Experiment # 1
Vectors – Equilibrium of a particle

Apparatus:
(1) A force table equipped with a ring, pin, pulleys, four cords with hooks and pans attached.
(2) Set of known masses.
(3) Ruler.
(4) Protractor.
The apparatus consists of a horizontal force table about the circumference of which pulleys may be set at desired angles. Cords passing over the pulleys support pans upon which various loads may be placed. A pin holds a small ring (the particle) to which the cords are attached. When a test for equilibrium is to be made the pin is removed.

Objective:
To determine the x- and y-components of a vector and to find the equilibrant of two vectors.

Procedure:
The experimental set up will be explained in class. Take notes carefully.

Part I. Determination of the x- and y-components of a force.

Place a pulley on the 30° mark of the force table and apply a known load over it. By means of a vector diagram (see figure 1), find the magnitude of the component forces through the 0° and the 90° positions of the force table. Set up these component forces, \( F_x \) and \( F_y \) on the force table as determined. Keeping \( F_x \) and \( F_y \) on the force table, swing the initial force \( \vec{F} \) from its 30° position to a point 180° removed (see figure 2) from the initial angle. Test for equilibrium by removing the pin.

Question: Does this show that a force can be replaced by its rectangular components? Explain your answer. Your report for this part should answer this question and show the completed circle and vector diagrams.
Part II. Resultant and Equilibrant of two Forces.

Mount two of the pulleys on the force table in any positions not $90^0$ apart, and suspend unequal loads on the cords running over them. Sketch a circle diagram showing the location and direction of the forces acting on the ring (see figure 3). The circle diagram serves as a means of summarizing the data. Each pan weighs 50 grams and it must be included as part of each load. Draw the vector diagram for the arrangement and from it determine the direction and magnitude of the resultant (see figure 4). Choose a scale for the vector diagram so that the diagram occupies at least half a page in your report.

To check the above procedure, first determine from the vector diagram the angle between the resultant and the $0^0$ reference direction. Note carefully where it would be located on the circle diagram. Then mount a third pulley $180^0$ from this position and apply a load over it equal in amount to the determined magnitude of the resultant. Cautiously remove the center pin. If any appreciable motion occurs, an error has been made and you must repeat your work. Your report for this part consists of the completed circle and vector diagrams.