

Scalars and Vectors

September-21-16 1:43 PM

Scalar: Form of measurement that only account for size or magnitude of the measurement.

Vector: measurements that account for both size and direction.

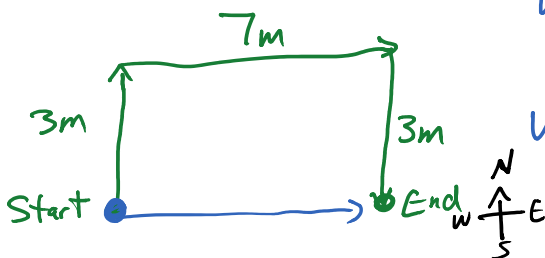
<u>Scalars</u>		<u>Vectors</u>
Distance	←→	Displacement
Speed	←→	Velocity
Mass		Acceleration
Time		Force
Volume		Momentum
Energy		

Distance vs Displacement

Distance: the total length an object has travelled, the length between two objects

Displacement: the total length from an object's initial position to its final position.
(A Change in position)

Ex. Hailey is walking as shown:



What distance did Hailey walk?
 $3+7+3 = 13\text{m}$

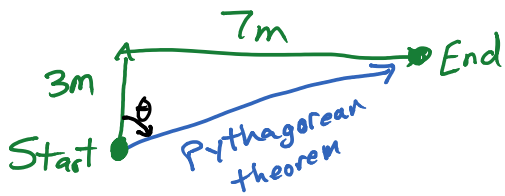
What is Hailey's displacement?
7m East

Ex Oskar was following Hailey.



What distance did Oskar walk?

— vector was returning



What distance did Oskar walk?
10m
What is Oskar's displacement?
 $\sqrt{58}$ m at 66.8° E of N

$$3^2 + 7^2 = c^2$$

$$9 + 49 = c^2$$

$$c = \sqrt{58}$$

$$\sin \theta = \frac{O}{H}$$

$$\cos \theta = \frac{A}{H}$$

$$\tan \theta = \frac{O}{A}$$

$$\tan \theta = \frac{7}{3}$$

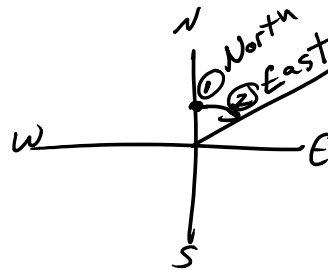
$$\theta = \tan^{-1}\left(\frac{7}{3}\right) = 66.8^\circ$$

Remember

SOHCAHTOA

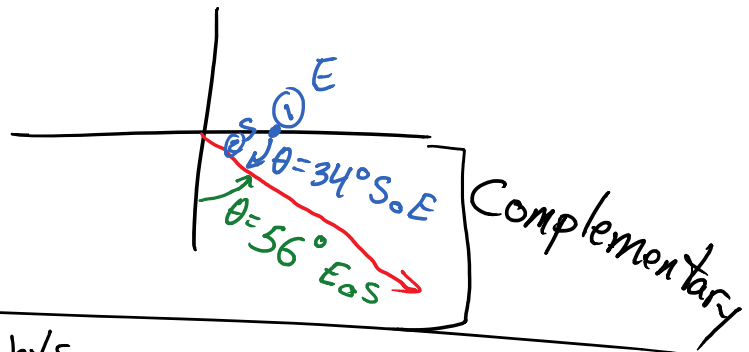
Direction

- ① Where do we measure from? N
- ② What direction do we move to get to the line?



- ③ Order it

② 0 ①
E 0 N



Scalar and Vector Symbols

distance - d

speed - s or v

time - t

mass - m

Volume - V

energy - E
more stuff

displacement - \vec{d}

velocity - \vec{v}

acceleration - \vec{a}

force - \vec{F}

Momentum - \vec{p}

Note:
vectors always have arrow hats

Ex. Cyrus runs 4 laps around the track.
Distance travelled? (400m)

Distance travelled?

