EXP.3: Standing Waves in a String

Lab Report

Complete this report YOURSELF except DATA taking parts! This report will not be submitted (except the very last page), but you should carefully complete it as preparation for the applied exam.

Suggested Pre-Lab Questions

Q1. **In this experiment standing waves are going to be studied. Speed of the standing wave depends on the tension and the density (mass per unit length) of the string;**

$\boldsymbol{v} = \sqrt{\frac{T}{\mu}} = \boldsymbol{f\lambda}$ **.** Explain this equation. Do not say “if T increases f increases” etc. This is obvious. Explain the physics behind it. Define the elements in it and comment on the relation between them.

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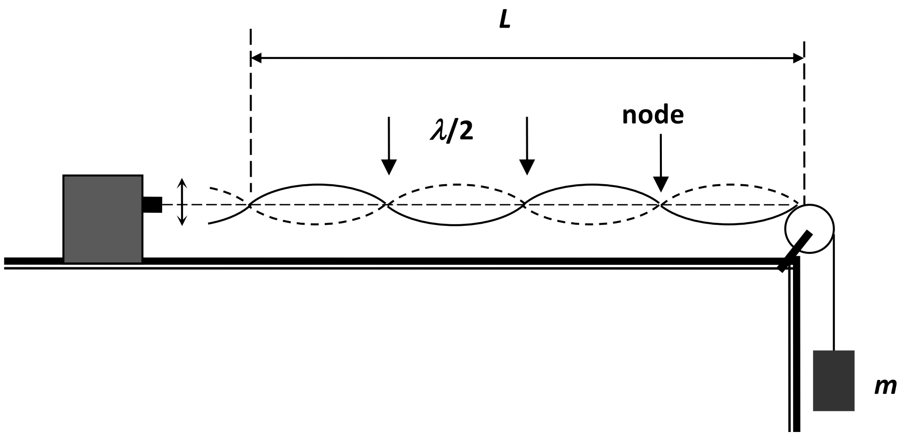
Q2. Give the definition of node. Discuss the relation between the node concept and the frequency of the wave on string.

Q3. Show the dimensional **analysis** for μ, using the tension formula.

Experiment

OBJECTIVE : To study the standing waves in a cord, and to verify the equation for the velocity of a wave on a string.

THEORY :



When a string fixed on both ends and under tension is excited on one end, there will be waves traveling along the string. If we continue to excite the string, the waves reflected from the other end will interfere with the waves traveling in the forward direction. If the length of the string is exactly equal to the integer multiples of the half wavelengths, there will be standing waves along the string. The points where the string is motionless are called *nodes* and the distance between successive nodes will be equal to the half wavelength. Speed and the wavelength of the waves traveling along the string depend on the tension and the mass per unit length of the string:

$$v = \left(\frac{T}{\mu}\right)^{\frac{1}{2}} = f\lambda$$

$$T = \mu\lambda^2 f^2$$

A Plot of the tension versus the square of the frequency data pairs that produce standing waves should follow a straight line whose slope is equal to the mass per unit length times the square of the wavelength. Tension on the string is provided by the masses placed on the hanger on the other end.

