

# VECTORS

Goal:

- to represent vectors graphically
- to determine the norm and orientation of vectors
- to determine the components of vectors

What is a vector?

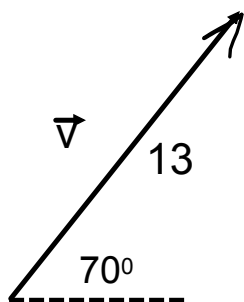
A quantity with magnitude and direction.  
(size)

Graphically represented by a vector arrow.

What is not a vector?

A quantity with magnitude but no direction  
is a scalar

Vectors have length and direction. The length of the vector is called norm (or magnitude) and the direction is called orientation.

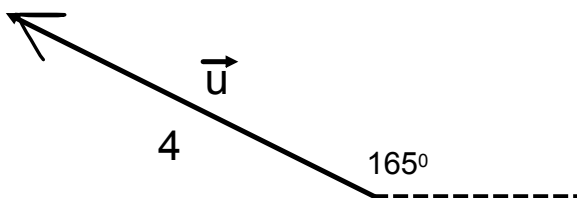


$$\|\vec{v}\| = 13$$

"norm of vector v"

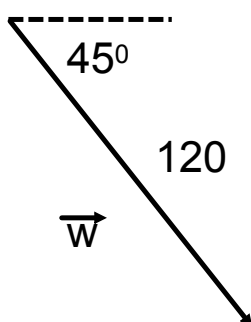
$$\text{orientation} = 70^\circ$$

measured from positive  
x-axis in CCW direction  
(trig. angle)



$$\|\vec{u}\| = 4$$

$$\text{orientation} = 165^\circ$$



$$\|\vec{w}\| = 120$$

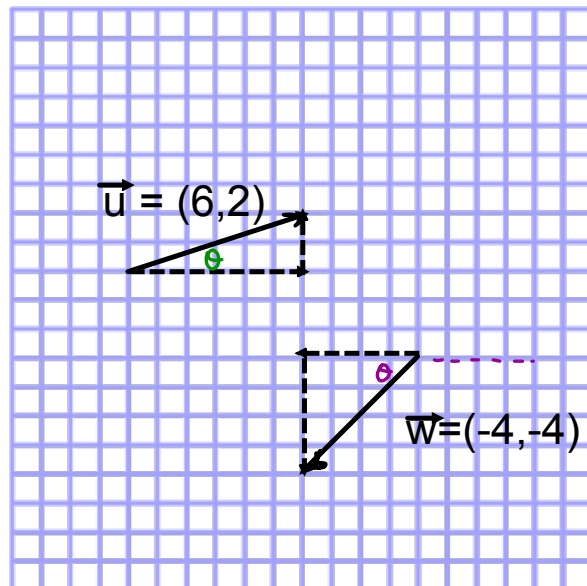
$$\text{orientation} = 315^\circ = -45^\circ$$

Vectors can also be described in terms of their horizontal and vertical components.

$$\vec{v} = (\Delta x, \Delta y) \Rightarrow \vec{v} = (a, b)$$

$$\|\vec{v}\| = \sqrt{a^2 + b^2}$$

$$\theta = \tan^{-1}\left(\frac{2}{6}\right) = 18.4^\circ$$



$$\|\vec{u}\| = \sqrt{6^2 + 2^2} = \sqrt{40} = 2\sqrt{10}$$

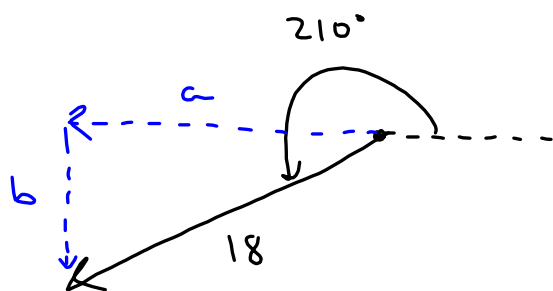
$$\text{orientation} = 18.4^\circ$$

$$\theta = \tan^{-1}\left(\frac{4}{4}\right) = 45^\circ$$

$$\|\vec{w}\| = \sqrt{(-4)^2 + (-4)^2} = \sqrt{32} = 4\sqrt{2}$$

$$\text{orientation} = 225^\circ = -135^\circ$$

Determine the components of vector a with norm of 18 units and direction of  $210^\circ$ .



$$\vec{v} = (a, b)$$

$$a = \|\vec{v}\| \cos \theta$$

$$b = \|\vec{v}\| \sin \theta$$

$$a = 18 \cos 210^\circ = -9\sqrt{3} \approx -15.5$$

$$b = 18 \sin 210^\circ = -9$$

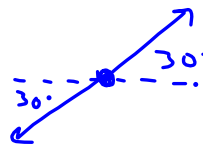
Some terminology:

- equipollent: equivalent vectors i.e. same magnitude + direction

- opposite: same magnitude opposite direction

$\vec{a}$  : 10 units at  $30^\circ$

-  $\vec{a}$  : 10 units at  $210^\circ$



$\vec{a}$  and  $-\vec{a}$  are opposite vectors

- collinear: vectors with same direction

- orthogonal: vectors at  $90^\circ$  to each other  
(perpendicular)

- unit vector : vector with magnitude of 1.

Homework: p.23 #1,3,4,5