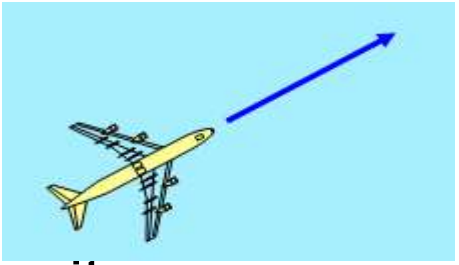
Physics Honors: Vector Components

Vector Components

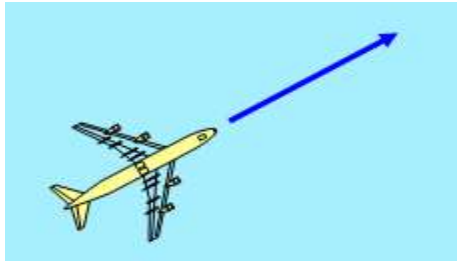


For that airplane, there is another way to express its velocity. We can say that it is moving at 200 m/s at 30^{o} as we did on the previous slide. Or we can find its components.

The word “component” means a part. The x and y *components* of a vector are the *parts* of the vector in the x and y directions. To find them, we have to use a little trigonometry.

Remember your *SOH CAH TOA* from geometry?

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$



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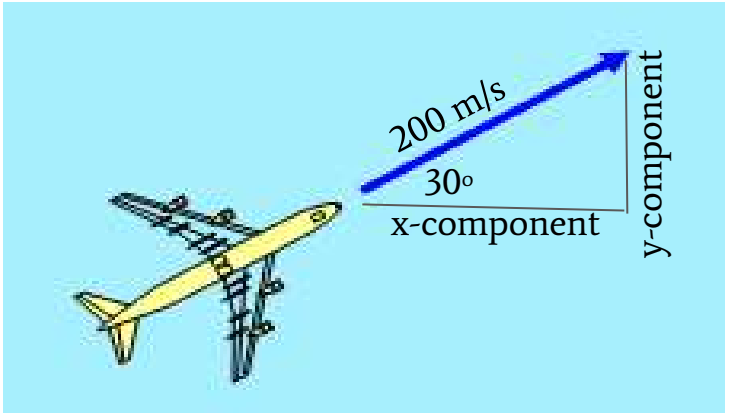


In the diagram, lines have been added to show the x and y-components. The magnitude of the vector (200 m/s) has also been added on the hypotenuse of the triangle.

To find the x-component, we are looking for the side of the triangle adjacent to the angle. Since we know the hypotenuse, we will use cosine

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$\cos\theta$ = adjacent / hypotenuse

$\cos(30^o)$ = x-component / 200

x-component = 173.2 m/s

Note: your calculator must be in degrees mode!

Vector Components

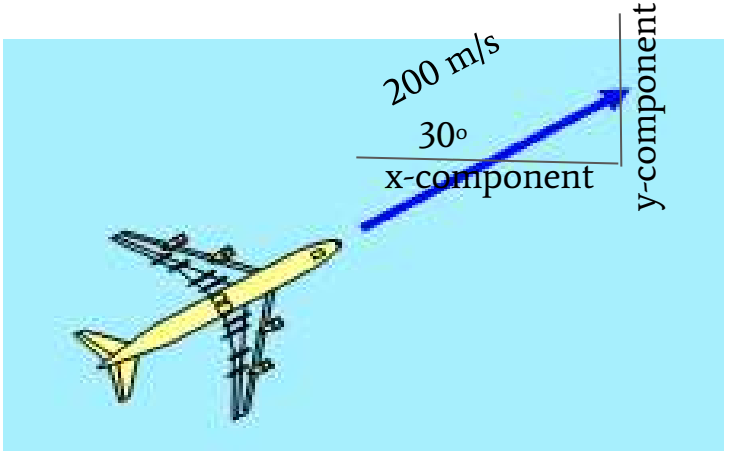
To find the y-component, we are looking for the side of the triangle opposite the angle. Since we know the hypotenuse, we will use sine

