

Name \_\_\_\_\_

Date \_\_\_\_\_

## PHYS 1401 General Physics I Standing Waves

### Equipment

Mechanical Vibrator  
Function Generator  
Mass Hanger  
Weights  
Plastic Spacer  
Aluminum Rod  
Pulley with Clamp  
C-Clamp  
String  
Ruler

### **Figure 1**

### Overview

In this lab you will explore the properties of standing waves generated on a string. Standing waves are produced when a condition of resonance exists between the natural frequencies of the string and the frequency of the disturbance. In this lab, the string will be fixed at both ends so a standing wave must have a node at each end. As a result, standing waves are produced only at frequencies that produce integral numbers of half-wavelengths that fit into the length of the string.

### Theory

The wavelengths  $\lambda$  are related to the frequency  $f$  of the disturbance and the velocity  $v$  of the wave on the string by the following equation:

#### **Equation 1**

The velocity of a wave on a string is given by the following equation:

#### **Equation 2**

where  $\mu$  is the linear mass density of our physics string.  $F_T$  is the tension force in the string given by:

#### **Equation 3**

### Procedure

In this experiment the string used is highly elastic, and the linear mass density  $\mu$  will have to be calculated for each different amount of tension force. Here is how it is done: The unstretched string has a mass density =  $4.2 \times 10^{-3}$  kg/m. You will find two brightly colored marks separated by some distance in the middle of your string. With a meterstick measure the distance between these marks without stretching the string, and record here:

$L_0 =$  \_\_\_\_\_ m

Calculate the mass of string between these marks as = \_\_\_\_\_ kg.

Finally, for each case where the tension is different calculate the corresponding linear mass density using the equation , where  $m$  is the mass between the marks just recorded, and  $L$  is the (new, stretched) distance between the marks. Be sure to use the correct value for each tension case in the data table below.

After the lab assistant sets up the apparatus, begin the lab. Vary the frequency and/or tension for various waves and number of antinodes and record in the table. The table has room for you to record four different scenarios.

Hanging Mass $M$ (kg)	Tension $F_T = Mg$ (N)	For "n" anti-nodes	Distance, $d$ , between nodes (m)	Wavelength $\lambda = 2d$ (m)	Velocity $v = (F_T/\mu)^{1/2}$ (m/s)	$f = v/\lambda$ <u>predicted</u> (Hz)	Function generator applied <u>"f"</u> (Hz)	% difference from function generator

In the final column of the table you will calculate the percent difference between your predicted (calculated) frequency and the frequency actually applied by the function generator. Use the following formula: