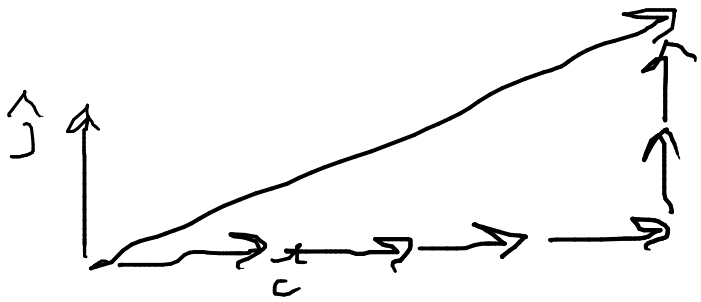
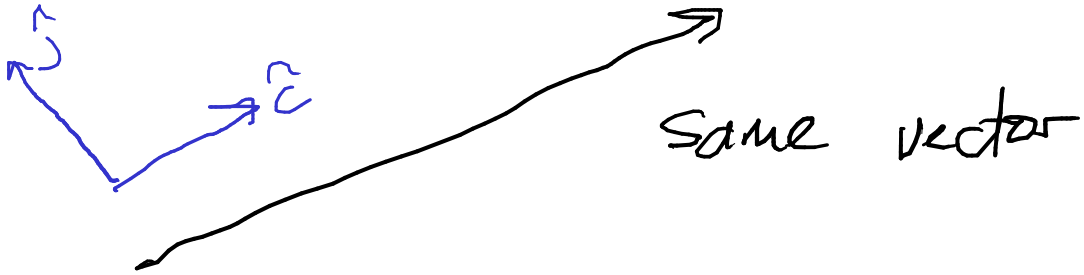
Positions and Vectors



$\vec{v}$ dir., mag.

$\vec{v} = 4\hat{i} + 2\hat{j}$

"free" vectors



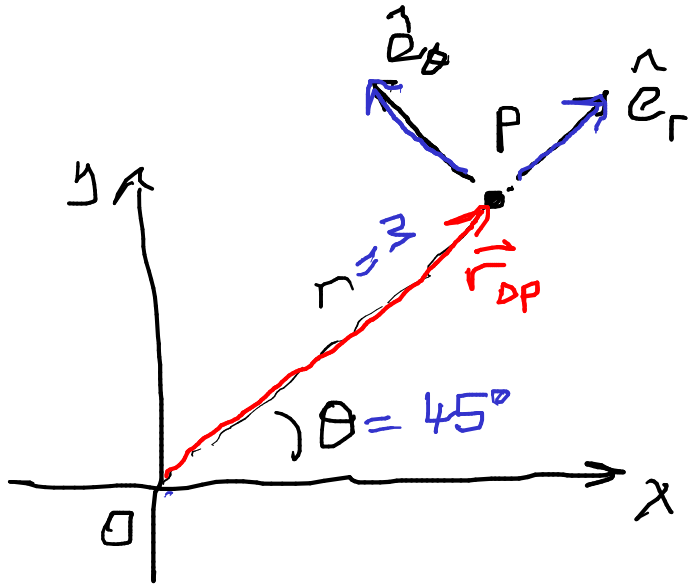
positions don't depend on coord system

vectors don't depend on the basis

positions have <u>coordinates</u> $x = 4m$, $y = 2m$

$r = 6ft$, $\theta = 20°$

vectors have <u>components</u> $\vec{v} = 4\hat{\imath} + 2\hat{\jmath}\ m$



P has position

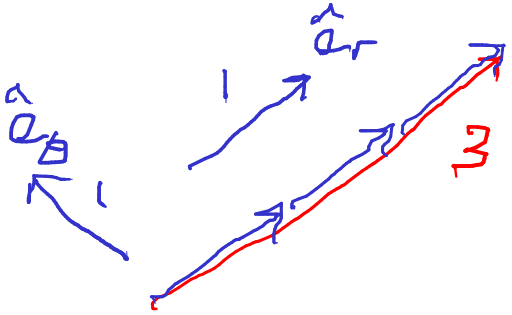
$r = 3m$ $\theta = \frac{\pi}{4}$

P has position vector

$\vec{r}_{OP} = \vec{r} = \underline{3}\ \hat{e}_r + \underline{0}\ \hat{e}_\theta$

