

Determining the correct form of the components of vectors

We have long established that the x and y components of a vector can be written as

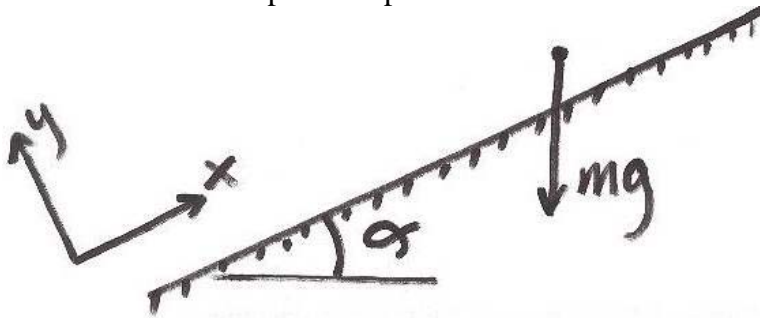
$$A_x = |\vec{A}| \cos \theta$$

$$A_y = |\vec{A}| \sin \theta$$

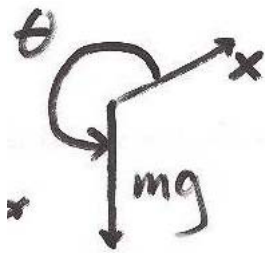
Where theta is the angle measured counter-clockwise from the positive x-axis. In some sense, this is basically the definition of the sine and cosine functions.

It's important to remember that these only work if you use the right value for theta. In the case of a sloping ramp, we often choose a coordinate system where one of the axes lies parallel to the ramp surface (I usually use x, out of habit). It's worth noting that the reason we do this is to turn a potentially 2-D problem into a 1-D problem, noting that if the object stays on the ramp, its acceleration in the perpendicular direction is always zero, allowing us to concentrate on the other dimension.

Here's the basic setup for the problem.



The goal is to determine the x- and y- components of the gravitational force vector. Remember that the angle we're interested in is not necessarily alpha, the slope of the ramp, but the angle, measured CCW, from the positive x-axis:



From this, you can show that $\theta + \alpha = 270$, or $\theta = 270 - \alpha$.

Now you can compute the x- and y- components of the gravity vector in the coordinate system we chose:

$$mg_x = mg \cos \theta = mg \cos(270 - \alpha) = -mg \sin \alpha$$

$$mg_y = mg \sin \theta = mg \sin(270 - \alpha) = -mg \cos \alpha$$

That last step you can look up in a trig textbook. The minus signs suggest that the vectors point in the negative direction. When you draw the components on the graph, you'll see that this is true.