Supplemental Experiments
Student Journal

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Supplemental Experiment 1

Measuring Vector Forces

Observations and Data Collection

1. Complete the following Data Table.

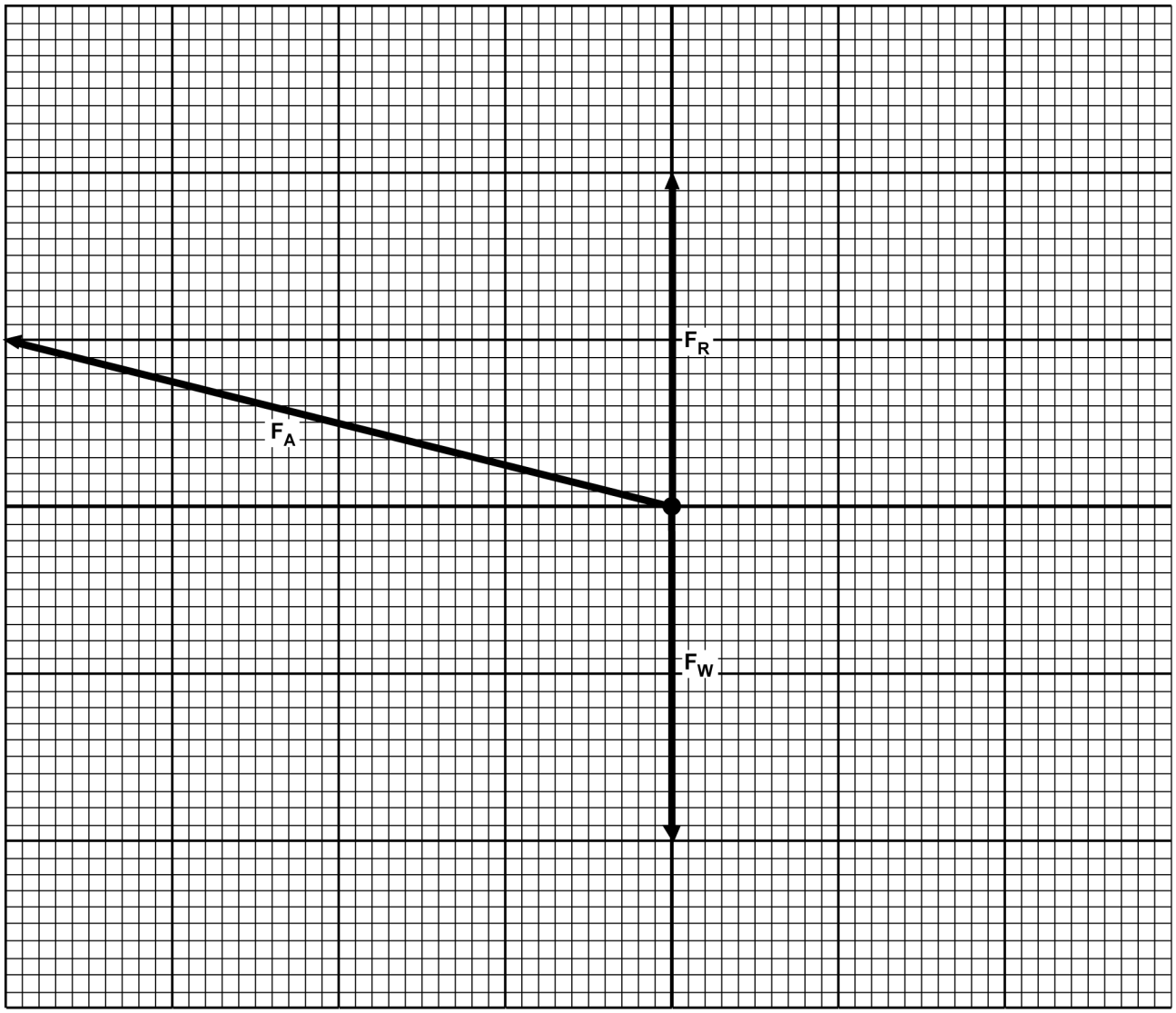
Data Table 1

Component	Angle L (°)	Force Magnitude F (N)
Scale A	L_A = ____	F_A =____
Scale B	L_B =____	F_B = ____
Weight Hanger	L_W =____	F_W = ____

Graphing the Data

3. Complete the following Data Graph.

Data Graph 1



1 Major Division = 1 Newton

Questions and Interpretations

1. What should your resultant vector have been? Was it as expected?_____

_____

_____

_____

2. Give as many reasons as you can for a non-zero resultant force. _____

_____

_____

_____

_____

3. Figure 11 shows vectors acting at a point, similar to the experiments you did. Vector F_R is the resultant of vectors F_A and F_B. Draw the missing vector, F_B, on the graph in the Student Journal.

