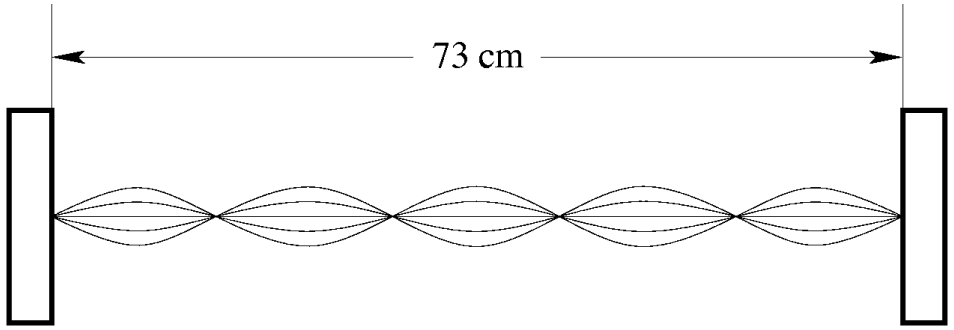
PHY138Y
Physics Department

Waves Assignment 3
Due November 29, 2004

Prof. Jason Harlow
University of Toronto

Please complete the following problems on separate paper. Show all your work legibly, and draw a box around the final numerical answer where applicable. Use one staple in the upper left-hand corner to connect multiple pages, and slip the entire assignment in the drop-box for your Tutorial Section at the bottom of the stairs of Burton Tower in McLennan Physical Laboratories (MP). Assignments must be in the box by 5:00 PM on the due date.

Supplemental Problem:



A standing wave is set up on a single string, as shown above. The two fixed ends are attached to walls 73 cm apart. The string is represented at several times.
a) What is the wavelength of the traveling waves on the string which make up this standing wave?
b) If waves on the string travel at a speed of 15 m/s, what is the frequency of the standing wave that is shown?
c) What mode of vibration is shown?

From the Textbook:

14.4, 14.29, 14.36 (part a only), 24.32

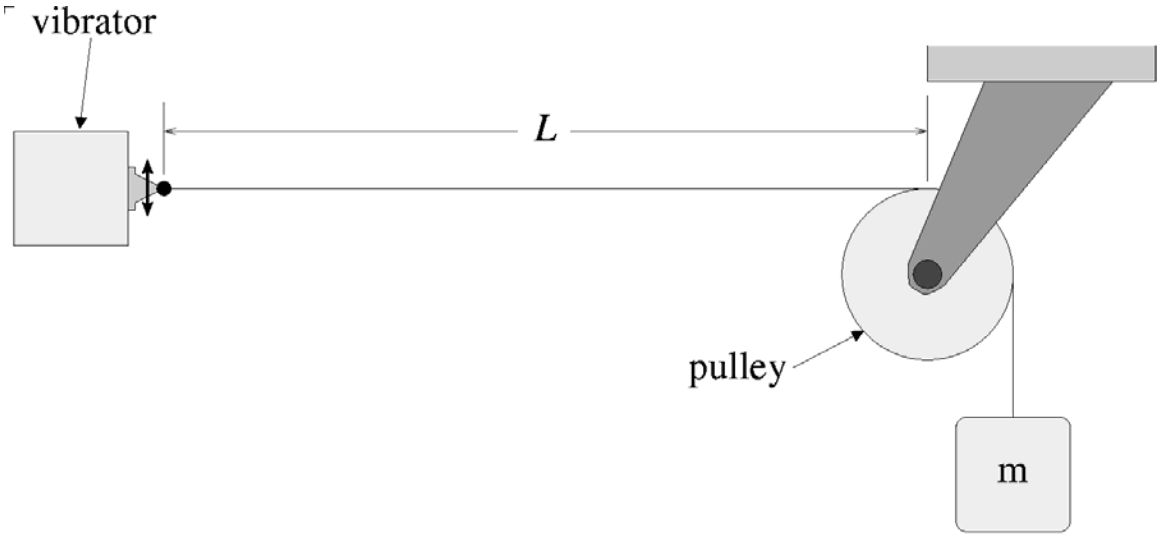
Some suggested problems from the Textbook (not to be turned in):

Question 11 on page 495
Problems 14.5, 14.11, 14.21, 14.25, 14.28, 14.35
Question 13 on page 925
Problem 24.35

Some PHY138Y Laboratories that relate somewhat to this material:

Standing Waves and Acoustic Resonance (core)
The Speed of Light (non-core)
Spectra (core)

Suggested Supplemental Problem from Waves Assignment 3 – Not for marks



An object of mass, m=16 kg is hung from a string, which passes over a light, frictionless pulley. The other end of the string is connected to a vibrator, which sends waves along the string with a constant frequency, *f*. It has been found that 20 metres of this kind of string, when coiled up and placed on a scale, has a mass of 40 grams. The distance between the point where the string is tied to the vibrator and the point where the string touches the pulley is *L*=2.0 m.

A) What is the linear mass density of the string?
B) What is the tension of the string between the pulley and vibrator?
C) What is the speed of waves on the string between the pulley and vibrator?

Note that the vibrator forms an anti-node of the standing wave, and the point where the string touches the pulley forms a node. This makes the standing wave on this string similar to a standing wave in an air column that is closed at one end.

D) What is the fundamental (*n*=1) frequency of standing waves on the string?
E) What is the wavelength of the fundamental frequency?
F) What is the frequency of the *n*=5 mode of vibration? Sketch the appearance of the string in this mode, indicating positions of nodes and antinodes.