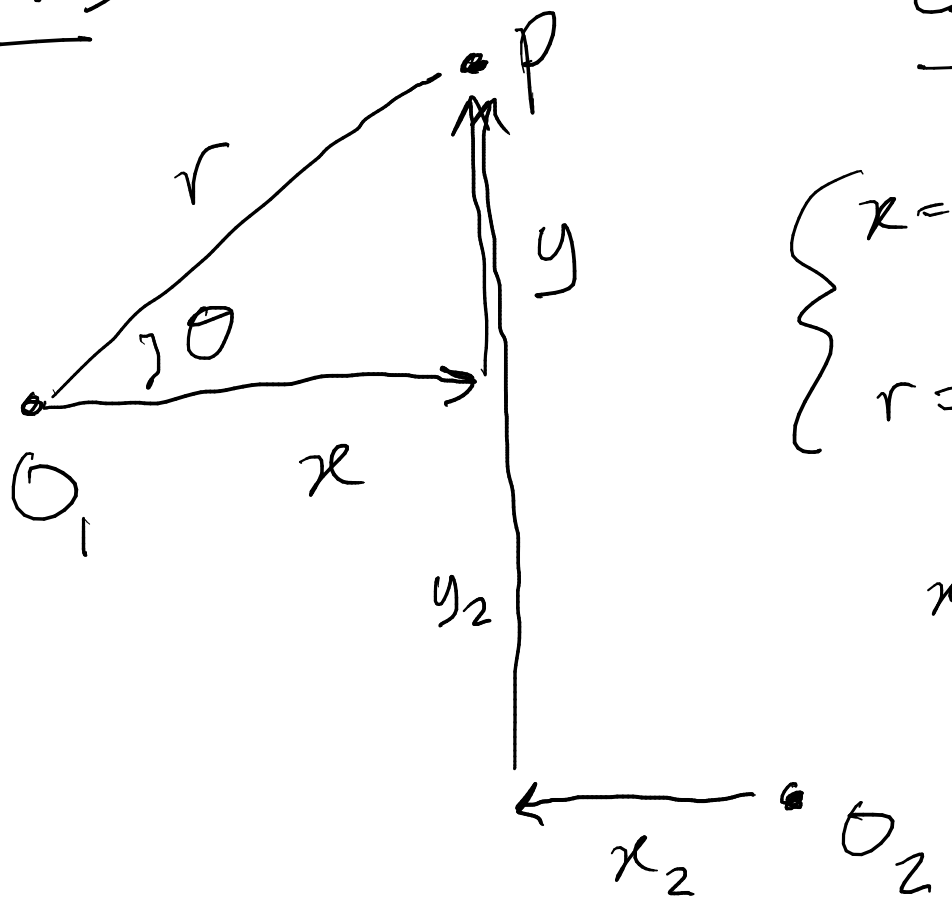
Positions



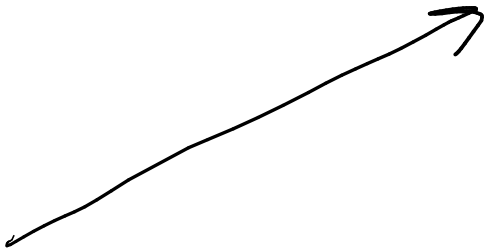
Coordinates

$$\begin{cases} x=3 \ , y=2 \\ r= \ , \theta= \end{cases}$$

$x_2=-2 \quad y_2=6$

length	meter	foot
dimension	unit	unit
time	second	decade

Vectors



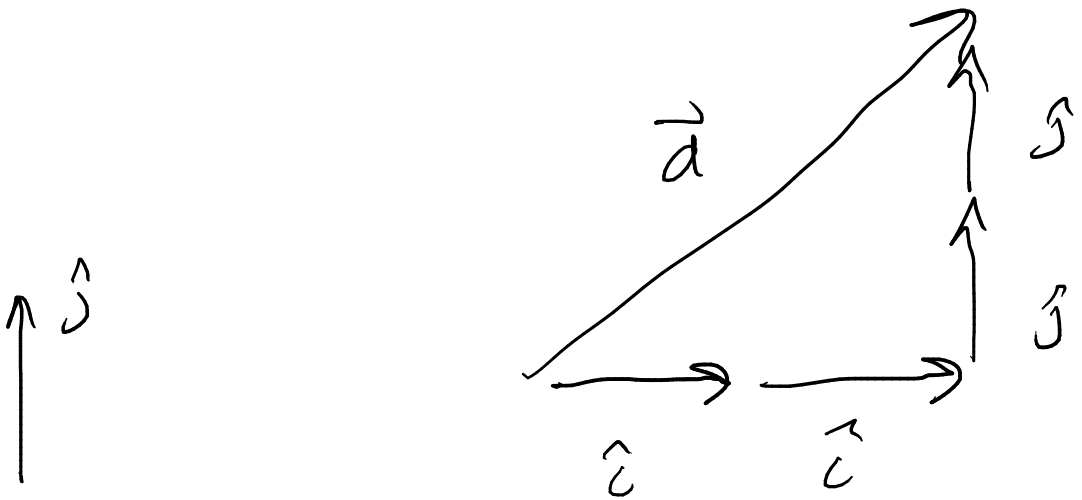
length
magnitude
modulus

direction
bearing
angle

SAME

~~position~~

Vector Components



$$\vec{a} = 2\hat{i} + 2\hat{j}$$

Components in the $\hat{i}, \hat{j}$ basis

linear

unit vectors

→ $\hat{i}$ has <u>no</u> units

{ dimensionless
{ dimension 1

$\vec{a} = a_1 \hat{i} + a_2 \hat{j}$ $\quad a_1 = 3m$

$\vec{a} = (3m)\hat{i} + (2m)\hat{j}$ $\quad a_2 = 2m$

units belong to the components.

$$\vec{a} = (3m)\hat{i} + (2m)\hat{j} = 3\hat{i} + 2\hat{j} \ \ m$$

