PH 201 **Force Table Lab**

The force table allows the sum of several force vectors to be found experimentally using strings pulling on a ring. The goal of this lab is to find the experimental vector sums and compare them with the mathematical vector sums.

Instructor example.
$\vec{F}_1$: 250 grams at 0° and $\vec{F}_2$: 350 grams at 250°. Suppose $\vec{F}_E$ has 336 grams at 115°.

Your instructor will work out this example. Pay attention to the steps, including:

- setting up forces on the apparatus
- finding the strength of the force in Newtons from the hanging mass in grams
- finding the equilibrant force $\vec{F}_E$
- using the equilibrant force to find the resultant (or sum) force $\vec{F}_R$
- finding the x and y components of any one force, with correct sign based on the quadrant
- using a component table to sum up all the x components and all the y components
- finding the magnitude and direction of the resultant force mathematically from the components
- finding the percentage difference between the experimental strength and the mathematical one
- finding the angular difference between the resultants found by the two methods

Lab exercises:

There are three exercises to hand in, the first two adding a pair of vectors and the third one adding three vectors. Do each example on a new answer sheet. For each vector, use the axes to draw a diagram, with labels, to get the components. Also draw the resultant vector to find the direction θ_R and determine the correct quadrant.

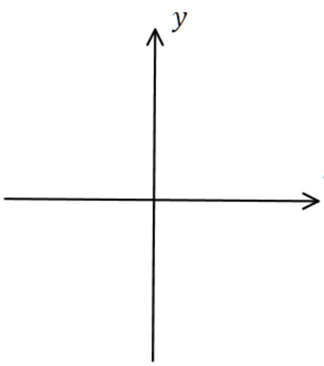
Hand in:
1. Your neatly completed worksheets for each of the three exercises below.
2. Any other materials your instructor asks for

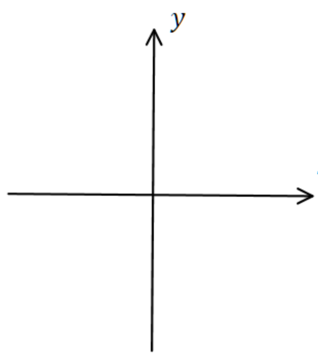
Exercise 1. $\vec{F}_1$: 230 grams at 180° and $\vec{F}_2$: 450 grams at 90°
Exercise 2. $\vec{F}_1$: 550 grams at 174° and $\vec{F}_2$: 300 grams at 306°
Exercise 3. $\vec{F}_1$: 300 grams at 250°, $\vec{F}_2$: 150 grams at 300°, and $\vec{F}_3$: 400 grams at 30°

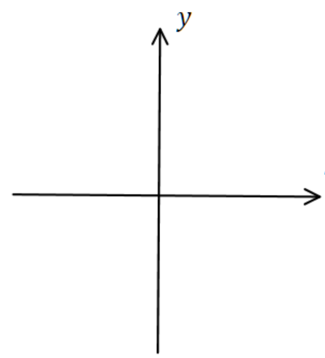
Exercise # _____ **Day:** T / R / F **Time:** ____ **Partner:** ___________ **Your Name:** _________________

Theory calculation: For each vector to be added, find the weight in Newtons, use a set of axes to draw and label it, and find the components with correct signs. Enter each vector in one line of the table, with correct units. Enter the totals for $\vec{F}_R$

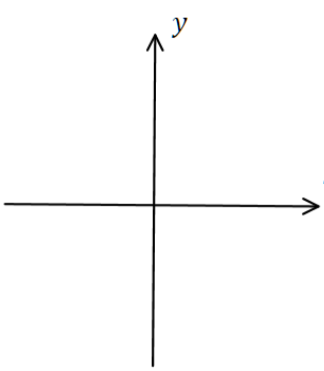
$|\vec{F}_1| =$ $|\vec{F}_2| =$ $|\vec{F}_3| =$







	x component (Newtons)	y component (Newtons)
$\vec{F}_1$		
$\vec{F}_2$		
$\vec{F}_3$		
Total $\vec{F}_R$		



Draw the resultant vector in the correct quadrant, and so find the correct angle θ_R measured counterclockwise from the $+x$ axis. Then find the magnitude of the resultant (in Newtons):

$\theta_R =$

$|\vec{F}_R| =$

Experimental data found: $\theta_E =$ so $\theta_R =$

$|\vec{F}_R| =$

Compare the results from theory and experiment:

Percentage difference between the magnitudes $|\vec{F}_R|$:

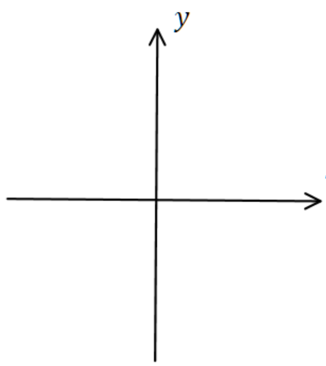
$$\frac{|\text{expt}-\text{calc}|}{\text{average}} \times 100\% =$$

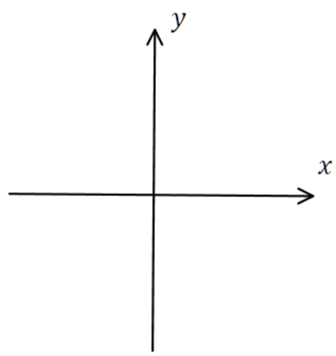
Angular difference: $\Delta\theta = |\theta_R(\text{expt}) - \theta_R(\text{calc})| =$

