PHYS LAB **VECTORS** Name:______________________________

Partners:____ Day________Time________

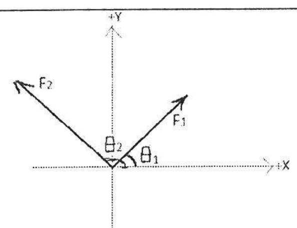
Purpose: To determine
(a) the resultant and equilibrant of two or more vectors
(b) the components of a vector
analytically and to verify the results using a force table and a website.

Apparatus: force table with pulleys, mass hangers, mass set, string, level, and PC.

Theory: Analytical method

Let's say two forces F_1 (making an angle θ_1, counterclockwise from the +X-axis) and F_2 (making an angle θ_2, counterclockwise from the +X-axis) are acting on an object.

To find the resultant (net) force, F_R we need to find the X and Y components of the two forces, as shown below:

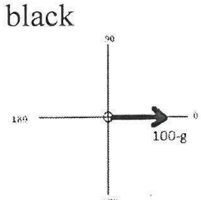
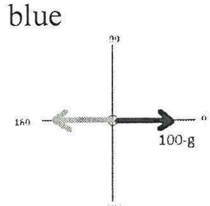


Magnitude of the resultant (F_R) is given by;

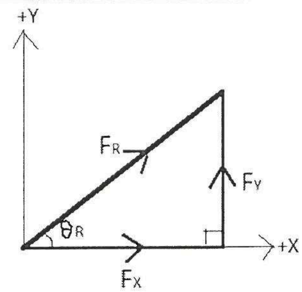
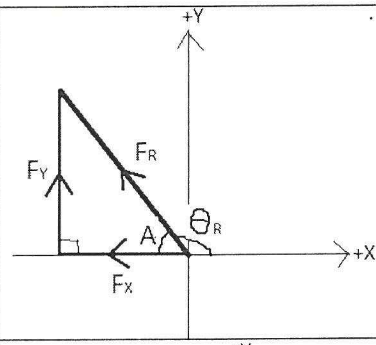
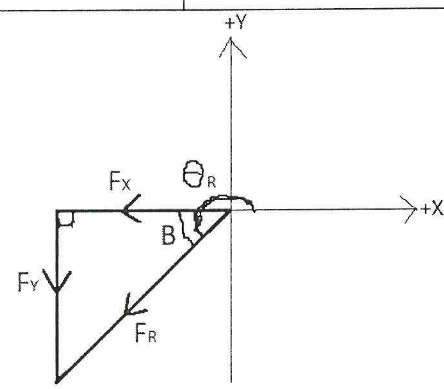
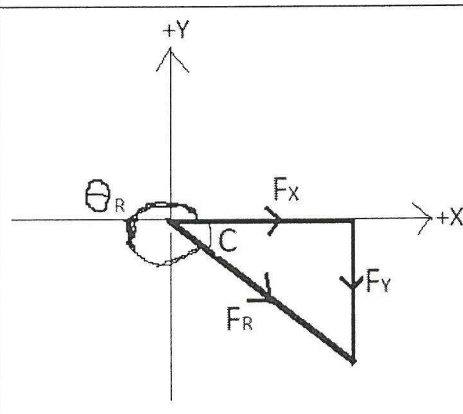
$$F_R = \sqrt{|F_x|^2 + |F_y|^2}$$

Force	X component	Y component
F_1	$F_1 \cos\theta_1$	$F_1 \sin\theta_1$
F_2	$F_2 \cos\theta_2$	$F_2 \sin\theta_2$
$F_R = F_1 + F_2$	$F_x = F_1 \cos\theta_1 + F_2 \cos\theta_2$	$F_y = F_1 \sin\theta_1 + F_2 \sin\theta_2$

Equilibrant vector: A single vector that will make a system to be in equilibrium. You will need the equilibrant vector when you use the force table.

For a single vector 100 g @ 0^0	Resultant Vector, black 	Equilibrant vector, blue 	Magnitude of the equilibrant = magnitude of the resultant. Direction of the equilibrant = $\theta_E = \theta_R \pm 180$.

