

Sign Hanging Lab

Teacher's Guide

Topic:

Vectors and Forces

The following information is provided to the student:

Question:

How does the measured tension in the string supporting a sign compare to the theoretically predicted value?

Purpose:

To compare the measured tension in the string supporting a sign to the tension which would be theoretically predicted based on the mass of the sign and the angle the two strings make with the horizontal.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion of Results. The Data section should include a diagram of the sign and supporting strings; strategic measurements should be recorded on the diagram. Calculations of the theoretically predicted tension should be clearly shown in an organized fashion beginning with a *force triangle*. The Conclusion/Discussion should answer the question posed in the Purpose and include an error analysis with a percent difference calculation

Materials Required:

Hooked mass (0.50 kg or 1.00 kg); spring scale; string; meter stick; protractor; two secure supports.

Description of Procedure:

A string is hung between two hooks; on one of its ends, a spring scale is inserted, connecting the string to the hook. A mass is hung from the string, creating tension in the string. Students measure some angles and use the known mass that is hanging to determine the theoretical tension in the string. This theoretical value is then compared to the value which is read from the spring scale.

Alternative Materials and Procedure:

Elastic cords and two force scales could be used to create the same arrangement and a similar activity without the need for a hanging mass. Tie three 1-meter (approximately) lengths of cord together and stretch them across a lab bench. Secure them at their ends with C-clamps. Insert spring scales between the C-clamps and the cord for two of the cords. Challenge students to determine the tension in the third cord (the one without the spring scale). Once students have computed the value, use a third spring scale to determine the measured value; be sure to stretch the cord to the same distance that it was stretched when connected to the C-clamp.

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

The Laboratory

Suggestions, Precautions, Notes:

1. If allowed, coffee mug hooks can be screwed into the underside of wall cabinets to form two secure supports. The string is stretched between the hooks with a spring scale on one of the ends. The mass is then hung
2. To insure that the mass is hung symmetrically, a meter stick can be used to measure the distances from the ends of the string to the point from which the mass is suspended. They should be the same distance.

Auxiliary Materials:

None

Scoring Rubric:

VF3. Sign Hanging Lab	Score
____ Included, labeled and organized all parts of the lab report. ____ Data section includes an informative diagram of the sign and supporting strings; important measurements are clearly identified on the diagram; units are stated. A force analysis, beginning with a force triangle, is accurately presented; documentation of analysis is thorough and complete. ____ Conclusion/Discussion answers the <i>question</i> posed in the Purpose. An error analysis is included; the reliability of the results are evaluated; a percent difference calculation is performed and discussed; work is shown.	____/____

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/vectors/u313b.cfm>

<http://www.physicsclassroom.com/Class/vectors/u313c.cfm>

Connections to Minds on Physics Internet Modules:

Sublevels 3 and 4 of the Forces in Two Dimensions module are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>