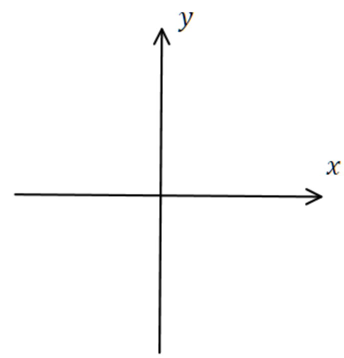
Exercise # _____ **Day:** T / R / F **Time:** ____ **Partner:** ___________ **Your Name:** __________________

Theory calculation: For each vector to be added, find the weight in Newtons, use a set of axes to draw and label it, and find the components with correct signs. Enter each vector in one line of the table, with correct units. Enter the totals for $\vec{F}_R$

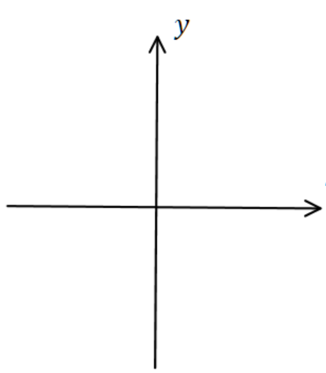
$|\vec{F}_1| =$ $|\vec{F}_2| =$ $|\vec{F}_3| =$







	x component (Newtons)	y component (Newtons)
$\vec{F}_1$		
$\vec{F}_2$		
$\vec{F}_3$		
Total $\vec{F}_R$		



Draw the resultant vector in the correct quadrant, and so find the correct angle θ_R measured counterclockwise from the $+x$ axis. Then find the magnitude of the resultant (in Newtons):

$\theta_R =$

$|\vec{F}_R| =$

Experimental data found: $\theta_E =$ so $\theta_R =$

$|\vec{F}_R| =$

Compare the results from theory and experiment:

Percentage difference between the magnitudes $|\vec{F}_R|$:

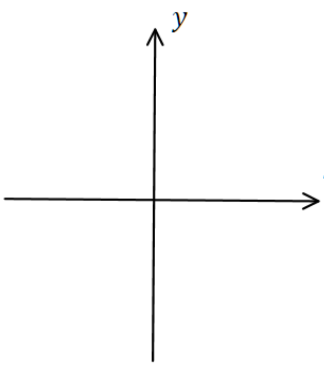
$$\frac{|\text{expt}-\text{calc}|}{\text{average}} \times 100\% =$$

Angular difference: $\Delta\theta = |\theta_R(\text{expt}) - \theta_R(\text{calc})| =$

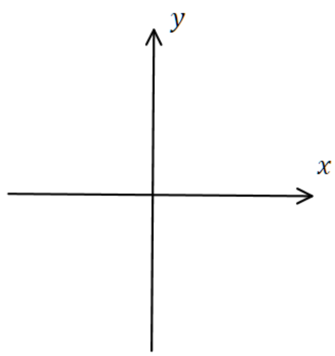
Exercise # _____ **Day:** T / R / F **Time:** ____ **Partner:** ___________ **Your Name:** ________________

Theory calculation: For each vector to be added, find the weight in Newtons, use a set of axes to draw and label it, and find the components with correct signs. Enter each vector in one line of the table, with correct units. Enter the totals for $\vec{F}_R$

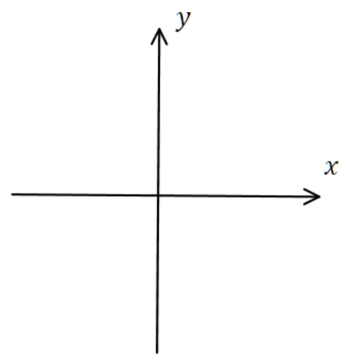
$|\vec{F}_1| =$



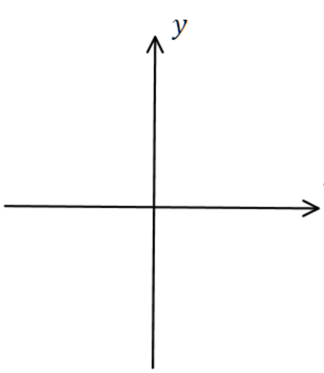
$|\vec{F}_2| =$



$|\vec{F}_3| =$



	x component (Newtons)	y component (Newtons)
$\vec{F}_1$		
$\vec{F}_2$		
$\vec{F}_3$		
Total $\vec{F}_R$		



Draw the resultant vector in the correct quadrant, and so find the correct angle θ_R measured counterclockwise from the $+x$ axis. Then find the magnitude of the resultant (in Newtons):

$\theta_R =$

$|\vec{F}_R| =$

Experimental data found: $\theta_E =$ so $\theta_R =$

$|\vec{F}_R| =$

Compare the results from theory and experiment:

Percentage difference between the magnitudes $|\vec{F}_R|$:

$$\frac{|\text{expt}-\text{calc}|}{\text{average}} \times 100\% =$$

Angular difference: $\Delta\theta = |\theta_R(\text{expt}) - \theta_R(\text{calc})| =$