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Jan 27-10:05 AM

§9.3 Vector Addition By Components

In the previous section, we took a singular resultant vector A with an angle θ and broke it into A_x and A_y vectors. Now we will work in reverse. We will take the A_x and A_y vectors and obtain the resultant vector and its respective angle θ.

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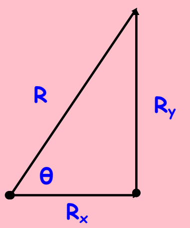
Since the A_x and A_y are both horizontal and vertical vectors they will form a right angle with the resultant. Hence the resultant is just the hypotenuse, hence the use of Pythagorean equation. The angle θ is just a tangent argument.



Recall from the terminal arm that:

$R = \sqrt{(R_x^2 + R_y^2)}$

$\theta = \tan^{-1}\left(\frac{|R_y|}{|R_x|}\right)$

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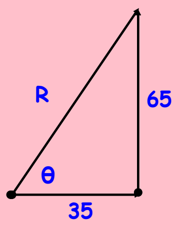
Example: Given that A_x = 35 m A_y = 65 m, find resultant and the direction.



Solution:

$R = \sqrt{((35)^2 + (65)^2)}$

$R = \sqrt{(1225 + 4225)}$

$R = \sqrt{(5450)}$

$R = 73.8$ m

$\theta = \tan^{-1}\left(\frac{|65|}{|35|}\right)$

$\theta = \tan^{-1}(1.86)$

$\theta = 61.7°$

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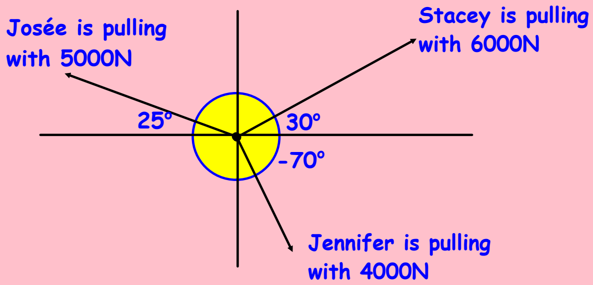
Example: The TUG-OF-WAR Question
Three girls are fighting for a guy at a dance as shown below by pulling on his shirt. Find out where the guy will go and in which direction.



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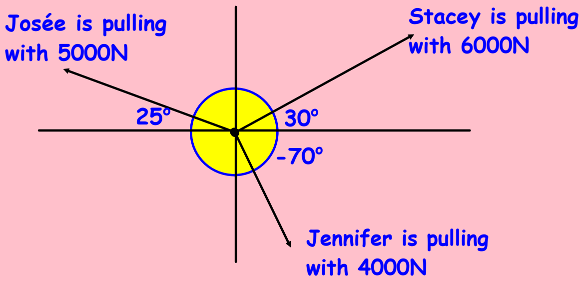
Solution: From a physics standpoint, notice that some of the pulling will cancel itself out. The first step is that we must find out the proper angle values of each girl. Stacey's angle is fine θ=30°, Josée's angle is actually θ=(180°-25°), so θ=155°, and Jennifer's angle is actually θ=(360°-70°), so θ=290°.



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<u>Solution:</u> Now let's break each girl's components.
Stacey's vector is:
S_x = 6000cos30°
S_x = 5196.2 N

S_y = 6000sin30°
S_y = 3000 N

Josée's vector is:
J_x = 5000cos155°
J_x = -4531.5 N

J_y = 5000sin155°
J_y = 2113.1 N

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<u>Solution:</u> Now let's break each girl's components.
Jennifer's vector is:
J_x = 4000cos290°
J_x = 1368.1 N

J_y = 4000sin290°
J_y = -3758.8 N

Now we can add all the x and y components separately.

$R_x = \Sigma(R_{x1} + R_{x2} + R_{x3})$
$R_x = \Sigma(5196.2-4531.5+1368.1)$
R_x = 2032.8N

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$R_y = \Sigma(R_{y1} + R_{y2} + R_{y3})$
$R_y = \Sigma(3000+2113.1-3758.8)$
R_y = 1354.3 N

Now we will find the resultant vector:
$R = \sqrt{((2032.8)^2 + (1354.3)^2)}$
$R = \sqrt{(4132275.8+ 1834128.5)}$
$R = \sqrt{(5966404.34)}$
R = 2442.6 N

$\theta = \tan^{-1}\frac{(1354.3)}{(2032.8)}$
$\theta = \tan^{-1}(0.666)$
θ = 33.7°

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It looks like Stacey is in luck as the guy will be pulled with a force of 2442.6N at angle of $\theta = 33.7°$.

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In a nut shell:

1. Convert all vectors into A_x and A_y components using $A_x = A\cos\theta$ and $A_y = A\sin\theta$.

2. Add all respective components and create the resultant vector $A = \sqrt{(A_x^2 + A_y^2)}$ and then determine the reference angle using: $\theta = \tan^{-1}\left(\frac{|A_y|}{|A_x|}\right)$

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Exit Ticket: Complete & hand-In. §9.3 #29,30

Homework:
§9.3 #7-27 (odd only)

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