Survey of Physics

# Lab 4: Vectors

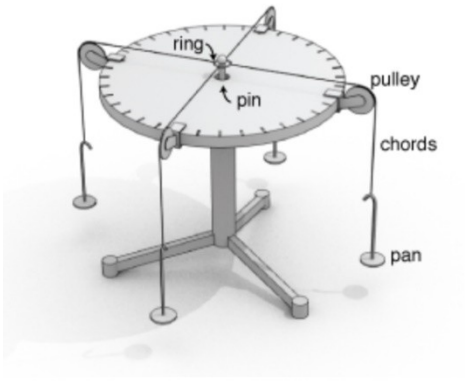
Name:_____

partner name(s):_____

**Theory:**

Physical quantities that require both a magnitude and direction for their description are called vector quantities.

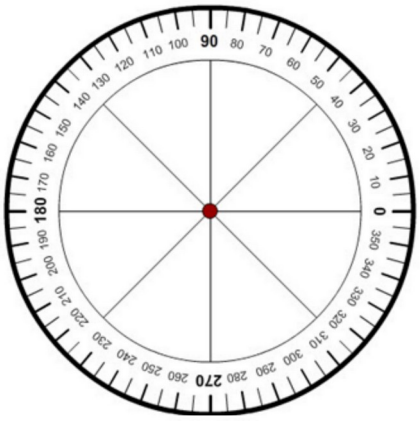
Vectors must be added by special rules that take both parts of the description into account. In this lab, we will make use of a force table to understand how to add vectors together. A mass is placed in each *pan* (**each pan has a mass of 50g**). This mass experiences a force due to gravity given by its mass times *g* . This force, acting in the vertical direction, is redirected to act in a horizontal direction with chords and pulleys.




You may place several forces at the angles you choose, using the angles shown around the perimeter of the table.

**Purpose:**

1. Understand the definition of a vector.
2. Learn to add vectors together using the component method and the graphical method.




**Equipment:**

1. Force table and accessories
2. Slotted masses
3. Weight hangers
4. Calculator

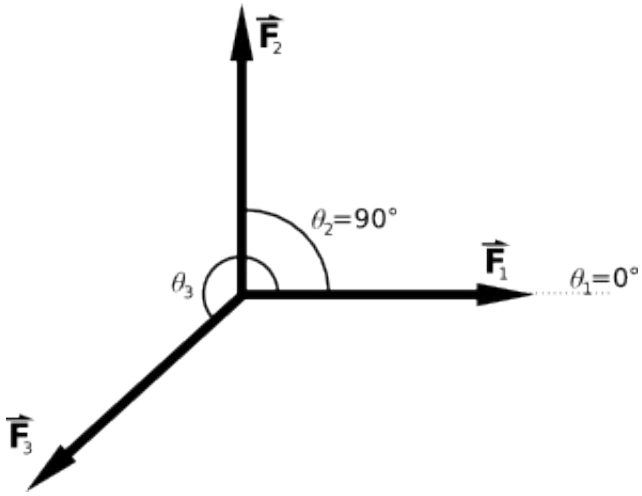
**Procedure:**

You will assemble the following two cases and adjust them so that all forces balance. When this happens, the force vectors will add to zero. On the table, make sure you have pulleys to pass the string over the edge. Units of grams (g) will be used for the force magnitudes.

For each case below, balance the forces and then answer the questions that follow.

CASE 1:

Two perpendicular forces, $\vec{F}_1$ and $\vec{F}_2$ **,** balanced by force $\vec{F}_3$, which is equal in magnitude but opposite in direction to the *sum* of $\vec{F}_1$ and $\vec{F}_2$ .




Use the magnitudes of

$F_1$ = 400 g
$F_2$ = 300 g

$\vec{F}_1$ should be at 0° and $\vec{F}_2$ should be at 90°, as shown.

Adjust the magnitude and angle of $\vec{F}_3$ to balance all three forces. Record them here:

| | $\vec{F}_1$ | $\vec{F}_2$ | $\vec{F}_3$ |
|---|---|---|---|
| magnitude (g) | 400 | 300 | |
| direction (°) | 0° | 90° | |

Find the components of force $\vec{F}_3$ .

$F_{3x} = F_3 \cos\theta_3$ = _____

$F_{3y} = F_3 \sin\theta_3$ = _____

Compare these components to the other two vectors, $\vec{F}_1$ and $\vec{F}_2$. If you did it correctly, $F_{3x}$ should balance $\vec{F}_1$ and $F_{3y}$ should balance $\vec{F}_2$.

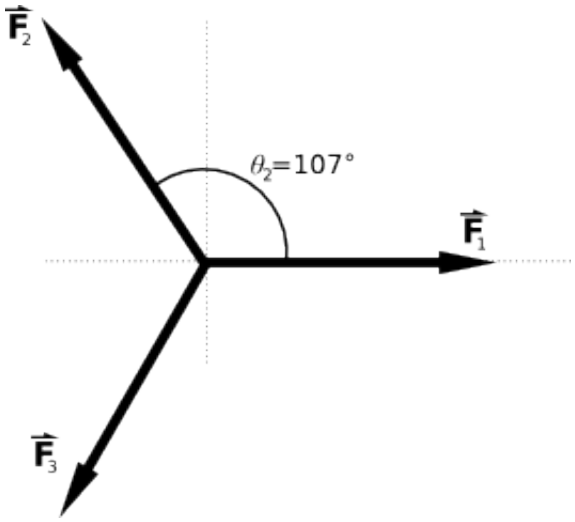
CASE 2:

Two forces, $\vec{F}_1$ and $\vec{F}_2$, balanced by force $\vec{F}_3$.

Use the magnitudes of

$F_1$ = 250 g
$F_2$ = 300 g

$\vec{F}_1$ should be at 0° and $\vec{F}_2$ should be at 107°.




Adjust the magnitude and angle of $\vec{F}_3$ to balance all three forces. Record them here:

| | $\vec{F}_1$ | $\vec{F}_2$ | $\vec{F}_3$ |
|---|---|---|---|
| magnitude (g) | 250 | 300 | |
| direction (°) | 0° | 107° | |

Find the components of force $\vec{F}_1$.

$F_{1x} = F_1 \cos\theta_1$ = _____

$F_{1y} = F_1 \sin\theta_1$ = _____

Find the components of force $\vec{F}_2$.

$F_{2x} = F_2 \cos\theta_2$ = _____

$F_{2y} = F_2 \sin\theta_2$ = _____

Find the components of force $\vec{F}_3$.

$F_{3x} = F_3 \cos\theta_3$ = _____

$F_{3y} = F_3 \sin\theta_3$ = _____

Next we find the sum $\vec{F} = \vec{F}_1 + \vec{F}_2$.

Add the components of $\vec{F}_1$ and $\vec{F}_2$ :

$F_x = F_{1x} + F_{2x}$ = _____

$F_y = F_{1y} + F_{2y}$ = _____

Finally compare the components of the sum $\vec{F} = \vec{F}_1 + \vec{F}_2$ to the components of $\vec{F}_3$. Are they nearly opposite?