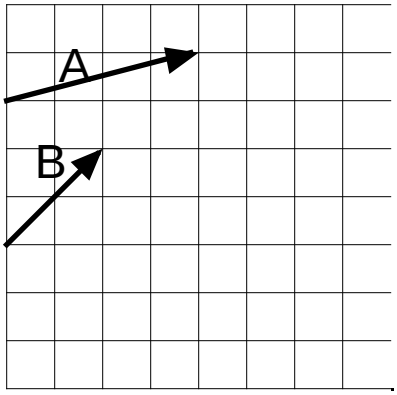
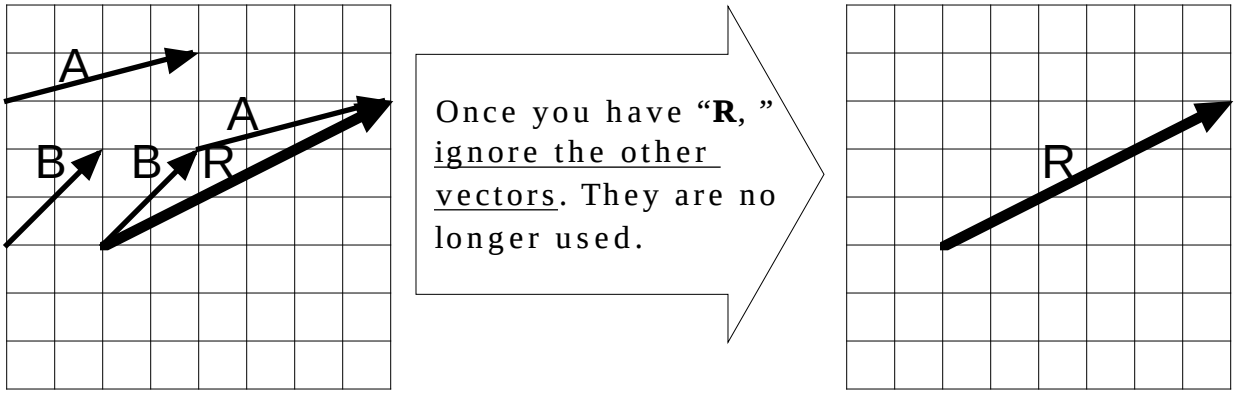
A vector is made of two parts
(1) Magnitude: Describes how big a quantity is.
(2) Direction: Up, down, left, right, 10° East of North, etc.

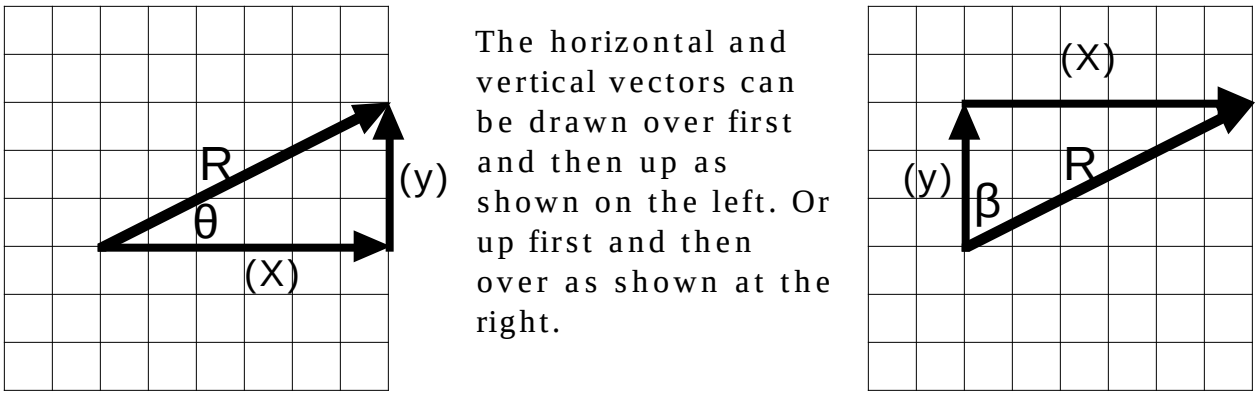
Go through an example to show how to calculate the pieces of a vector.
Begin with vectors A and B as shown below.



The equation to solve is **A + B = R**. Move the A & B vectors head to tail and draw "R" from the beginning of the combination to the end. This is shown on the drawing at the left below.



Make "R" the hypotenuse of a right triangle by drawing horizontal and vertical lines.

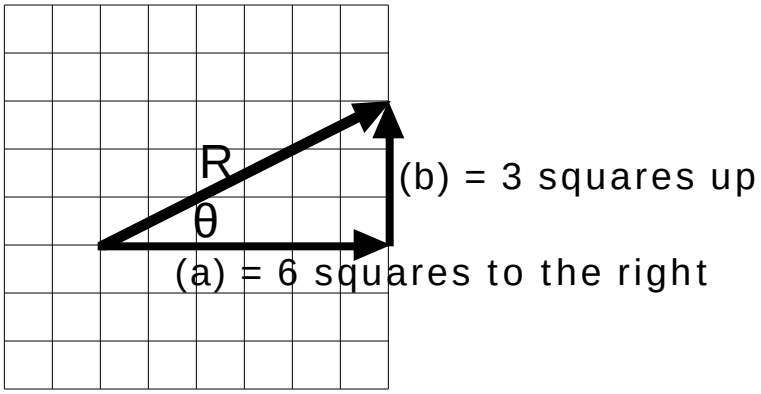


θ & β are complementary angles. That is to say they add up to 90°. This means that there are TWO POSSIBLE CORRECT ANSWER for every vector. Keep this sin mind when comparing answers.

