Speed

vs

Velocity

They're different!

Motion involves changing your position over time. In other words, traveling a distance.

But there are two ways to measure that.

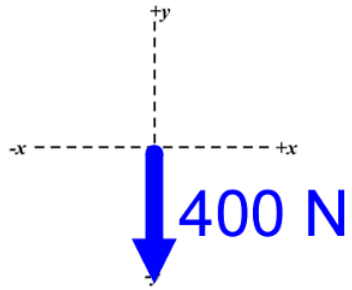
But first...

VECTOR

Any quantity that includes directional information.

ex: F_{net} (x) = -5 N

a = 10 m/s/s downward



SCALAR

Any quantity that doesn't include directional information.

ex: m = 65 kg

a = 10 m/s/s

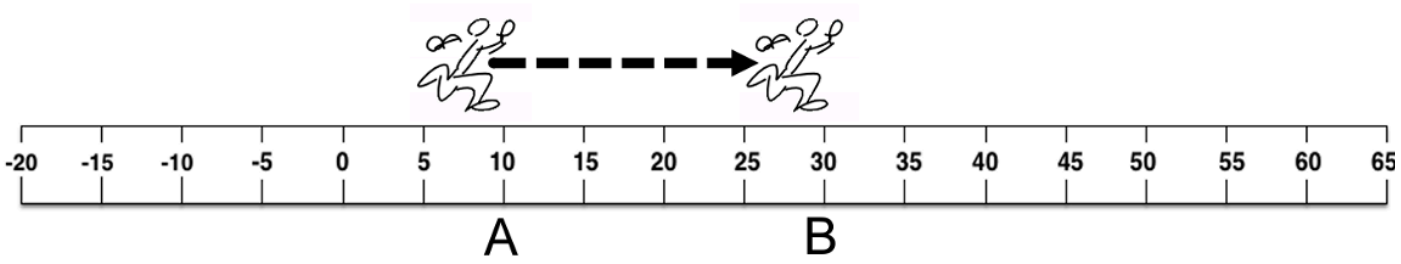
$$\text{AVERAGE SPEED} = \frac{\text{distance traveled}}{\text{elapsed time}}$$

Just add up all the distance traveled, regardless of direction.

It's always positive; it says something about how fast you went.

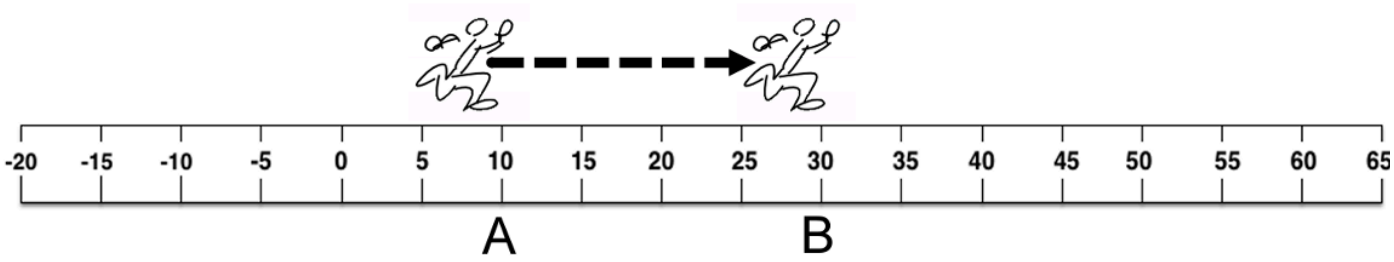
It's not a vector. It won't tell you anything about direction or where you ended up.

Calculate the average speed from A to B.



The person goes from A to B in 4 seconds.

Calculate the average speed from A to B.

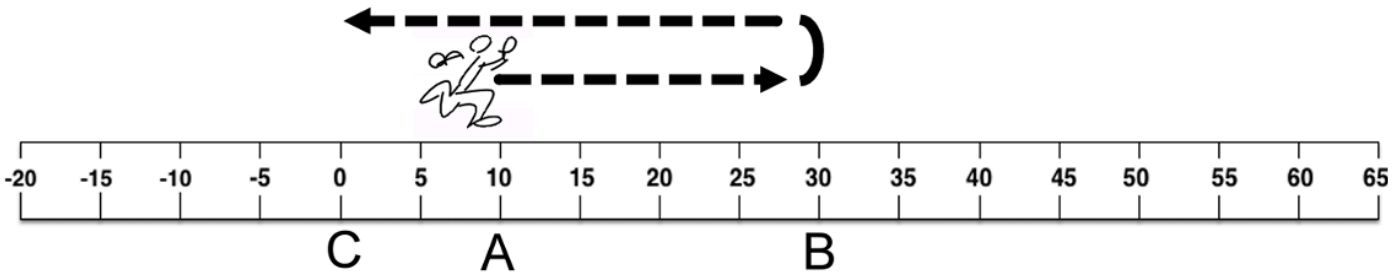


The person goes from A to B in 4 seconds.

