Forces in Equilibrium Lab Protocol

Physics

A *concurrent force system* is a set of forces that act together on a single point. When these forces are added together (as vector quantities), the resultant vector is the *net force* acting on the point. If the set of forces sums to zero, the system is in equilibrium. Any concurrent force system that is NOT in equilibrium can be balanced by adding a single force (called an *equilibrant*) in the opposite direction of the net force.

For this lab, your goals are to practice calculating component vectors, vector arithmetic, and finding an equilibrant.

Protocol:

1. If you haven't already had a chance, spend some time on the Force Table Simulation assignment. This is a good way to quickly get a feel for what using the force table looks like.

2. With a group of 2-3 other students, get a force table and the other lab materials. You will have to work with other groups since there is a limited number of force tables. Set up your force table on a flat surface. You may need to construct a "ring octopus" from a plastic washer and string if there are none made already.

3. Before making any calculations or measurements, set up your force table with three random masses hanging in random directions. Carefully remove the pin while holding the ring in place. Then, pull a fourth (unused) string to make the ring move back over the hole. **In your notes, write down the approximate directions that the masses were hanging, along with an estimate of the size of each mass. Then write down the direction you needed to pull the string along with a verbal description of the size of the force you used.** Repeat this step until you feel you can make a good initial prediction of the direction and magnitude of the force you need to exert to re-center the ring. (This force is the equilibrant to the net force created by the three hanging masses.)

4. Working with your group, make a formal calculation of an equilibrant for your force table (you can leave it set up as it was for your last observation in step 3). **In your notes, carefully show your work and include drawings where necessary.** Remember that force and mass are two different things – so you will need to use the force of gravity pulling on your masses (i.e., their weight) in order to have correct information in your calculations. Test your calculation to see if it is correct.

5. With your group, discuss how you could come up with a general set of equations that you could use to find the equilibrant for any three masses hanging in any three directions from a force table. **In your notes, clearly write these equations, along with relevant drawings.** Make sure to clearly differentiate your variables for the three different forces and the equilibrant.