

Laboratory – Vector Addition on the Force Table

The purpose of this lab is to verify Newton's 1st Law, which states:

An object at rest will remain at rest, and an object in motion will remain in uniform motion, unless a net force is exerted.

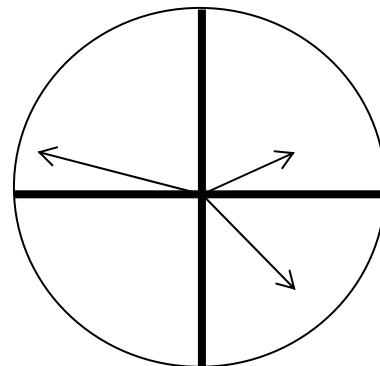
Using the force table, we see that the ring in the center, being pulled on by 3 scales, is at rest. Look again, it's still at rest. This satisfies the first part of Newton's first law. Based on this observation, we can say that the net force is 0 Newtons. Thus, we may assume that any forces that are acting on the ring are canceling each other out. We will attempt to prove this fact in three ways, stated on side 2.

Methods:

- Carefully measure and sketch forces on an object in equilibrium.
- Calculate the components of force vectors ("decompose the vectors").
- Calculate the resultant vector from components.

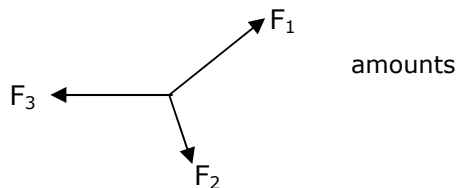
In this lab, you will resolve force vectors into their perpendicular components, verifying that for a system in equilibrium:

$$\sum \vec{F} = 0 \quad \text{or} \quad \begin{aligned} \Sigma F_x &= 0N \\ \Sigma F_y &= 0N \end{aligned}$$



While this is simple in principle (especially for one dimension), it can be rather complex for systems in two dimensions. The force board is an example of one such system. You will add 3 force vectors (using spring scales to exert the forces) and will bring the system to equilibrium. The system will be in equilibrium when the ring is motionless. To ensure that you are at equilibrium with a minimum of friction forces involved, wiggle the spring scales a bit.

At equilibrium, note the relative positions of each string and the of force in each direction. Draw this as a vector drawing. For example, with 3 force vectors:



Procedure and Data

1. Set up 3 stable force tables scenarios, with 3 force vectors on each. In the first scenario, place two of the forces at right angles. In the others, make sure there are no right angles.
2. Record all angle and force values. **Accuracy is very important here.** Otherwise, you will have great difficulty making any sense of your data.
3. The experiment should go quickly, but analysis will be time-consuming. Perform at least one calculation before you leave class (to make sure you can solve these problems).

Calculations

For **each problem**:

- A) make force diagram for the central ring, to scale, and label it.
- B) Add the vectors graphically to find graphical resultant (distance between tail of first vector and tip of last).
- C) Add the vectors analytically to find ΣF_x and ΣF_y .
- D) State whether the added vectors equal to zero. Give reasoning in either case (yes or no... why?)

What you hand in:

You will hand in the calculations as described above for each problem.