Standing Waves on a String

Purpose: To study standing waves in a string and thus determine their velocity - both experimental and theoretical.

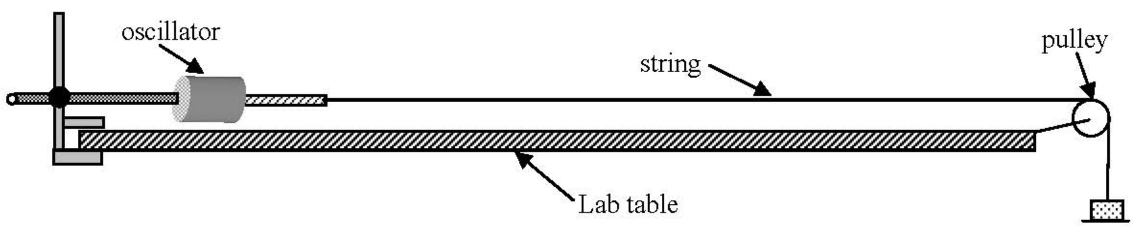
Apparatus: Lightweight nylon string, weight hangers, weights, clamps, pulley, oscillator, stroboscope.

Introduction: Standing waves can be produced on a string tied at both ends if the frequency, f, is related to the length of the string, L, by

$$f = \frac{nv}{2L}, \qquad n = 1,2,3,...$$

where v is the velocity of the waves The wave velocity is related to the tension in the string, T, and the mass per unit length, μ, by

1) $$v = \sqrt{T/\mu}$$



Procedure:

1. Connect the flexible, lightweight cord to the oscillator and attach a weight hanger so that the cord passes over a pulley as shown. Use a length of cord such that the distance between the pulley and the oscillator extends over the length (~4 m) of the laboratory table.
2. Start the oscillator and then by adding weights to the hanger adjust the cord tension until two complete standing waves result (four loops). Carefully adjust the hanging weight so that the amplitude is a maximum. Measure the length of the standing wave which is in the center portion (Neglect the one-half wave at each end.) Record the hanging weight.
3. Reduce the hanging weight in succession so as to obtain measurements of the standing waves with five, six, seven, and eight loops (half waves). Determine the wavelength for each case. Record for each the amount of the hanging weight.
4. Obtain the frequency of the oscillator using a photocell and light source (see your instructor).
5. Obtain measurements so that the mass per unit length of the cord may be found.

Note: Determine if, during the course of the experiment, the elongation of the cord is sufficient to significantly change the mass per unit length. If it does have an effect, take the appropriate measurements so that the correct mass per unit length may be computed for each trial.

6. Use the frequency of the vibrating source and the measured wavelength for each of the five trials to obtain the velocity of the wave in the cord ($v = f\lambda$).
7. Compute the predicted velocity from equation 1 using the tension and the mass per unit length of the cord for each of the five trials. Compare this velocity with the velocity obtained in part 6.
8. In your report show diagrams of the standing waves observed.