Standing Waves on a String

Name:____________________________________Date:_____________________TA_______________

Section: ________________ Partners: ____

Please use SI units (m, kg, s) through this experiment.

Fixed Tension

Suspended mass M: 0.01kg (10 g) Tension = Mg:____________________________

Initial read of counter	Final read of counter	n |initial-final|	Frequency f (=n/10)	Nodes distance L	Wavelength λ ($=2L$)	Product $f\lambda$ (wave speed)

- How does the wavelength change when the frequency is increased?
- What is the average value for the product $f\lambda$?____
- How well do the values of the product $f\lambda$ found for various frequencies agree with each other?

Fixed Frequency

Frequency f: (|initial read-final read of counter|)÷(10 seconds)___________________________________

Mass M	Tension $F(=Mg)$	Wavelength λ ($=2L$)	Product $f^2\lambda^2$	$\mu = F/f^2\lambda^2$ (linear density)
0.005 kg				
0.010 kg				
0.015 kg				
0.020 kg				
0.025 kg				

- How does the wavelength change when the tension is increased?
- Are the values of the last column, μ (linear density), close each other?
- What is the average of linear density? ____________________(kg/m)

Questions to Ponder (Please answer these questions to your TA before you leave, and also discuss these on your report.)

1. When a violinist tunes a violin, what is she or he adjusting?
2. Why do the "heavier" strings sound different from the "lighter" strings on a guitar?
3. On a harp, the strings are of various lengths. What effect does this have?
4. What is going on when a guitarist presses down a string on the neck of a guitar and then strums?

Lab Procedure for Standing Waves on a String

Do not place fingers in moving motor parts. Do not extend rubber transmission part in the apparatus ¾ of full speed.

1. Fixed Tension

- **The suspended mass is always 0.01 kg (10 g).**
  After setting up a string to the apparatus, hang the mass on the end of the string.

- **Turn on the machine. Adjust the frequency with the knob, and measure the distance between nodes, *L*. Then calculate the wavelength.**
  From one node to the next node is just a half of the wavelength, which means $L=\lambda/2$. Therefore, the wavelength is 2L.

- **Write down the initial number of the counter, and then press the tiny metal plate for 10 seconds. Then you will read the final number of the counter to calculate the frequency.**
  Frequency is obtained by the number of vibrations divided by the time interval, which is $f=n/s$. The "s" is 10 seconds.

- **Calculate the speed, $v=f\lambda$.**
  Throughout this part of the experiment, this value should be the same. Sometimes you measure a few values that are off; however, the average will be close to 20 m/s after all. (It should be!)

- **Repeat the process 5 times with different frequencies.**
  <u>You should NOT use a very high frequency for safety.</u>

- **Calculate the average speed.**
  This should be about 20 m/s as mentioned above. Try to repeat it unless you have a close value.

2. Fixed Frequency

- **Select a vibrating speed, and calculate the frequency.**
  The procedure is the same as the previous part. Again, the formula is: $f=n/s$. You shouldn't use too slow of a vibration. This frequency will be fixed throughout this part.

- **Measure the wavelength for each mass.**
  With fixing the frequency, change the hanging mass. The masses are specified on the data sheet.

- **Calculate the product $f^2\lambda^2$, and $F/f^2\lambda^2$.**
  The value of $F/f^2\lambda^2$ is the linear density, which should be constant in accordance with the theory. Make sure the values obtained are close to each other. The linear density, μ, will be like $\times10^{-4}$ (kg/m) order.

3. Lab Report

Please answer the questions on the data sheet for your discussion.