**PHYS211 VIBRATING STRING**

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    Partner(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Watch the video below

<https://www.youtube.com/watch?v=aCu4VRKMstA>

1. A string, stretched between two clamps, is made to oscillate in standing wave patterns as shown below. Determine the loop length and wavelength for each of the oscillations in terms of *L*, the length of the vibrating string.

|  |  |  |
| --- | --- | --- |
|  | Loop Length | Wavelength |
|  |  |  |
|  |  |  |
|  |  |  |

**Experiments:**

Purpose: To investigate waves in a stretched string and determine the wave speed.

Apparatus: String vibrator, clamp for string vibrator, string, mass set, mass hangers (50-g and 5-g), electronic balance (accuracy 0.01-g), meter stick, and pulley w/clamp.

Theory: Stringed musical instruments are played by plucking or bowing a stretched string. In the first investigation a string vibrator will make the string to vibrate at a frequency of 60 Hz. The tension will be provided by a hanging mass. The vibrations will travel along the string and get reflected at the other end. The reflected waves and the incoming waves will interfere and form standing waves. By varying the tension, *T* standing waves with different number of loops can be obtained. The standing waves for two and three loops are shown below. Loop length is obtained by dividing the length of the vibrating string by the number of loops. Wavelength is twice the loop length.



In terms of hanging mass, *m* and acceleration due to gravity, *g* tension, *T* is given by:
 

In terms of frequency, f and wavelength, λ the wave speed, *v* is given by:
 

In terms of tension, *T* and strings linear density, *μ* the wave speed, *v* is given by:
 

Linear Density: Linear density, *μ* is a property of the string which tells us whether the string is "heavy" or "light". You may know that the four violin strings are not the same. Some are thick and others are thin. The heavy strings are used for low tones and the light ones are for high tones. In this investigation you will determine *μ*, by measuring the length and mass of the string before attaching it to the string vibrator, to 3 significant figures.

Procedure:

Cut about 2 meters string, weigh the string and measure the length after cutting it.



Mount the string vibrator at one end of the table, and tie the string to the vibrator



Mount the pulley on one side of the table:



 Make sure that the string is straight and attach 50g hanger to the other part of the string



Connect the string vibrator to start the vibrations



DATA: **Use SI units**

Total length of string = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Total mass of string = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Linear Density = *μ* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Acceleration due to gravity = *g* = 9.8 m/s2

Length of the vibrating string = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**I.** In the first part of the experiment, you will keep the frequency constant, and change the mass. For a particular # of loops, obtain resonance with the highest amplitude by changing the hanging mass.  Frequency = *f* = 60 Hz. If you prefer, use Excel to construct this data table.

Record the mass for 2 loops, 3 loops, and so on.



Use the meter stick to measure the length of the loop, and record it in table I

Table I:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| # of Loops | Loop length | Wavelength, *λ*  | Hanging mass, *m* | Tension,  | Wave Speed, *V* | % Difference |
| Using *f* & λ | Using *T* & *μ*  |
| 2 |   |   |   |   |   |   |   |
| 3 |   |   |   |   |   |   |   |
| 4 |   |   |   |   |   |   |   |
| 5 |   |   |   |   |   |   |   |
| 6 |   |   |   |   |   |   |   |

**II.** In the second part of the experiment you will keep the number of loops fixed, change the mass, and record the frequency.

Connect the sine wave generator to the string vibrator:



For a particular hanging mass, obtain resonance with the highest amplitude by changing the frequency. Keep the #of loops constant. If you prefer, use Excel to construct this data table.

Table II:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Hanging Mass (kg) | Loop length | Wavelength, *λ*  | Frequency,f  | Tension,  | Wave Speed, *V* | % Difference |
| Using *f* & λ | Using *T* & *μ*  |
| 0.1 |   |   |   |   |   |   |   |
| 0.2 |   |   |   |   |   |   |   |
| 0.3 |   |   |   |   |   |   |   |
| 0.4 |   |   |   |   |   |   |   |
| 0.5 |   |   |   |   |   |   |   |
| 0.6 |   |   |   |   |   |   |   |

Write and overall conclusion: