Name: _____

LAB 4. STATIC FORCES

Introduction

This lab consists of combining three forces to give a zero net force.

Supplies

Force table, three pulleys, central ring with three leads, mass hangers, disk masses, protractor, ruler, graph paper

Activity

The force table is a circle with several pulleys around the edge to support threads tied to a central ring. Weights are hung from the threads and positioned on the circle so that the forces all cancel, centering the ring at the center of the table.

1. Obtain the angles and masses for two of your weights from the instructor.

   Mass 1: _____ Angle 1: _____ Mass 2: _____ Angle 2: _____

2. Center the ring on the removable pin at the center of the force table. Position two of the pulleys as directed and hang the directed masses, including the masses of the hangers, from their threads.

3. Determine the mass and angle that produces the **equilibrant** vector that combines with the other two tensions to yield a zero net force on the ring. You may determine this any way you like: graphically, by calculation (recommended), or by trial and error (not recommended). You may even show your work below. Write the equilibrant here.

   Equilibrant: Mass: _____ Angle: _____

4. Once you have determined the correct equilibrant, summon your instructor to witness that the two given vectors are correct and the equilibrant properly equilibrates. (If it doesn't, you get one more try.)

Data Analysis

You worked with three tension vectors in this activity: the two that were assigned, and the equilibrant. Here, you will add the vectors graphically and by components.

Cartesian components

Express the three vectors in terms of their Cartesian components, add them, and see that their sum is close to the zero vector. Show your work.

Graph paper

Using graph paper, a ruler, and a protractor, represent the three tension vectors as scaled arrows and add the arrows together graphically (head-to-tail). I find that a scale of 1.0 cm = 10 g works nicely. See that the sum is close to the zero vector.

Report

There is not much to this lab, so you ought to be able to complete most of the report before the class is out. Each student should make an individual lab report. This one is worth a total of 75 points.

Abstract (5 points)
One sentence will suffice. What task did you perform, and how did you accomplish it?

Purpose
"The purpose of this activity is to demonstrate that forces are vectors following the mathematical rules of vector addition."

Theory (10 points)
How do force vectors add together? Under what circumstances do vectors combine to a zero vector?

Experimental (15 points)
What did you need to do to ensure that you applied the correct (both magnitude and direction) tension vectors to the central ring? Be sure to explain how you set their directions. How did you find your equilibrant vector? Explain your procedure, whether you did it empirically or mathematically.

Observations and Data (5 points)
Report your assigned hanging masses and angles, and your empirically determined equilibrant hanging mass and angle.

Analysis and Discussion (30 points)
Tabulate the Cartesian decomposition of your two assigned vectors and their equilibrant, and attach the graph paper on which you plotted the graphical addition of the tension vectors.

Conclusion (10 points)
Do the force vectors empirically combine according to the mathematical rules of vector addition?