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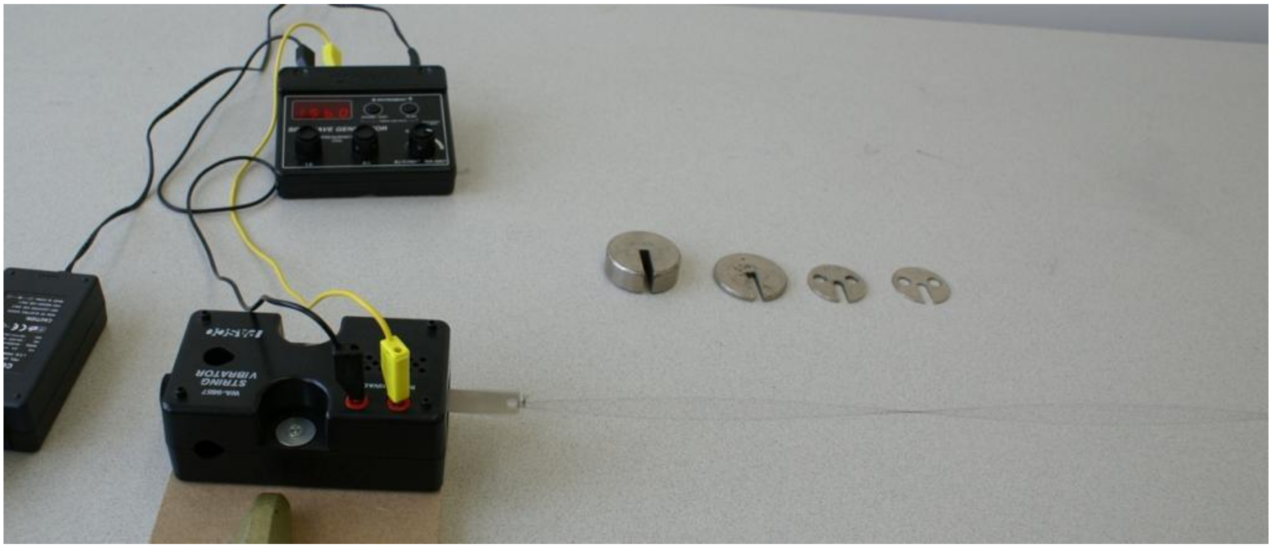
APPARATUS: String vibrator and its variable frequency power supply, hanger and mass set, string.



PROCEDURE :

1. Length of the cord between the vibration generator and the pulley is kept constant.
2. Place a mass on the mass holder and set the vibration generator in motion.
3. Arrange the frequency of the vibration generator until standing waves are clearly observed.
4. Determine the number of nodes and the wavelengths.
5. Record the frequency value along with the corresponding mass on the mass holder.
6. By keeping the **wavelength constant**, change the mass and read the corresponding frequency for clearly observed standing waves for 4 more times.
7. **Plot tension, *T*, versus f^2** and determine the slope.
8. Calculate the mass per unit length for the cord.
9. Make dimensional analysis for μ.

DATA:

Description / Symbol			**Value & Unit**
Length of the Cord	*L*	=	. . . .
Acceleration due to gravity	*g*	=	. . . .

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Mass, *m* ( )	**# of λ / 2** ***(kept constant)***	**λ ( )** ***(kept constant)***	**Frequency,** *f* ( )	**f^2** ( )	**Tension** ***T* = *m.g*** ( )

NOTE on SF: The number of significant figures (SF) is reduced by ONE when squaring data, though you may choose to leave it as it is if you wish to do so, as both conventions are widely accepted. However, only one of these methods should be implemented consistently for all data.

Plot T versus f^2

CALCULATIONS & RESULTS:

A) **From the graph, choose two SLOPE POINTS other than data points,**

SP_1 : (;)

SP_2 : (;)

B) **Calculate:**

SLOPE = ...

Description / Symbol	**Calculations (show each step)**	**Result**
Mass per unit length of the Cord μ =	. . . .	. . . .
	. . . .	
Dimension of μ =	. . . .	. . . .

Suggested Post-Lab Question

Q1. If we only increased the hanged mass in the experiment setup, what would happen to

a) the wavelength, λ

b) the frequency, f

c) mass per unit length of the cord, μ

Post-Lab Report

Aim of the experiment:

Suggestions for possible solutions to the problems experienced during the experiment:

Conclusion:

7 I have completed this experiment myself as specified in the lab sheet and as explained by the lab instructor.

Name & Surname:

Student ID:

Lab Section:

Table #:

Date:

Signature of the student

As the instructor of this Lab Section I confirm that the student has participated in and completed this experiment on time.

Stamp of the PHYS Labs and signature of the instructor

This page serves as proof of the fact that the student participated in and completed the experiment, only if it is submitted in time and accepted by the Lab instructor. The student and the instructor shall sign it along with the stamp of the Physics Laboratories.