Speed and Velocity

Reference Point Examples

Reference Point Scenarios

Suppose you are in a train, and you cannot tell if you are stopped or moving. Outside the window, another train is slowly moving forward. What could be happening?

- Your train is stopped, and the other train is moving slowly forward…
- The other train is stopped, and your train is moving slowly backwards…
- Both trains are moving forward, with the other train moving a little faster…
- Your train is moving very slowly backward, and the other train is moving slowly forward…

Could you be sure as to which is actually happening??

An object is in motion if it changes position relative to a reference point.

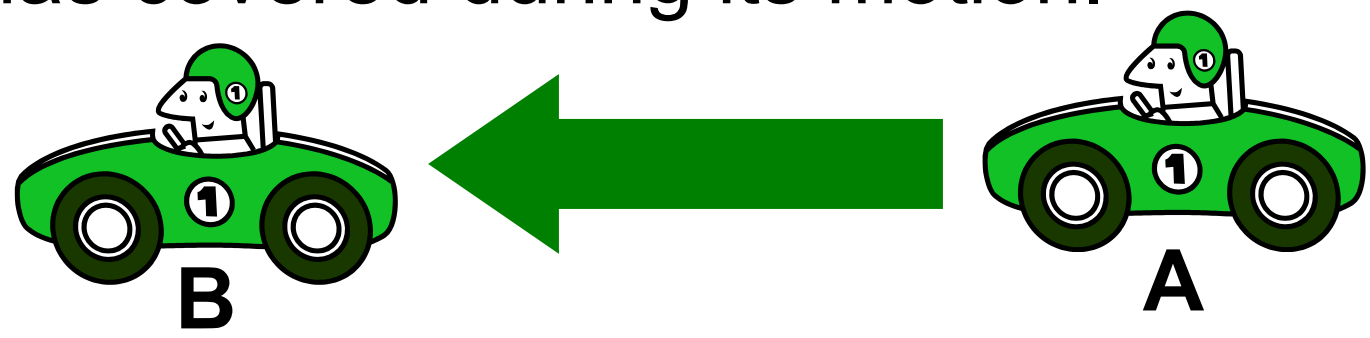
- Objects that we call stationary—such as a tree, a sign, or a building—make good reference points.

The passenger can use a tree as a reference point to decide if the train is moving. A tree makes a good reference point because it is stationary from the passenger's point of view.

Distance

When an object moves, it goes from point A to point B – that is the DISTANCE it traveled. (SI unit is the meter)

Distance is how much ground an object has covered during its motion.



Displacement

Knowing how far something moves is not sufficient. You must also know in what direction the object moved.

Displacement is how far our of place the object is; it is the object's overall change in position.

Speed

- It is a rate!
- What does that mean?
- A change over time. What is the change?
- Change in position, in other words, distance.
- Standard unit: meters per second (m/s)

Calculation

- Average speed – rate for the duration of an entire trip
- This can be calculated…ready for the equation?

- v = d/t
- v – velocity
- d – distance
- t – time
- What units do we use?

Average speed = Total distance/Total time

Speed

Calculating Speed: If you know the **distance** an object travels in a certain amount of time, you can calculate the **speed** of the object.

What is instantaneous speed?

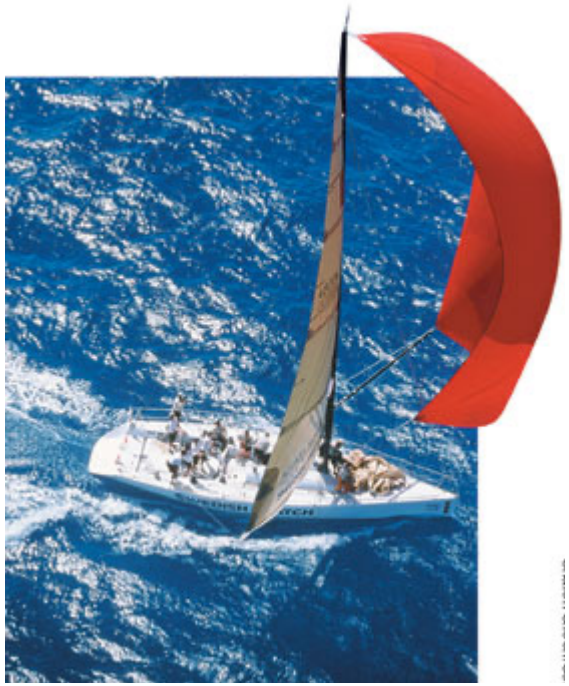
Instantaneous speed is the velocity of an object at a certain time.

Speed = Distance/time

Average speed = Total distance/Total time

Velocity

Velocity is a description of an object's **speed** and **direction**.

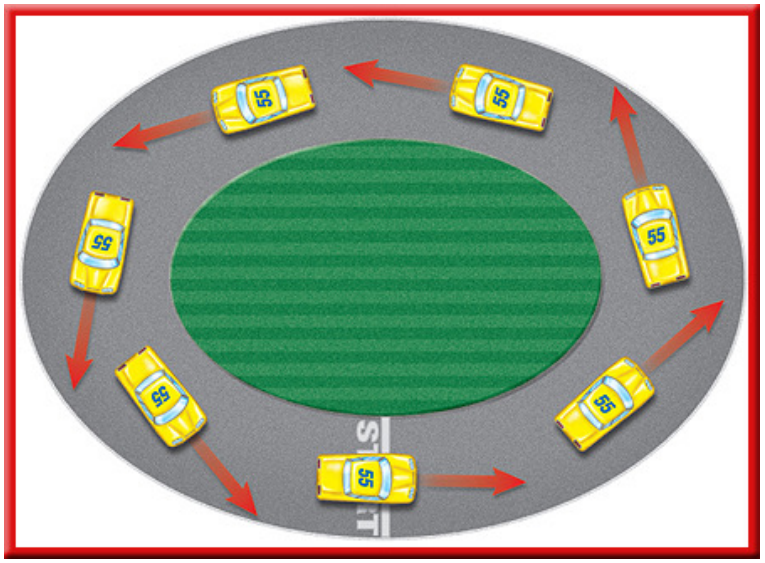


As the sailboat's direction changes, its velocity also changes, even if its speed stays the same. If the sailboat slows down at the same time that it changes direction, how will its velocity be changed?