Direction of the resultant, θ_R, measured from the +X axis counterclockwise, depends on the signs of Fx and Fy, as shown in the data table below.

Case	Vector Diagram	θ_R	F_R
Fx > 0 and Fy >0		$\theta_R = tan^{-1}\frac{F_y}{F_x}$	$F_R = \sqrt{\lvert F_x\rvert^2 + \lvert F_y\rvert^2}$
Fx < 0 and Fy > 0		$A = tan^{-1}\frac{F_y}{\lvert F_x\rvert}$ $\theta_R = 180 - A$	$F_R = \sqrt{\lvert F_x\rvert^2 + \lvert F_y\rvert^2}$
Fx < 0 and Fy < 0		$B = tan^{-1}\left\lvert\frac{F_y}{F_x}\right\rvert$ $\theta_R = 180 + B$	$F_R = \sqrt{\lvert F_x\rvert^2 + \lvert F_y\rvert^2}$
Fx > 0 and Fy < 0		$C = tan^{-1}\frac{\lvert F_y\rvert}{F_x}$ $\theta_R = 360 - C$	$F_R = \sqrt{\lvert F_x\rvert^2 + \lvert F_y\rvert^2}$

Procedure

A) Analytical Method

Using the analytical method (component method) find the magnitude and the direction of the resultant. Also estimate the direction of the equilibrant.

B) From the website: http://www.1728.org/vectors.htm

1. Open the above website, enter the vectors, and obtain the magnitude and the direction of the resultant.

C) Force Table Check

1) Use a level to make sure the force table is leveled.
2) Mount a pulley on the 0^0 mark and suspend a 50-gram mass hanger. Mount a second pulley on the 90^0 mark and suspend a 100-gram mass (hanger and a 50-gram mass).
3) Set up the equilibrant on the force table and test the system for equilibrium.
4) Remove all the masses from the force table.

5) Mount a pulley on the 20^0 mark and suspend a 50-gram mass. Mount a second pulley on the 120^0 mark and suspend a 250-gram mass.
6) Set up the equilibrant on the force table and test the system for equilibrium.
7) Remove all the masses from the force table.

8) Repeat the above procedure for (3) 50 g @ 20^0, 250 g @ 120^0 and 300 g @ 300^0.

9) Repeat the above procedure for (4) 100 g @ 30^0, 150 g @ 140^0, 125 g @ $200^0$and 200 g @ 300^0.

10) Repeat the above procedure for (5) A + B + C + D.

11) Repeat the above procedure for (6) Resolution 300 g @ 30^0.

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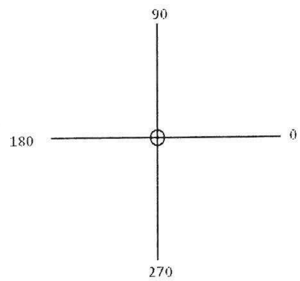
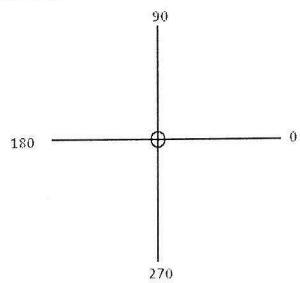
12) Write a conclusion for the purpose.