$$\|\vec{a}\| = a = \sqrt{13}\ m$$

$$= \sqrt{(3m)^2 + (2m)^2}$$

$$= \sqrt{9m^2 + 4m^2}$$

$$= \sqrt{13m^2}$$

$$\vec{a} \Rightarrow \text{unit vector } \hat{a} = \frac{\vec{a}}{a} = \frac{3m\hat{i} + 2m\hat{j}}{\sqrt{13}\ m}$$

$$\text{no units.} \longrightarrow = \frac{3}{\sqrt{13}}\hat{i} + \frac{2}{\sqrt{13}}\hat{j}$$

Projections and Products

Products: dot product $\vec{a} \cdot \vec{b}$

cross product $\vec{a} \times \vec{b}$

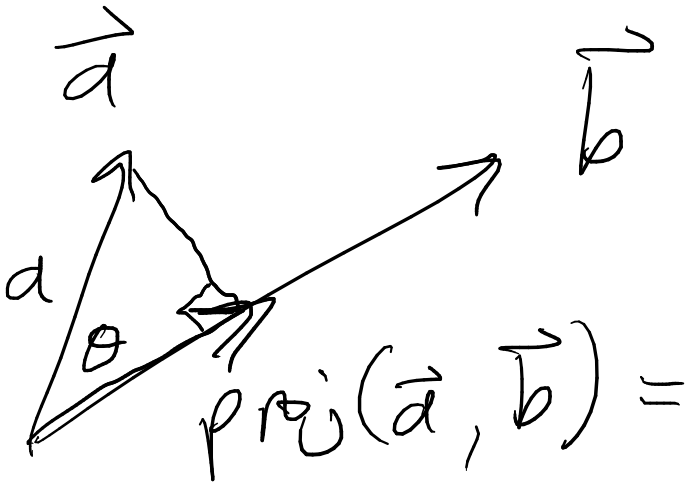
Components $a_1 b_1 + a_2 b_2$

or

physical meaning $ab\cos\theta$

$\|\vec{a} \times \vec{b}\| = ab \sin\theta$

Projections



$$proj(\vec{a}, \vec{b}) = (\vec{a} \cdot \hat{b})\hat{b}$$

$$a\cos\theta = \vec{a} \cdot \hat{b}$$