$\uparrow + \leftarrow = \nwarrow$

A) $\nearrow$ C) $\searrow$

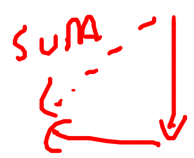
B) $\nwarrow$ D) $\swarrow$

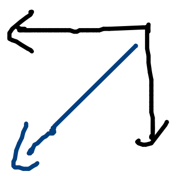
$\downarrow - \rightarrow =$

$\downarrow + (-\rightarrow)$

D

$\downarrow + \leftarrow = \swarrow$

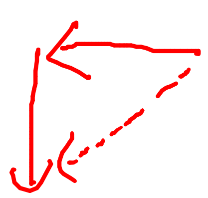




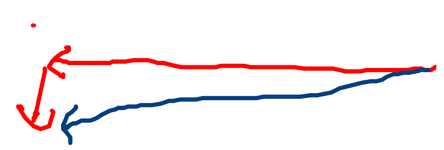
sum $= \swarrow$

A) $\nwarrow$ B) $\nearrow$

C) $\swarrow$ D) $\searrow$

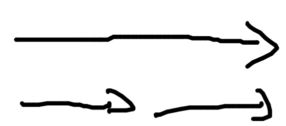


sum



$\vec{A} = \rightarrow$

$2\vec{A} =$



$\vec{A} - \vec{A}$ $\rightleftarrows$

$\vec{0}$ zero vector

arrow with no length

vector with no magnitude

Changes

Δx "change in x"

does not mean $\Delta \times x$

DO NOT DO THIS: $\frac{\cancel{\Delta} x}{\cancel{\Delta} t}$ NO!

$\frac{1\cancel{6}}{\cancel{6}4} = \frac{1}{4}$

e.g. m: money in a bank account

$m_i = \$40$ at start of month

$m_f = \$10$ at end of month

Δm = A) $+\$50$ B) $+\$30$ C) $-\$30$ D) $-\$50$

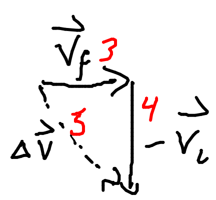
$$\boxed{\Delta m = m_f - m_i}$$

e.g. $\uparrow \vec{v}_i = 4\,m/s$ $\vec{v}_f \xrightarrow{3\,m/s}$ What is $\Delta \vec{v}$?

Direction: A) ↖ B) ↗ C) ↙ D) ↘ F) ?

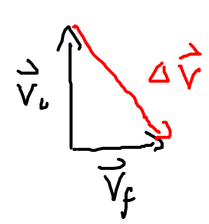
Magnitude: A) $1\,m/s$ B) $5\,m/s$ C) $7\,m/s$ F) ?

$\Delta \vec{v} = \vec{v}_f - \vec{v}_i =$

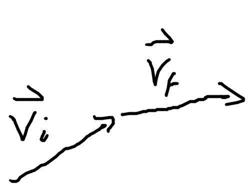


$|\Delta \vec{v}| \neq |\vec{v}_f| - |\vec{v}_i|$

$\vec{v}_i + \Delta \vec{v} = \vec{v}_f$



$\Delta \vec{v}$: vector to add to $\vec{v}_i$ to get $\vec{v}_f$

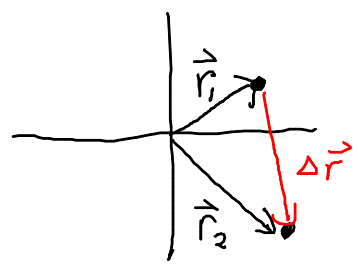


$\Delta \vec{v}$ =

A) ⟶ B) ↓

C) ⟵ D) ↑

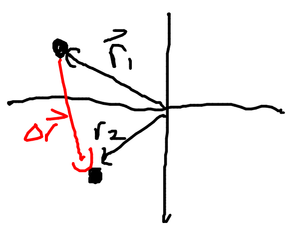
Position & Displacement



$\vec{r}$: position vector for that part

$\Delta\vec{r} = \vec{r}_2 - \vec{r}_1$

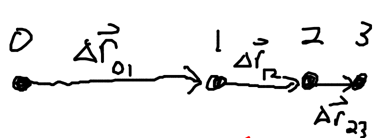
<u>displacement</u>



position vectors depend on your choice of origin & are arbitrary

displacement is <u>not</u>

Displacement can show up in physics equations but position (almost) never will.



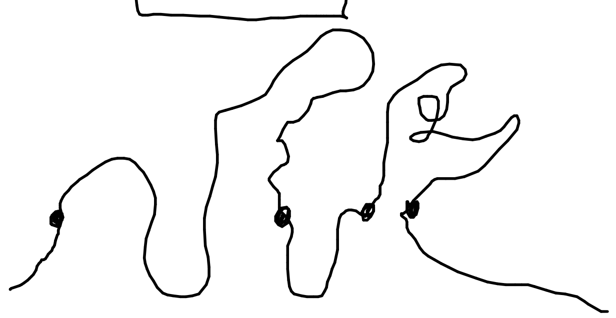
proportional to

$\vec{v} \propto \Delta\vec{r}$

if Δt is large (1 hour, e.g.)
then $\vec{v}$ is small

$\vec{v} \propto \frac{1}{\Delta t}$

$\rightarrow$ $\boxed{\vec{v} = \frac{\Delta\vec{r}}{\Delta t}}$ or $\Delta\vec{r} = \vec{v}\,\Delta t$



actual velocity $\vec{v} = \frac{\Delta\vec{r}}{\Delta t}$ when $\Delta t \rightarrow 0$
(derivative $\frac{d\vec{r}}{dt}$)

when Δt isn't tiny
$\frac{\Delta\vec{r}}{\Delta t}$ "average velocity"