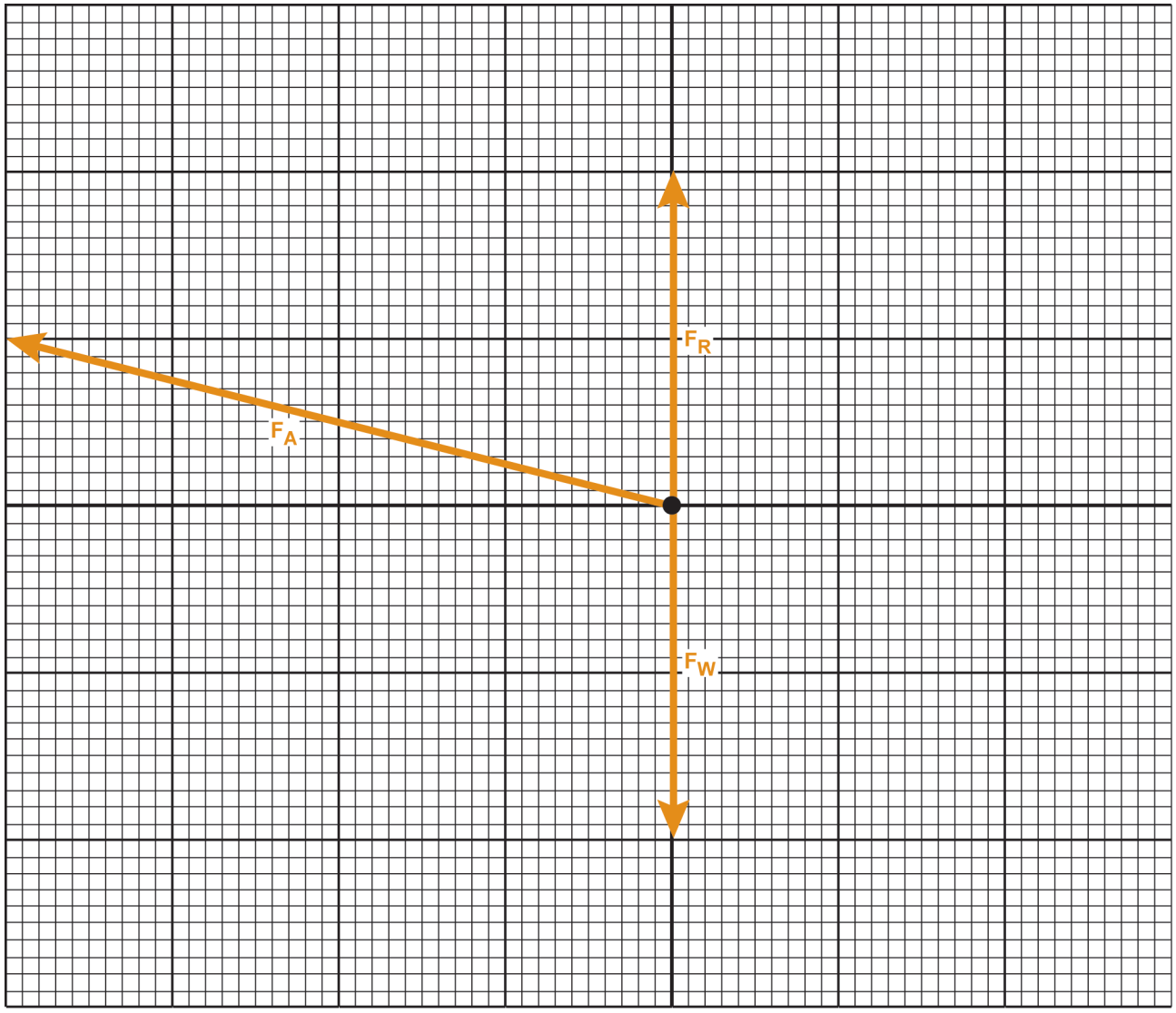


Figure 11
Graph for Question 3

4. If vector F_W in Figure 11 represents a force of 2N, what force does vector F_A represent? _____

5. Looking at the vectors in Figure 12 below, the resultant vector can consist of the sum of vectors F_A and F_B or the sum of vectors F_C and F_D. Comparing the angles L_A and L_C, can we say that the vector (or the force that it represents) increases or decreases as the angle increases? _____

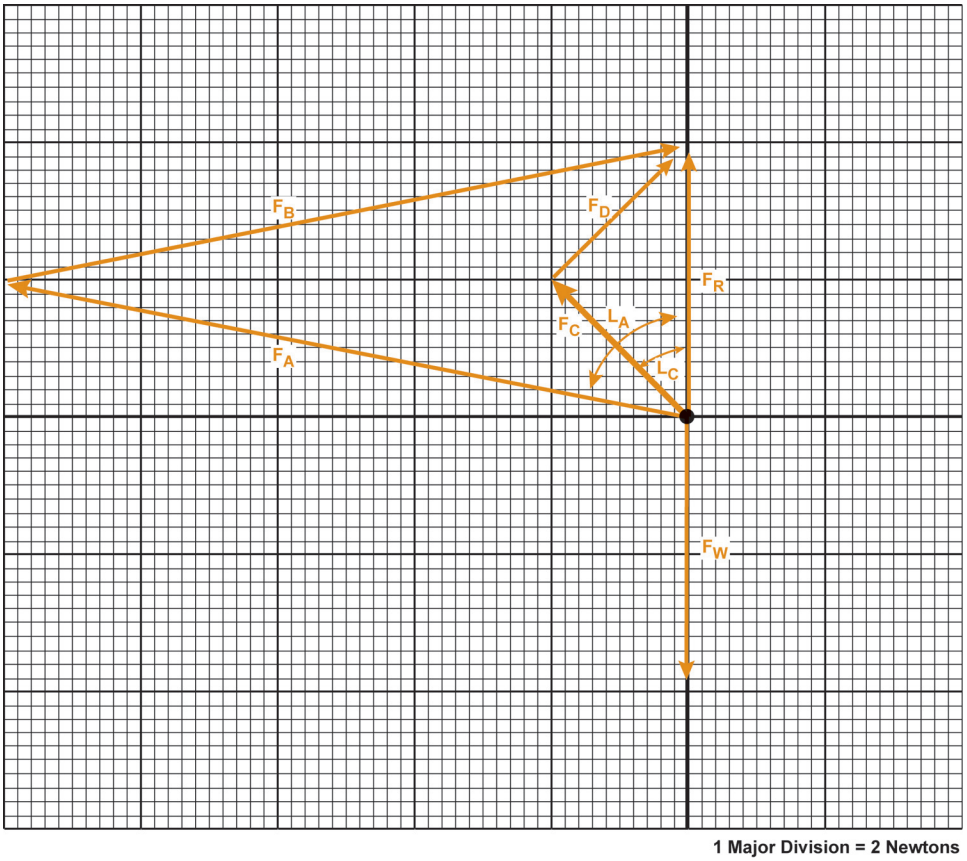


Figure 12
Graph for Question 5

Supplemental Experiment 2

Solving Vector Forces Using Trigonometric Functions

Observations and Data Collection

1. Complete the following data tables.

Data Table 1

Angle *A* =	
Angle *B* =	
θ =	
ϕ =	
F_1 =	
F_2 =	

Data Table 2

F_{X1} =	
F_{X2} =	

Data Table 3

F_{Y1}	
F_{Y2}	

Data Table 4

F_R	
Mass	
F_W	

Questions and Intrepretations

1. Show mathematically how F_{Y1} is the same as $F_1 \sin \phi$, and F_{Y2} is the same as $F_2 \sin \phi$. Refer to the equations in step 6.

