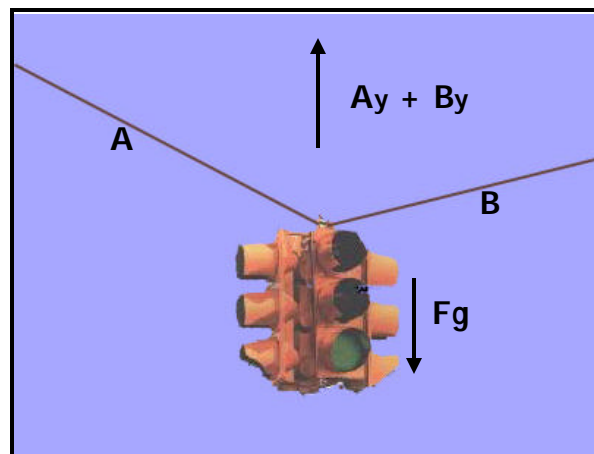


MND Physics

Addition of Vector Forces: Equilibrium

When two or more forces act at the same time on an object and their vector sum is zero, the object is in equilibrium with respect to those forces. An illustration of an object with 3 forces acting on it, yet in equilibrium, is the stop light shown here. The sum of the y-components of the tension vectors of both cables, $A_y + B_y$ (which is directed upward) is equal and opposite to the weight vector of the signal, F_g (which is directed downward).



Vector analysis is a very important tool for the design engineer. In the above traffic light example, vector analysis helps identify the appropriate types of cable that will insure the required margin of safety.

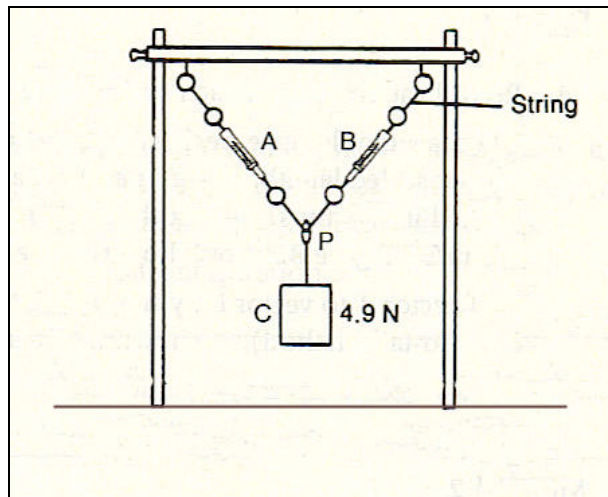
In this lab, you will investigate the forces acting on an object configured much like the traffic light shown above. You will establish the relationship of all the forces acting on an object in equilibrium.

EQUIPMENT:

Table H-rack system with clamps, meter stick, 2 spring scales, mass set, string, and protractor.

PROCEDURE:

1. Set up the apparatus as shown. IMPORTANT: Zero the hanging scales.



2. Arbitrarily select the angles and string lengths for the system.
3. With a protractor, measure each of the 3 angles at intersection "P".
4. Record the values (in newtons) of the two spring scales and the weight of the hanging mass in newtons. Save your data as "TRIAL # 1".
5. Make two scale drawings of the three forces on graph paper. A scale drawing requires an appropriate scale to be selected to represent the system; all markings are drawn to that scale.
 - a. Drawing #1 is a scale drawing of all three forces (see example #1 at the end of this lab)
 - b. Drawing #2 shows the addition of vector A to vector B using the tail-to-tip method (see example #2 at the end of this lab). Make sure to clearly indicate the resultant.
6. Repeat steps 2-5 above but change the angles and vary the string lengths. Record your data as "TRIAL # 2"

DATA:

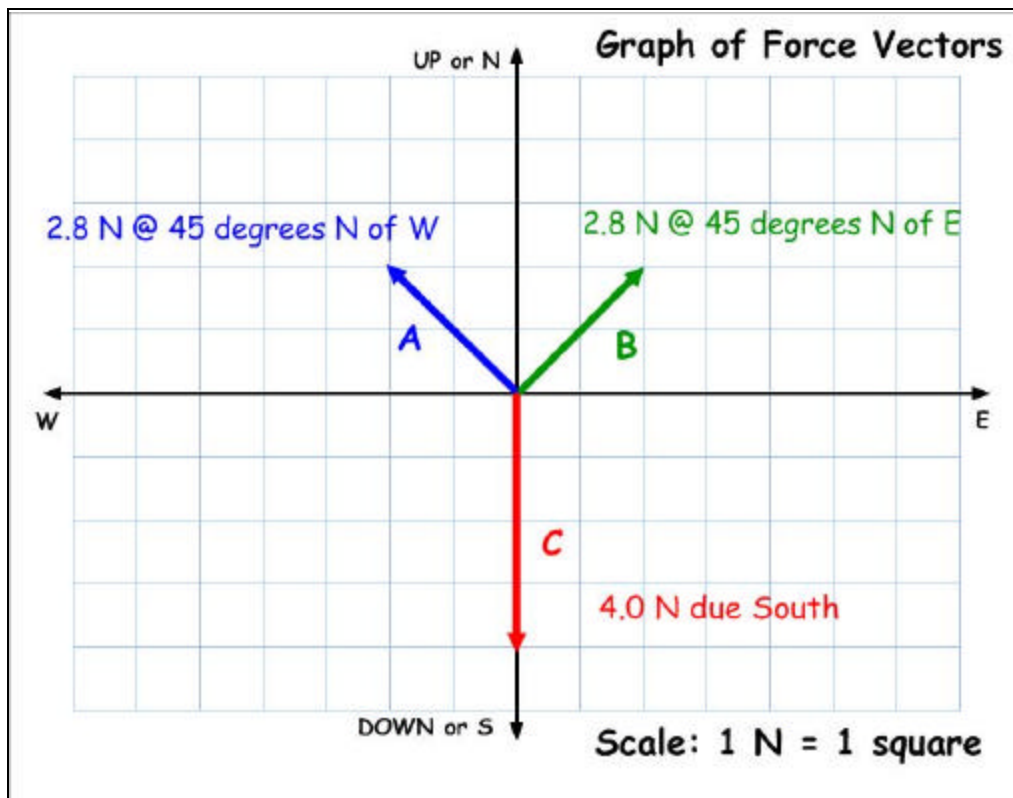
Create appropriate tables for the recording of data for trials 1 and 2.

QUESTIONS:

1. Compare the magnitude and direction of the computed resultant vector to the inverse of the vector representing the weight of the hanging mass (for each trial). Discuss relative error causes.
2. Explain the results of graphically adding vectors $A + B + C$ for each trial.
3. What is the result if you add vectors $A + C$? Use trial 1 data.
4. What is the result if you add vectors $B + C$? Use trial 1 data.

EXAMPLE OF SCALE DRAWINGS:

EXAMPLE #1



EXAMPLE #2

