# vectors

Ex: - displacement
- force
- acceleration
- velocity

- has a magnitude and a direction

- Adding vectors

$\vec{a} + \vec{b} = \vec{c}$

*result should be from tail to head


→ properties:

- Commutative $\vec{a}+\vec{b} = \vec{b}+\vec{a}$
- associative $(\vec{a}+\vec{b})+\vec{c} = \vec{a}+(\vec{b}+\vec{c})$

- $\vec{b}$ and $-\vec{b}$

$-\vec{b}$ has the same magnitude as $\vec{b}$ but differs in direction (opposite)

- Components of a vector

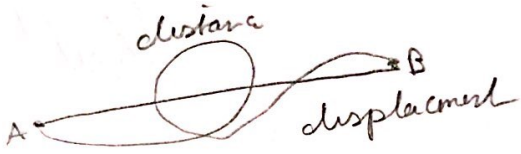
$\vec{a} = \vec{a}_x + \vec{a}_y$

$= a\cos\theta + a\sin\theta$

$a = \sqrt{(a_x)^2 + (a_y)^2}$ $\quad \tan\theta = \frac{a_y}{a_x}$

# scalars

- Mass
- density
- time
- energy
- Temperature
- distance: length of the curved line




- has no direction

- Adding scalars

$a+b=c$

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## Unit vectors

$a = a_x\hat{i} + a_y\hat{j}$ → vector components

scalar components

## Adding vectors by Components

$r = \vec{a} + \vec{b}$

$r = r_x + r_y + r_z$

$r = (a_x + b_x) + (a_y + b_y) + (a_z + b_z)$

## Multiplying vectors

### vector x scalar

= new vector

scalar > 0 : same direction

scalar < 0 : opposite direction

### Vector . vector

= scalar product

$= V_1 \times V_2 \times \cos\theta$

$\theta = 0 \Rightarrow V_1 \cdot V_2 = \text{Max}$

### Vector X vector

= vector product

$= V_1 \times V_2 \times \sin\theta$

$\theta = 90$

$V_1 \times V_2 = \text{Max}$

$\theta$: الزاوية بينهم (الوضع)

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