is sometimes larger than the amplitude generated by the motor. How can that be?

(f) Move the base unit to change the tension. How does the fundamental wavelength change? Compare this to the increasing the tension of a guitar string.

(g) Change the voltage (number of batteries) to change the driving frequency. How does the wavelength change?

3. **Organ-pipe plunger apparatus**. To find the resonances for a fixed frequency, one person holds the tube vertically while the second operates the plunger to change L.

   (a) First blow across the top of the tube and note the tone and how it changes when you change the length. Draw the **shape** of the fundamental standing wave in the pipe.

   (b) Using your diagram, find out how the length L of the pipe from opening to plunger and the wavelength are related mathematically:

   λ = ____________________________

   (c) Strike the tuning fork on the hockey puck and hold it close to your ear. You will hear different frequencies depending on the distance and arrangement. What are those?

   (d) One person holds the tube vertically while the second operates the plunger to change L. The third person strikes the tuning fork on the hockey puck and holds it about ¼" above the tube. Start with the plunger at the very end of the tube (smallest L) and move the plunger to find the position where the sound is most "amplified" by the tube. The first such position is the fundamental.

   L = _________________ _____, λ = ________________ ____

(e) Using the frequency of the tuning fork and the plunger length to figure out the **speed of sound**:

c = ___________________ ______

(f) Repeat the experiment with the unmarked tuning fork. Use the speed of sound to determine its frequency:

L = __________________ ______, λ = _________________ _____

f = __________________ _______