The magnitude is easy to calculate. It is done with Pythagoreom's Theorem.

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

Where "c" is the hypotenuse's length and "a" & "b" are the lengths of the other sides.

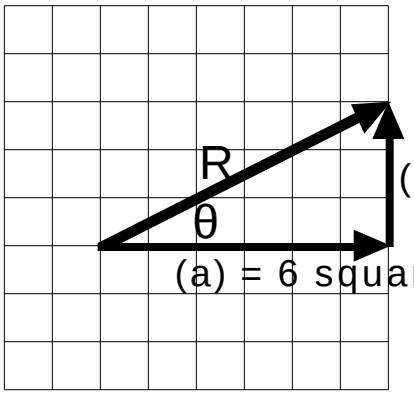


Note: The (x) & (y) notations have been replaced with (a) and (b) to match P's. Theorem.

$$c^2 = 3^2 + 6^2$$
$$c^2 = 9 + 36$$
$$c^2 = 45$$
$$c = \sqrt{45}$$

Therefore the magnitude is $\sqrt{45}$.

The direction is made from 2 parts. The angle in degrees and a compass heading. The angle is found from right triangle trigonometry. For class consistency, Always place the angle at the tail of the resultant and inside the triangle unless told to do otherwise.



(b) = 3 squares up
Opposite to θ.

(a) = 6 squares to the right.
Adjacent to θ.

The sides a have been labeled as opposite and adjacent. This is the tangent function.

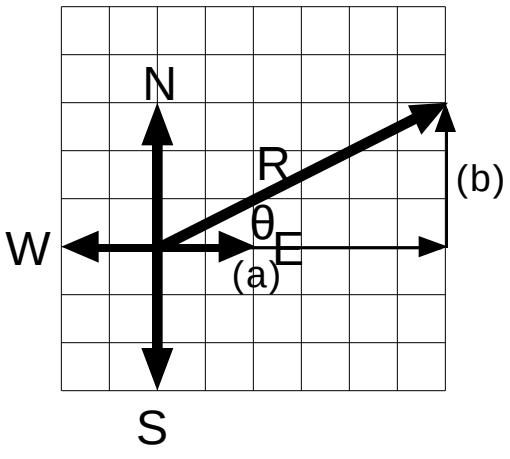
$$\tan(\theta) = \frac{\text{Opposite side length}}{\text{Adjacent side length}}$$

$$\tan(\theta) = \frac{3}{6}$$

$$\theta = \tan^{-1}\left(\frac{3}{6}\right)$$

$$\theta = 45°$$

45° is the first part of the direction. The other part is a compass heading. This is calculated by placing an imaginary compass on the tail of the vector.



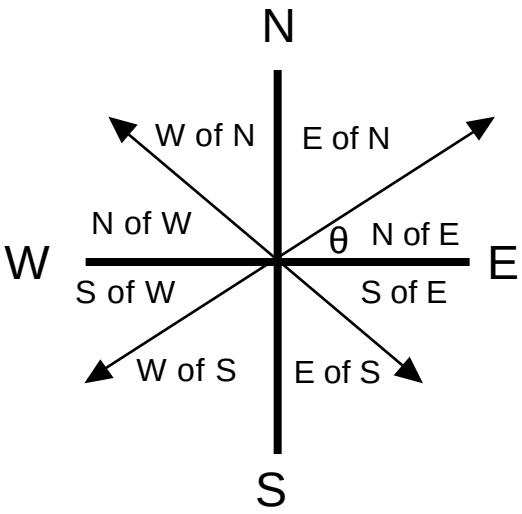
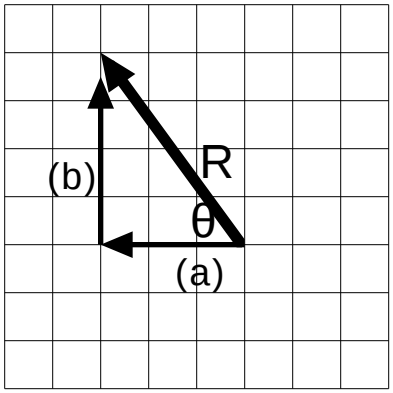


Figure were the angle is from the compass diagram on the left and that is the rest of the direction. In this case the angle is shown on the compass at the right as θ. That makes this vectors direction 45° N of E. the 45° is from the earlier trig calculation.

The answer is ($\sqrt{45}$, 45° N of E).



Example Problem

Find the vector's magnitude and direction.

ANSWER: (5, 53.13° N of W)