Lab #1 Addition of Force Vectors

The resultant of two forces acting at the same point on a body is that single force whose effect on the body is the same as the combined effect of the two forces. When two or more forces act at the same time on a body and the vector sum is zero, the object is said to be in "equilibrium". To find the resultant of two forces acting at the same point, a third force can be applied at that same point in such a direction and of such magnitude as to counter-balance the effect of the two forces. Since this third force produces equilibrium, it is called the equilibrant. The resultant of two forces is equal in magnitude to their equilibrant but acts in the opposite direction.

In this lab you will apply the methods of vector addition to experimentally investigate forces in equilibrium.

Procedure:

1. Set up "y" shaped metal frame, ring, strings, & spring scales as shown in demo.
2. Adjust apparatus until equilibrium is achieved (ring is not touching center pin) - tighten the knob to lock it.
3. Make sure that no meter is reading off scale.
4. Place a large sheet of paper under the apparatus.
5. Mark lines of force with a sharp pencil on tiny slits.
6. Extend three force lines to meet at center point.
7. Record the force readings of each meter next to the corresponding lines.
8. Select a scale to convert Newtons to cm (e.g. 1 N = 1 cm)
9. Mark off each force vector at its appropriate length (the length represents the magnitude).
10. Label the two shorter vectors F_1 & F_2.
11. Label the longer line "equilibrant".
12. Using the parallelogram method for tail to tail vectors, create the resultant of F_1 & F_2. (See diagram.)
13. Label the resultant.
14. Draw a line through the center point running perpendicular to the equilibrant.
15. Label this new line "x axis" and label the equilibrant "y axis" (if it does not line up perfectly with the resultant, extend the y-axis up along side the resultant.)
16. Using triangulation methods on the diagram itself, draw the x & y components of both F_1 & F_2.
17. Use the ruler to measure these x & y components in order to determine their magnitudes (in Newtons). Do this for both the F_1 & F_2 vectors.

Questions:

1. What is the vector sum of F_{1x} & F_{2x}?
2. What is the vector sum of F_{1y} & F_{2y} ?
3. How does the sum of F_{1y} & F_{2y} compare to the resultant you drew on your diagram?
4. How does the resultant compare to the equilibrant?
5. Under what conditions would the readings on all three meters be identical?
6. On an empty corner of your diagram sheet, draw (to scale and with careful attention to the angles) a tip to tail vector diagram of F_1, F_2 & the equilibrant. What does this mean?