$$\text{avg speed} = \frac{20\ \text{m}}{4\ \text{s}}$$

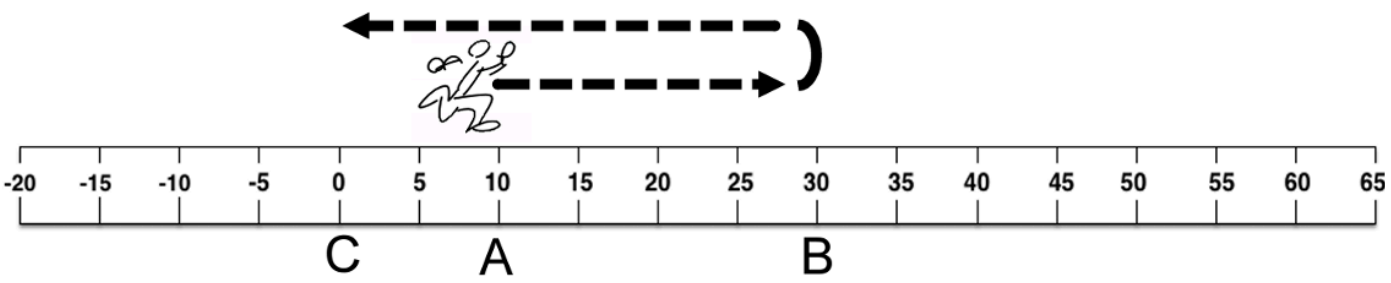
$$= 5\ \text{m/s}$$

Calculate the average speed from A to C.



The person goes from A to B in 4 seconds, but then immediately turns around and goes back to C in 6 more seconds.

Calculate the average speed from A to C.



The person goes from A to B in 4 seconds, but then immediately turns around and goes back to C in 6 more seconds.

$$\text{avg speed} = \frac{20\text{ m} + 30\text{ m}}{4\text{ s} + 6\text{ s}} = \frac{50\text{ m}}{10\text{ s}}$$

$$= 5\text{ m/s}$$

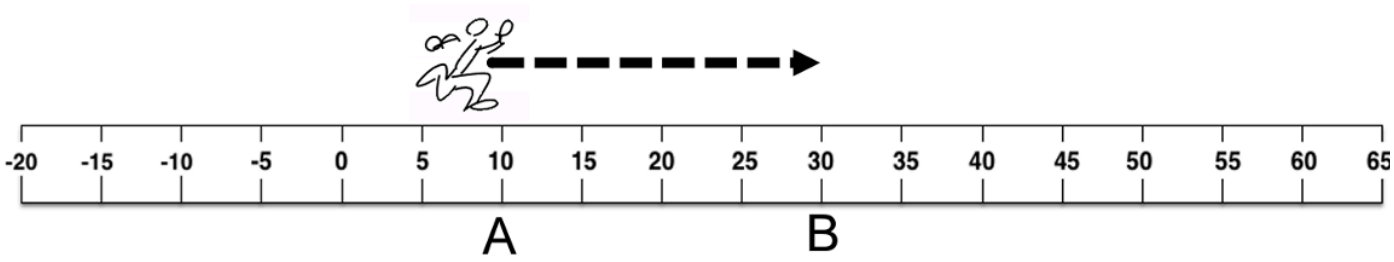
$$\text{AVERAGE VELOCITY} = \frac{\text{change in position}}{\text{elapsed time}}$$

Change in position is final position minus initial position.

The sign of the answer indicates direction.

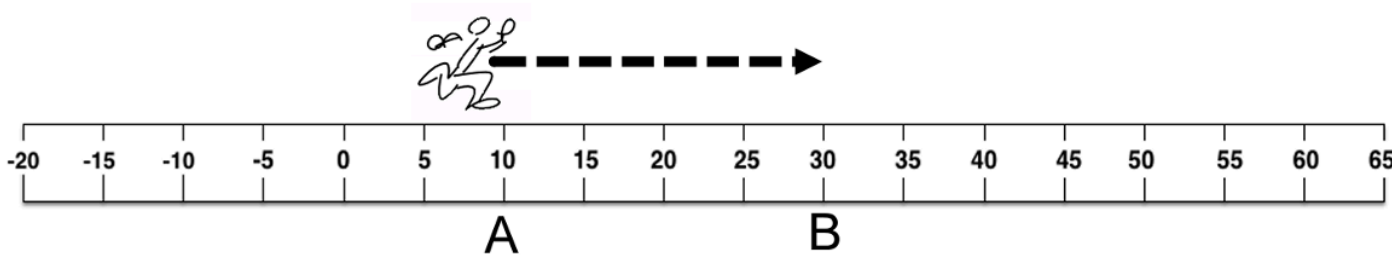
It's a vector - it tells you something about where you ended up.