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$\sin\theta$ = opposite / hypotenuse

$\sin(30^o)$ = y-component / 200

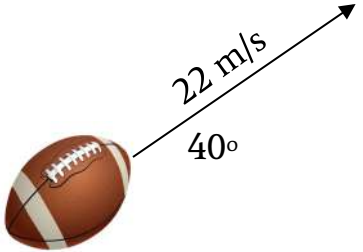
y-component = 100 m/s



The airplane that we were told is moving at 200 m/s at 30^o could also be said to be moving at 173 m/s east (x-direction) and 100 m/s north (y-direction)

Vector Components Practice

1) A football is kicked at 22 m/s in a direction of 40^{o} above the ground, as shown in the picture to the right.
   a) Calculate the x-component of its velocity
   b) Calculate the y-component of its velocity



2) A person walks 75 meters in a direction that is 25^{o} north of east. How far east has he walked? How far north has he walked?

Finding the magnitude and direction from components

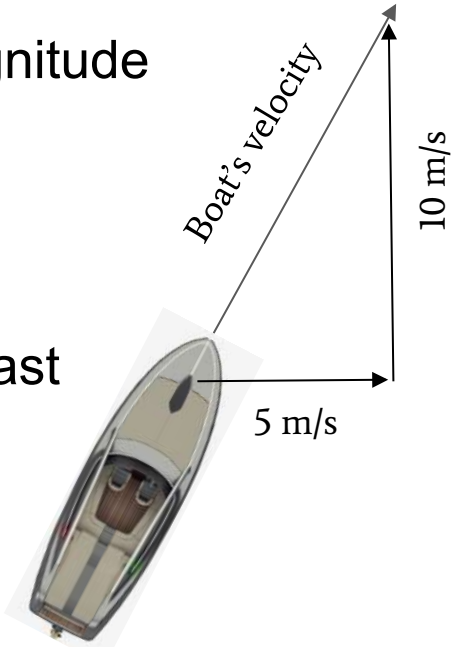
You can also do the opposite process and find the magnitude and direction if you know the components.

Example:

The boat in the picture to the right is moving at 5 m/s east (x-direction) and 10 m/s north (y-direction).

Does that mean that the boat is moving at 15 m/s?

No, the magnitude of the boat's velocity is the ***hypotenuse*** *of that triangle.*



Finding the magnitude and direction from components

To find the hypotenuse, use the Pythagorean theorem,

$a^2 + b^2 = c^2$

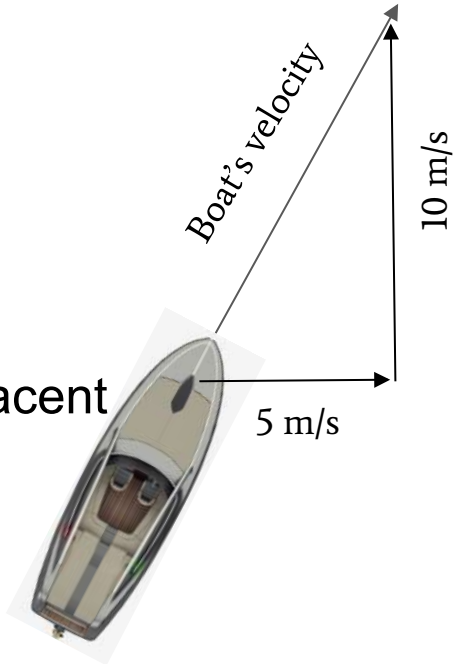
In this case, $5^2+10^2 = c^2$ and c = 11.2 m/s

To get the direction, since you know the opposite and adjacent sides you would use tangent

$\tan\theta$ = opposite / adjacent

$\tan\theta = 10 / 5$

$\theta = \tan^{-1}(10 / 5) = 63.4^o$



Also, watch this video and complete both practice problems in your notes

When you have finished taking notes, complete your homework or any other missing assignments you might have