Velocity

Because velocity depends on **direction** as well as **speed**, the velocity of an object can change even if the speed of the object remains constant.

The speed of this car might be constant, but its velocity is not constant because the direction of motion is always changing.



Speed v. Velocity

1. How are speed and velocity similar?

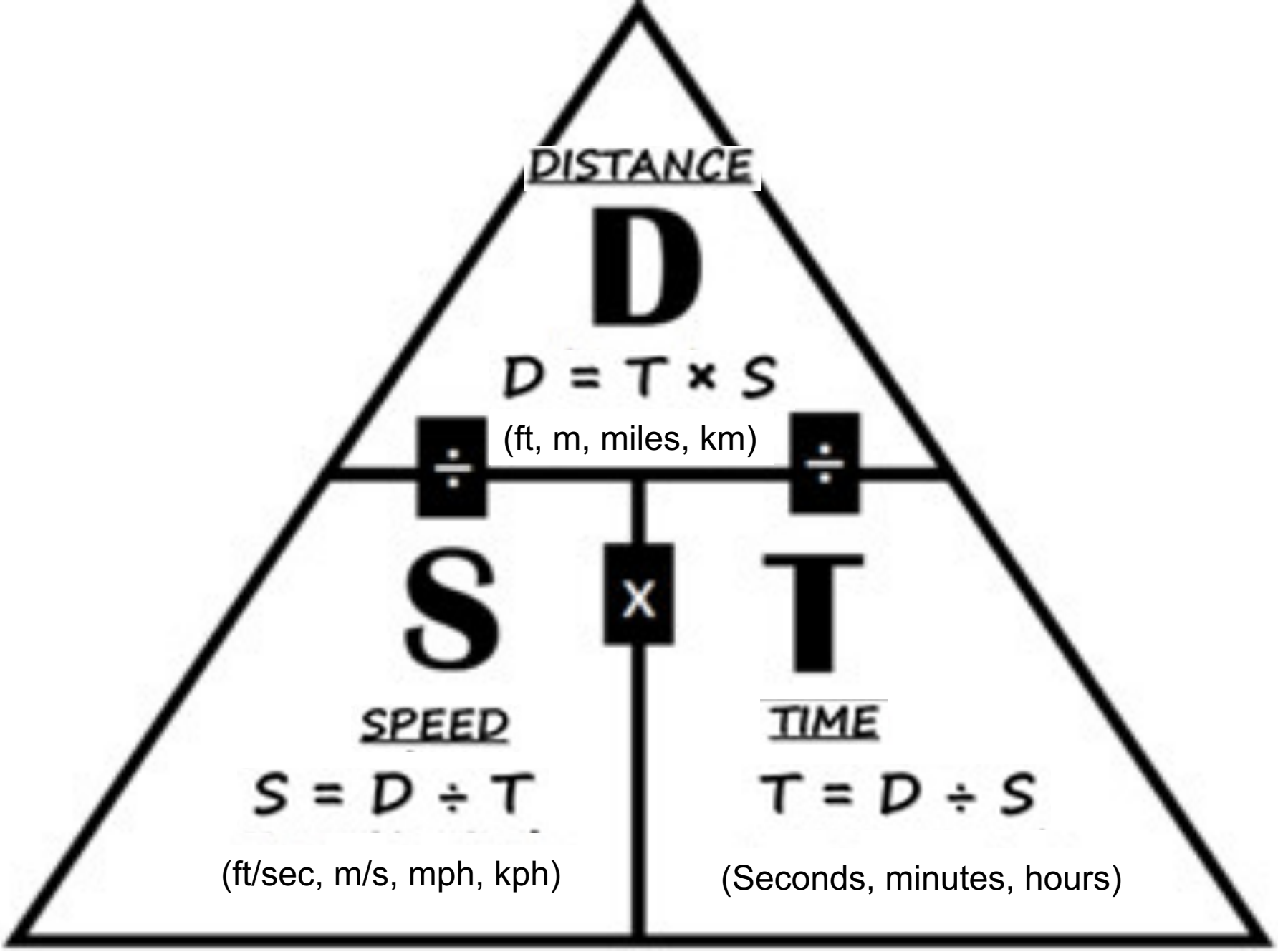
They both measure how **fast** something is moving

2. How are speed and velocity different?

Velocity includes the **direction** of motion and speed does not (the car is moving 5mph East)

3. Is velocity more like distance or displacement? Why?

Displacement, because it includes direction.


DISTANCE
D
D = T × S
(ft, m, miles, km)
÷
÷
S
X
T
SPEED
S = D ÷ T
(ft/sec, m/s, mph, kph)
TIME
T = D ÷ S
(Seconds, minutes, hours)

Practice

- If a runner runs 100 meters in 50 seconds, what is his speed in meters per second?
- How far could this runner run in 25 seconds?

$$S = D \div T$$

Speed = 100 meters / 50 seconds

Speed = 2 meters / second

$$D = T \times S$$

Distance = (25 seconds) x (2 meters / second)

Distance = 50 meters