(1) 50 g @ 0^0 and 100 g @ 90^0

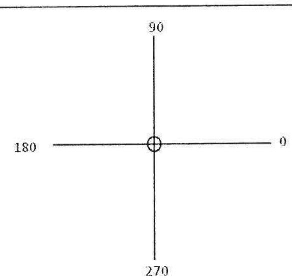


	X-Comp	Y-Comp
50 g @ 0^0		
100 g @ 90^0		
$\boldsymbol{F_R}$	$F_x=$	$F_y=$

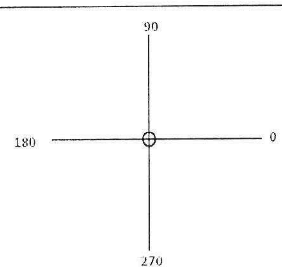


	F_R	θ_R	θ_E	Force Table check
Analytical				
Website			XXXXXXXX	

(2) 50 g @ 20^0 and 250 g @ 120^0

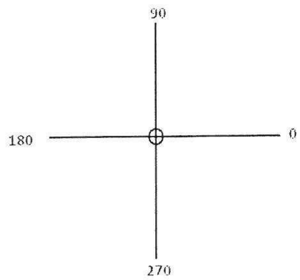


	X-Comp	Y-Comp
50 g @ 20^0		
250 g @ 120^0		
$\boldsymbol{F_R}$	$F_x=$	$F_y=$

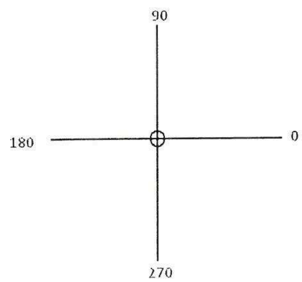


	F_R	θ_R	θ_E	Force Table check
Analytical				
Website			XXXXXXXX	

(3) 50 g @ 20^0, 250 g @ 120^0 and 300 g @ 300^0

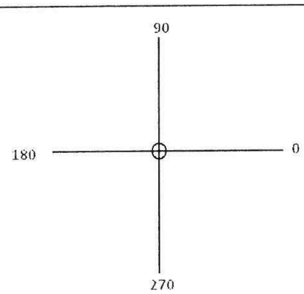


	X-Comp	Y-Comp
50 g @ 20^0		
250 g @ 120^0		
300 g @ 300^0		
$\boldsymbol{F_R}$	F_x=	F_y=

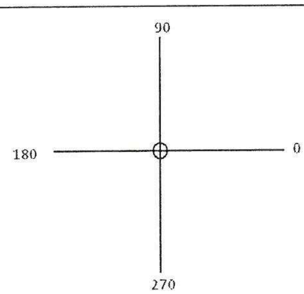


	F_R	θ_R	θ_E	Force Table check
Analytical				
Website			XXXXXXXX	

(4) 100 g @ 30^0, 150 g @ 140^0, 125 g @ $200^0$and 200 g @ 300^0

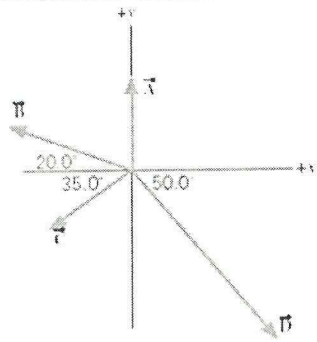


	X-Comp	Y-Comp
100 g @ 30^0		
150 g @ 140^0		
125 g @ 200^0		
200 g @ 300^0		
$\boldsymbol{F_R}$	F_x=	F_y=

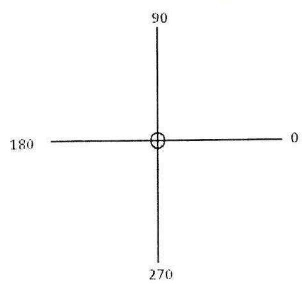


	F_R	θ_R	θ_E	Force Table check
Analytical				
Website			XXXXXXXX	

(5) **A** + **B** + **C** + **D**

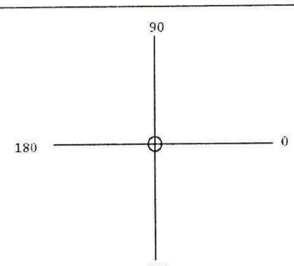


	X-Comp	Y-Comp
A = 100 g		
B = 160 g		
C = 120 g		
D = 260 g		
$\boldsymbol{F_R}$	F_x=	F_y=



	FR	θ_R=	θ_E=	Force Table check
Analytical				
Website			XXXXXXXX	
(				

(6) Resolution 300 g @ 30^0



	X-Comp	Y-Comp
300 g @ 30^0		

1. Set up the above components as they have been determined along the 0^0 (X- axis) and 90^0 (Y-axis) directions.
2. Set up the 300-gram mass at, 30 + 180 = 210^0, which is the direction of the equilibrant. Test the system for equilibrium.

Force Table check