from O to P

$\neq r\hat{e}_r + \theta\hat{e}_\theta$



Units

units go with values

$r = 4m = 400\,cm = 13.1\,ft$

r is in m ~~r = 43~~

A meter

B second

C length

D lightyear

E foot

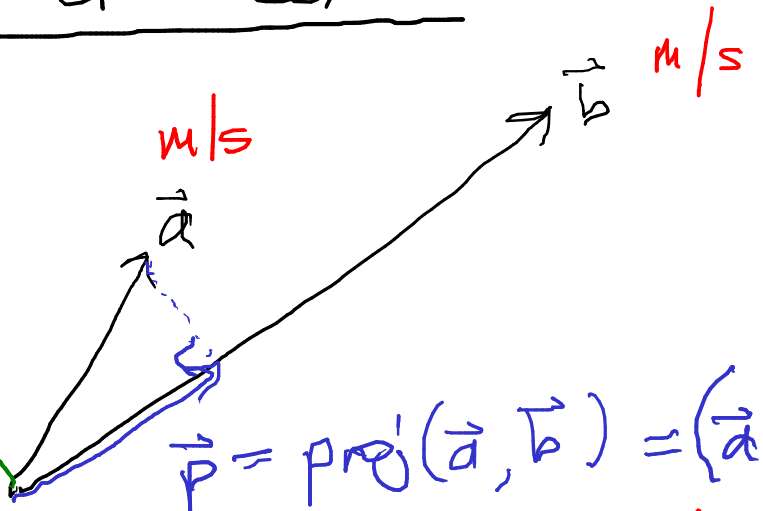
which one is not like the others?

second is time.

length is a dimension.

length, time, mass

Projections of vectors



$\vec{c} = \text{comp}(\vec{a}, \vec{b})$

$= \vec{a} - \text{proj}(\vec{a}, \vec{b})$

amount of $\vec{a}$ not in direction of $\vec{b}$

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

$(m/s \cdot 1)\, 1 = m/s$

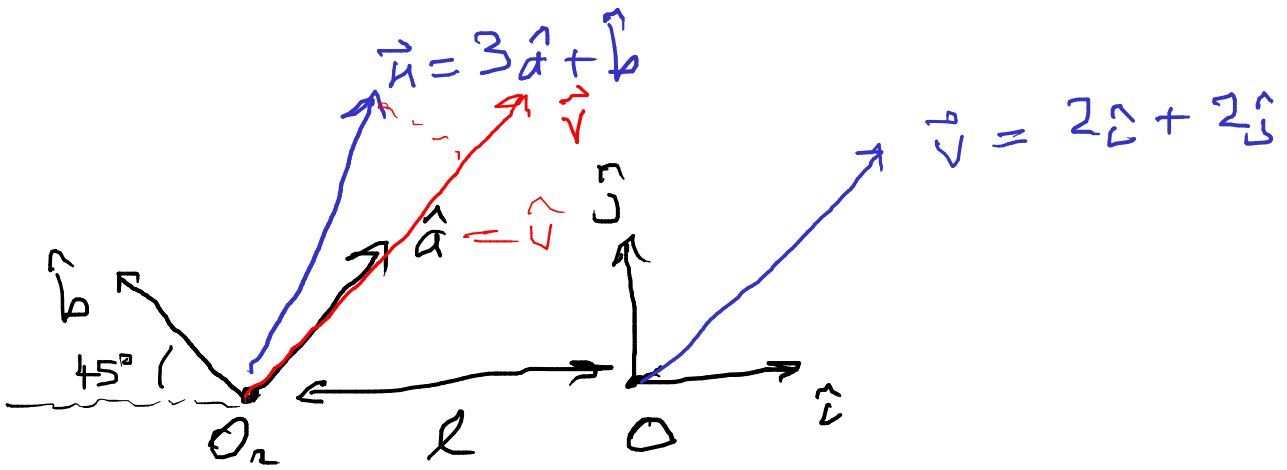
amount of $\vec{a}$ in direction $\vec{b}$

Aside:

$\vec{r} = 6\hat{i}\, m = 6m\,\hat{i}$

$\hat{r} = \dfrac{\vec{r}}{\|\vec{r}\|} = \dfrac{\vec{r}}{r} = \dfrac{6m\,\hat{i}}{6m} = \hat{i}$

no units dimensionless



$\text{proj}(\vec{u}, \vec{v}) =$

A 3

B $3\hat{a}$

C $\frac{1}{\sqrt{2}}(3\hat{\imath} + 3\hat{\jmath})$

D 6

E need to know ℓ