(400m)

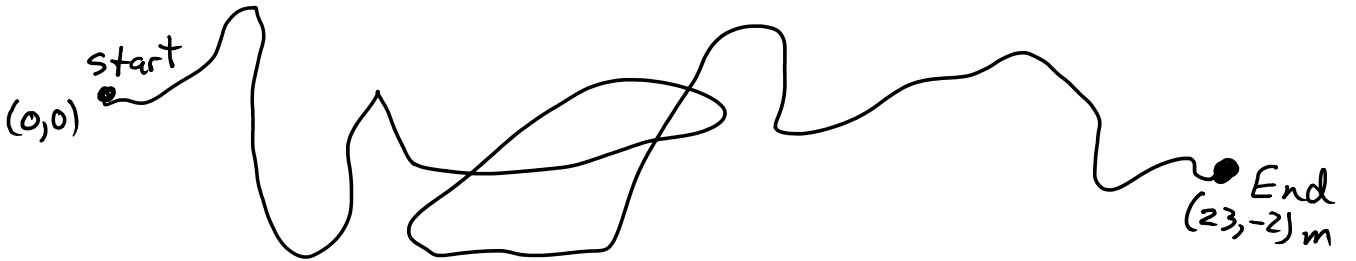
$$4 \times 400 \Rightarrow d = 1600m$$

Displacement?

$$\vec{d} = 0m$$

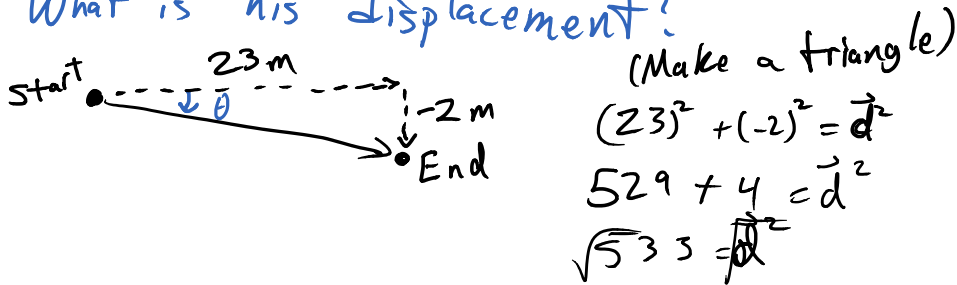
Finishes and starts at the same place.

Ex. Max is on fire. Thus he runs around.



What is Max's distance travelled?
We don't know.

What is his displacement?



$$(23)^2 + (-2)^2 = d^2$$

$$529 + 4 = d^2$$

$$\sqrt{533} = d$$

$$\theta = \tan^{-1}\left(\frac{2}{23}\right)$$

$$\theta = 4.97^\circ$$

$$\vec{d} = \sqrt{533} \text{ at } 4.97^\circ \text{ S of E}$$

$$\text{or at } 85.03^\circ \text{ E of S}$$

Vector Addition

All vectors of the same quality (displacement or velocity) can superimpose. (Add/subtract)

Ex. Displacements.

Justin walks 3m N then 2m S, 6m N, 1m N, 7m S, 4m N, 6m S, 1m S.



$$3 - 2 + 6 + 1 - 7 + 4 - 6 - 1 = -2m$$

\downarrow
 S^-

$$3 - 2 + 6 + 1 - 7 + 4 - 6 - 1 = -2 \text{ m}$$

$\vec{d} = -2 \text{ m}$
 implies South direction
 or 2 m S or -2 m N

Ex. Velocities

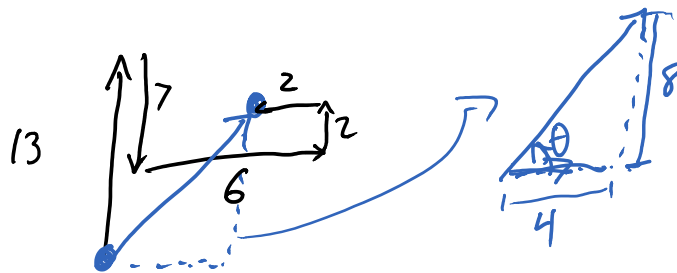
Shinro is flying a plane.

But lots of wind!

She flies $\rightarrow 13 \text{ km/h N}$, 7 km/h S , 6 km/h E ,
 wind #1, Wind #2

What is her total velocity?

wind #3 2 km/h N , wind #4 2 km/h W .



$$\vec{v} = \sqrt{80} \text{ km/h}$$

$$\text{at } 63^\circ \text{ NoE}$$

$$\tan^{-1}\left(\frac{8}{4}\right)$$