Calculate the average velocity from A to B.



The person goes from A to B in 4 seconds.

Calculate the average velocity from A to B.

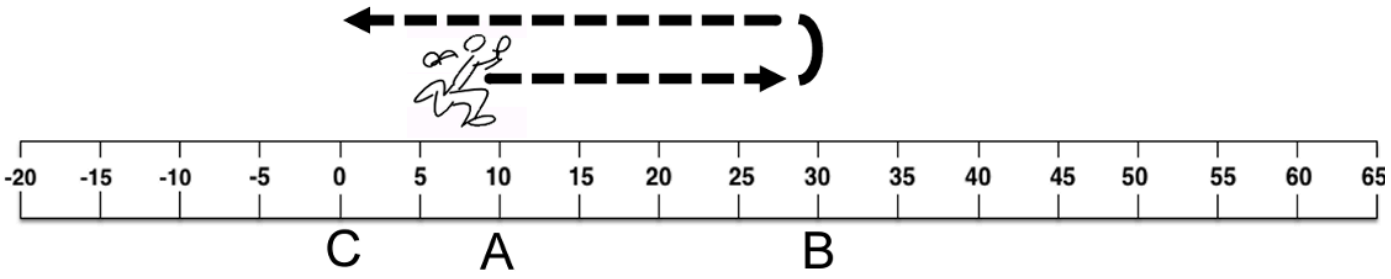


The person goes from A to B in 4 seconds.

$$\text{avg v} = \frac{30\text{ m} - 10\text{ m}}{4\text{ s}} = \frac{20\text{ m}}{4\text{ s}}$$

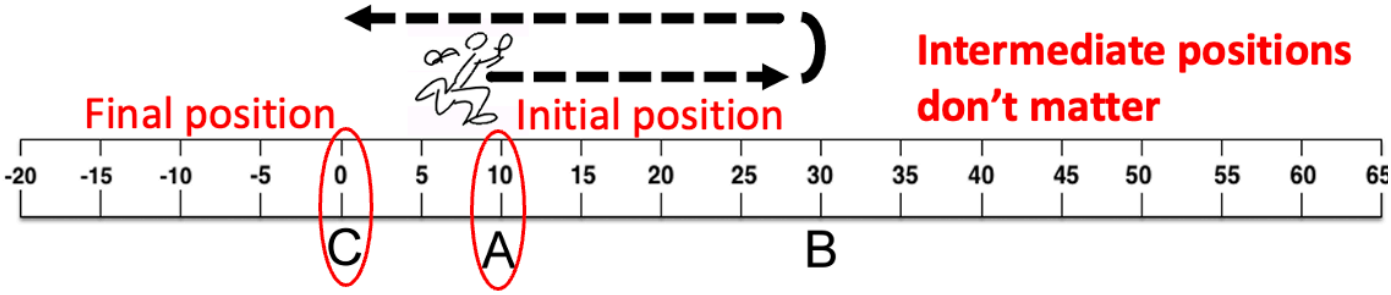
$$= +5\text{ m/s}$$

Calculate the average velocity from A to C.



The person goes from A to B in 4 seconds, but then immediately turns around and goes back to C in 6 more seconds.

Calculate the average velocity from A to C.



The person goes from A to B in 4 seconds, but then immediately turns around and goes back to C in 6 more seconds.

$$\text{avg v} = \frac{0\text{ m} - 10\text{ m}}{4\text{ s} + 6\text{ s}} = \frac{-10\text{ m}}{10\text{ s}}$$

$$= -1\text{ m/s}$$

Both are in m/s

Average Speed

Tells you how fast, but no indication of direction or where you ended up.

Average Velocity

Indicates direction and where you ended up, but not about the speeds along the way.

Which one do we go with?

And how do we make it so that it doesn't miss things?

Both are in m/s

Average Speed

Tells you how fast, but no indication of direction or where you ended up.

Average Velocity

Indicates direction and where you ended up, but not about the speeds along the way.

We prefer velocity... hopefully there's a way to make it say more about the speeds along the way.

Beijing, 2008

Olympic Competition

Usain Bolt runs the 100 m in a record 9.69 s.

What was Usain Bolt's Average Speed?

average speed

10.3 m/s

Time (s)	Position (m)	Velocity (m/s)
0	0	4
1	4	7
2	11	9
3	20	10
4	30	12
5	42	12
6	54	13
7	67	12
8	79	12
9	91	10
10	101	

The smaller you can make the time jumps, the more accurately you know the velocities during the motion. (You wouldn't miss things like turn-arounds and accelerations.)

The average speed and the average velocity give you the speed and velocity over the entire journey!

Instantaneous speed and instantaneous velocity give you speed and velocity over an increment of time in the journey!