2. If θ "theta" was to equal 47° and ϕ "phi" was to equal 12°, what would the new F_1 and F_2 be? Assume $F_R = 3.92$ N.

3. If we changed the height of 2.5 Newton scale from 9 cm below the crossbar to 3 cm below the crossbar, how would that affect the vector force of the 5 Newton scale (F1)? Will it increase, decrease, or stay the same? Refer to Figure 5. _____
   _____
   _____

4. Where should you position the 2.5 Newton scale in order for the 5 Newton scale to support the whole weight (vertically in line with the weight)? ____
   _____
   _____
   _____
   _____

Supplemental Experiment 3

Projectile Motion

Procedure Part 1

4. Complete the following data table.

Data Table 1

	Slow	Medium	Fast
Time (sec)			

5. Did the speed of the rolling ball matter? If so, how? _____

_____

_____

_____

_____

Procedure Part 2

4. The following formula uses initial velocity and acceleration to find the distance.

$$\mathbf{d = v_i\, t + 0.5\, at^2}$$

To use this equation the value of t must be one half of the measured t.

5. Find the final velocity.

Data Table 2

t =	
d =	
$V_{ballthrown}$ =	
$V_{ballcaught}$ =	

Procedure Part 3

7. Complete the following data table.

Data Table 3

Maximum height	
Height on the table	
Initial piston position, ℓ_i	
Final piston position, ℓ_f	

14. Complete the following data table.

Data Table 4

	Trial 1	**Trial 2**	**Trial 3**	**Average**
Flight time				
Horizontal displacement				
Estimated height above the table				

Observations and Calculations

Finding the Ejection Velocity

1. Find the average flight time, the average horizontal displacement, and the estimated height above the table.

4. Complete the following data table.

Data Table 5

Total moving mass, m_{total}	
Distance the piston moves, $\Delta\ell$	
Ejection velocity	

Calculate the total moving mass.

5. Convert the moving mass to kilograms.

6. Find the distance.

7. Convert $\Delta\ell$ from millimeters to meters.

9. Find the ejection velocity.

Determining the Final Velocity

5. Calculate the vertical component of the ejection velocity.

6. Convert the table height to meters.

7. Convert the height of the projectile apparatus above the table to meters.

8. Find the height between points C and D.

9. Find the vertical component of the final velocity at point D.

10. Find the final projectile velocity at point D.

11. Use the Pythagorean theroem to the final velocity at point D.

Data Table 6

Initial projectile velocity, v_i	
Initial projectile velocity, v_y	
Height of the table	
Height between points C to D	
Final velocity (vertical component), v_{yfinal}	
v_x	
$v_{f(point\ D)}$	

Determine the Maximum Height the Ball Reaches

1. Determine the flight time from point C to point D.

2. Find the flight time from point A to point C.

3. Find the flight time from point A to point B.

5. Find the maximum height of the ball above the projectile apparatus.

6. Find the total height above the table.

Data Table 7

$T_{(C \text{ to } D)}$	
$T_{(A \text{ to } C)}$	
$T_{(A \text{ to } B)}$	
V_y	
$y_{(max)}$	
Calculated height above the table	
Estimated height above the table	

8. Reasons for the discrepancy between the calculate height and the estimated height. _____

_____

_____

_____

Calculating the Horizontal Displacement

3. Calculate the horizontal displacement.

Data Table 8

Horizontal velocity, v_x	*3.45* m/s
Average flight time	*0.63* s
Calculated horizontal displacement	*2.1* m
Measured horizontal displacement	*1.12* m

5. Compare the measured horizontal displacement to the calculated horizontal displacement. _____

_____

_____

_____

_____

Questions and Intrepretations

1. A basketball player throws a ball from the same distance to the basket with the same projection velocity. For angles other than 45º there are two possible angles. Will the low angle shot take more or less time than a high angle shot? _____
_____
_____
_____

2. You are playing deep center field and you need to make a throw to home plate. However, you have very little strength. At want angle do you throw the ball to get the most distance? Neglect air resistance? _____
_____
_____
_____
_____
_____

3. Neglecting air resistance, if somebody dropped a sheet of paper and a bowling ball from a very tall building which would hit the ground first? _____
_____
_____
_____
_____
_____
_____