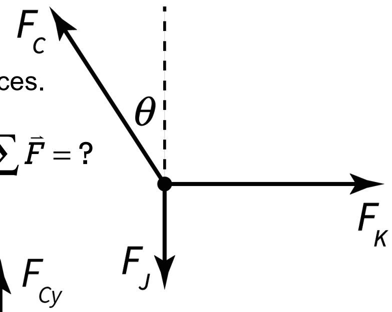
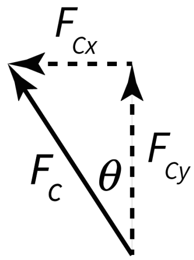
Flipping Physics Lecture Notes:
Summing the Forces is Vector Addition



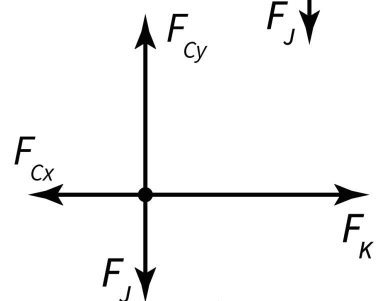
We just completed a problem where we found the net force caused by three forces.

Known Values: $\vec{F}_K = 270N\ E; \vec{F}_J = 130N\ S; \vec{F}_C = 260N\ @\ 33^\circ W\ of\ N; \sum \vec{F} = ?$
(K = Ken, J = Jim, C = Chris)

We drew the free body diagram.

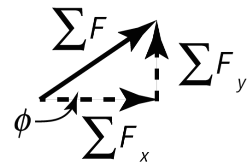


Broke the force of Chris in to its components.
$F_{Cy} = 218.054N$ & $F_{Cx} = 141.606N$



Redrew the Free Body Diagram:

Determined the net force in the x & y directions:
$\sum F_x = 128.394N$ & $\sum F_y = 88.054N$



Used the Pythagorean theorem to solve for the magnitude of the net force.
$\sum F = 155.687 \approx 160N$

Used tangent to find the direction.

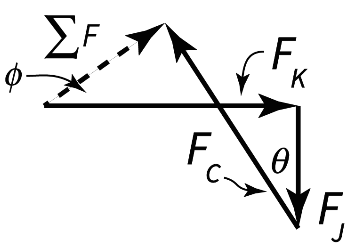
$$\phi = \tan^{-1}\left(\frac{88.054}{128.394}\right) = 34.4429 \approx 34^\circ$$

And found the net force.

$$\boxed{\sum \vec{F} \approx 160N @ 34^\circ N\ of\ E}$$

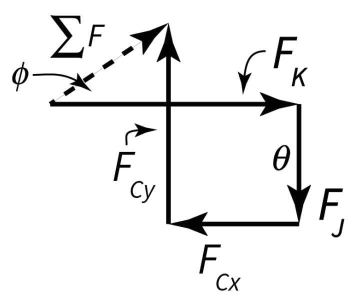
(Clearly the above is just a summary. Please see the previous video for a complete solution.
http://www.flippingphysics.com/three-force-example.html)

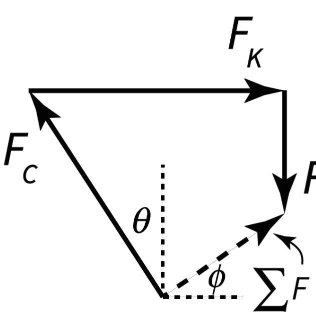
Even though it doesn't quite look like it, summing the forces is vector addition. So let's do the problem visually as tip-to-tail vector addition:



$\sum \vec{F} = \vec{F}_K + \vec{F}_J + \vec{F}_C$ (left diagram)

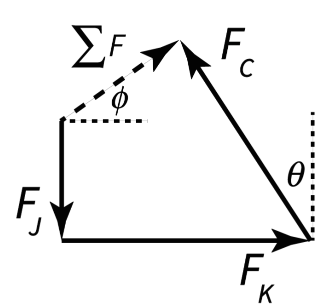
Or you can include the components of the force of Chris instead.
$\sum \vec{F} = \vec{F}_K + \vec{F}_J + \vec{F}_{Cx} + \vec{F}_{Cy}$ (right diagram)





Remember the order of the vectors is irrelevant so we could add the vectors in different orders.

$\sum \vec{F} = \vec{F}_C + \vec{F}_K + \vec{F}_J$ (left diagram)
or $\sum \vec{F} = \vec{F}_J + \vec{F}_K + \vec{F}_C$ (right diagram)
and we always get the same net force as before.



We could even solve this problem using a data table like we did when we introduced vector addition: (http://www.flippingphysics.com/data-table.html)

Vector:	x-direction (N)	y-direction (N)
$\vec{F}_K$	270	0
$\vec{F}_C$	-141.606	218.054
$\vec{F}_J$	0	-130
$\sum F$	$\sum F_x = 270 - 141.606 + 0 = 128.394N$	$\sum F_y = 0 + 218.054 - 130 = 88.054N$

So, it may not look like it at first, but summing the forces is simply another way to do vector addition.