Vector Basics:

N 30° **A** **E**
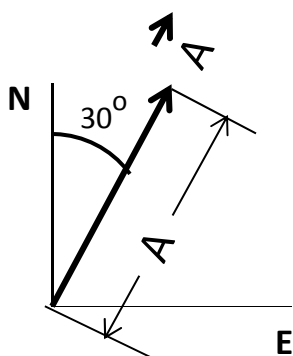
A vector is a line with a length and a direction.

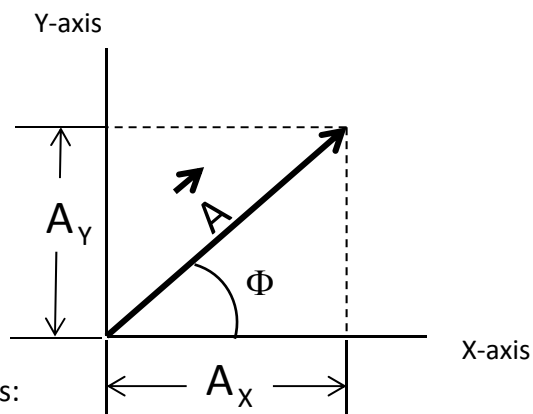We can move it around because it doesn't matter where it starts.

The length of a vector is also called its magnitude.

Here vector $\vec{A}$ has magnitude A and direction

30 degrees East of North

We can resolve a vector into its components.

Components are the projections of a vector onto perpendicular axes.

A_X and A_Y are the X- and Y-components

of $\vec{A}$

Y-axis

A_Y A Φ

X-axis

A_X

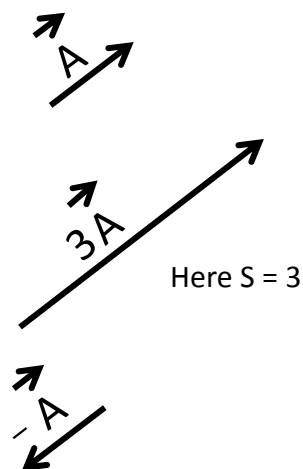To switch from magnitude and direction to components:

$$A_X = A \cos \Phi \qquad A_y = A \sin \Phi$$

To switch from components to magnitude and direction:

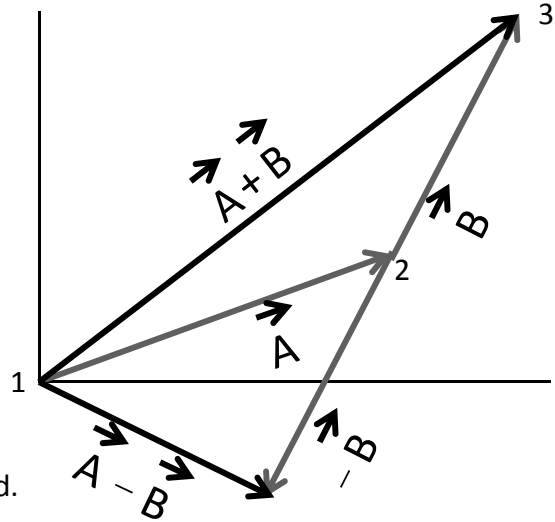$$A = \sqrt{A_X{}^2 + A_y{}^2} \qquad \Phi = \tan^{-1} \frac{A_y}{A_X}$$

Multiplying $\vec{A}$ by a number **S** makes $\vec{A}$ **S** times as long.

Here S = 3

A

$3A$

Multiplying $\vec{A}$ by a negative number reverses its direction.

A

<u>Use the "triangle rule" to add vectors:</u>

To add vector $\vec{B}$ to vector $\vec{A}$,

1. Move the start of $\vec{B}$ to the end of $\vec{A}$ (2)

2. Then $\vec{A} + \vec{B}$ starts where $\vec{A}$ starts (1)

   and ends where $\vec{B}$ ends (3).

3. To subtract $\vec{B}$ from $\vec{A}$, reverse $\vec{B}$ and add.
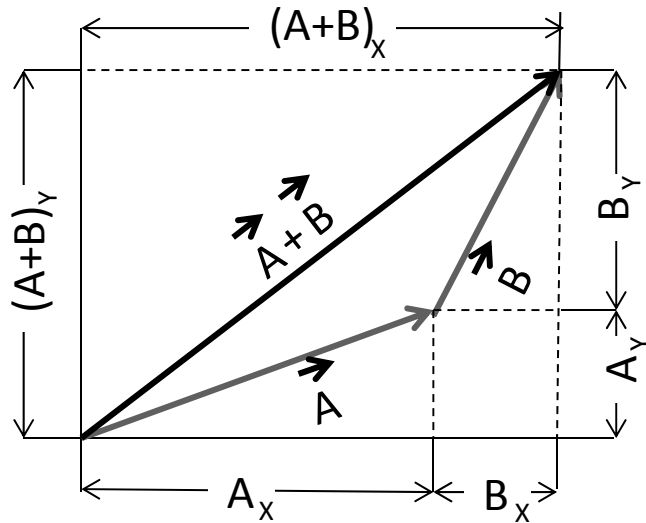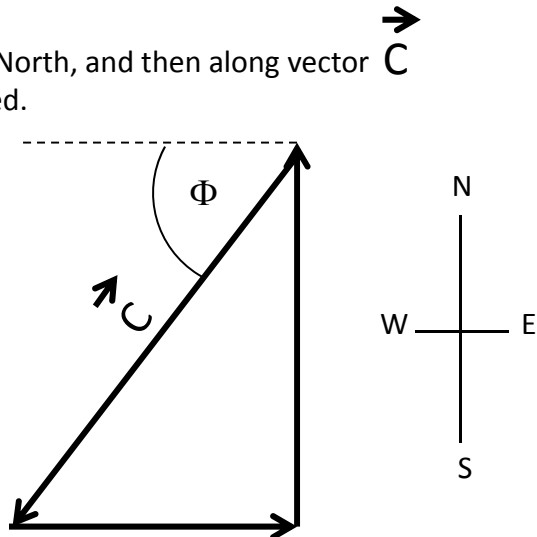
OR

We can just add the components:

$$(A+B)_X = A_X + B_X$$

$$(A+B)_Y = A_Y + B_Y$$

Question: James walks 15 m East, 20 m North, and then along vector $\vec{C}$ to get back to where he started.

a) How far does James walk along $\vec{C}$?

b) In which direction does James walk back?

   (i.e., find Φ)

Answer: a) 25 m b) 53.13 degrees South of West.