Vector Addition

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

When calculating direction, give your answers as values between 0° and 360°.

Note: A gram is a unit of mass which is *not* a vector but is directly proportional to an object's weight. For the purpose of this lab and the equipment that you will be using, the forces experienced by each pulley will be expressed in terms of the masses that you will hang from them.

A: Experimental Method for Determining the Equilibrant of Two Vectors

Case 1

Find the equilibrant vector associated with the two vectors that you have been given.

Upload your sketch. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

Find the experimental uncertainty for the magnitude of the equilibrant. (Record this uncertainty to the smallest mass available.)

Find the experimental uncertainty in the direction of the equilibrant. (Record this uncertainty to a fraction of a degree.)

Case 2

Find the equilibrant vector associated with the two vectors that you have been given.

Upload your sketch. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

Find the experimental uncertainty for the magnitude of the equilibrant. (Record this uncertainty to the smallest mass available.)

Find the experimental uncertainty in the direction of the equilibrant. (Record this uncertainty to a fraction of a degree.)

B: Graphical Method for Determining the Equilibrant of Two Vectors

Case 1

Record the magnitude and direction of the equilibrant and resultant.

Table 1

Vector	**Magnitude (g)**	**Direction (°)**
Equilibrant		
Resultant		

Upload a file with your graphs. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

Case 2

Record the magnitude and direction of the equilibrant and resultant.

Table 2

Vector	**Magnitude (g)**	**Direction (°)**
Equilibrant		
Resultant		

Upload a file with your graphs. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

C: Analytical Method of Determining the Equilibrant of Two Vectors

Case 1

Record the components of the forces.

Table 3

Vector	***x*-component (g)**	***y*-component (g)**
$\mathbf{F}_1$		
$\mathbf{F}_2$		
E		
R		

Record the magnitude and direction of the equilibrant and resultant.

Table 4

Vector	**Magnitude (g)**	**Direction (°)**
Equilibrant		
Resultant		

Upload a file with your graphs. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

Case 2

Record the components of the forces.

Table 5

Vector	***x*-component (g)**	***y*-component (g)**
$\mathbf{F}_1$		
$\mathbf{F}_2$		
E		
R		

Record the magnitude and direction of the equilibrant and resultant.

Table 6

Vector	**Magnitude (g)**	**Direction (°)**
Equilibrant		
Resultant		

Upload a file with your graphs. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

Calculations

Determine the percent error for the magnitude of the equilibrant obtained by the experimental and analytical methods.

Determine the percent difference for the magnitude of the equilibrant obtained by the experimental and graphical methods.

Questions

Concurrent forces are forces that act at a single point. The cases show concurrent forces but the forces on the force table act on a ring, not at a point. Nonetheless, the forces are still concurrent. Explain.

Could all three pulleys on the force table be placed in one quadrant and still be in equilibrium? Explain.

Suppose three forces with magnitudes of 182 N, 285 N, and 175 N are placed in equilibrium. If the 175-N force acts in the $+y$-direction, what is one of the two configurations in the xy-plane that the remaining forces may have? Give numerical values for the angles. (*Note: The values given may be different in the WebAssign question.*)

Show your results on a sketch.

What is the condition necessary for equilibrium? (Consider only linear motion.)