Mathematical Description of Motion

http://ionaphysics.org/classroom/Physlets2/IonaPuzzles/FlintConstVel/FlintConstVel.html

Revised June16,2020 Some diagrams from Pearson Physics by Walker. Used with permission.

Chapter 2 Motion

Coordinate System "Frame of reference"

You choose where 0 is, you choose the positive direction, BUT you must be consistent throughout the problem. In other words, if up is positive, then it must always be positive. If down is positive, then it must always be positive during this particular problem.

Distance= total length traveled (in meters) (scalar)
Displacement = change in position $\Delta x = xf - xi$ (vector)

$$\text{average speed} = \frac{\text{change in distance}}{\text{change in time}}$$

$$v = \Delta x / \Delta t$$

1. A car travels 30. m in 60. seconds. Find the average speed of the car.

2. How far will the car travel if it maintains the same speed for 10. minutes?

3. How long will it take the car to travel a total distance of 450. m ?

Textbook
Read pages 43-56

Go to

http://ionaphysics.org/classroom/Physlets2/IonaPuzzles/FlintConstVel/FlintConstVel.html

Run the simulation and calculate the speed of the car.

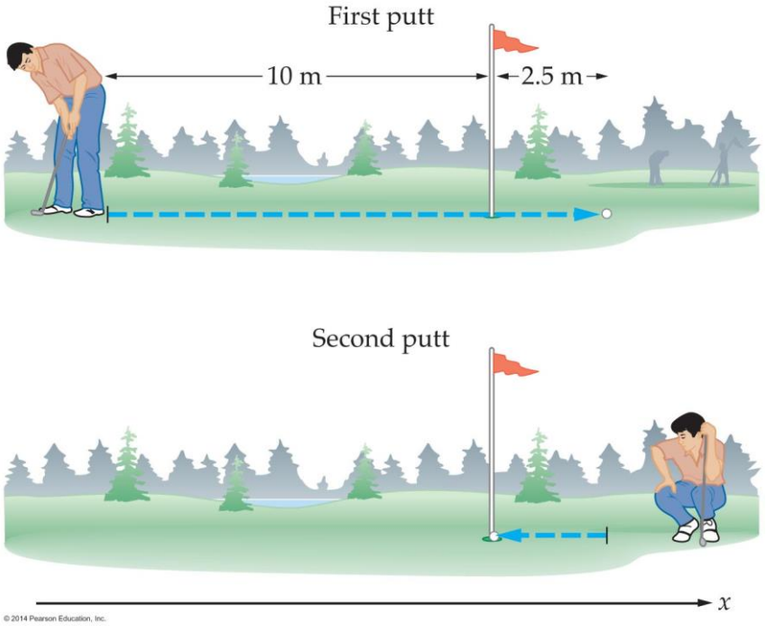
Consider:
Does it matter where you measure from? (front of frame, front of car, Fred's feet)?
What interval does each tic mark represent on the timeline?
What interval does each tic mark represent on the meter stick?

A real easy idea which frequently appears on tests!

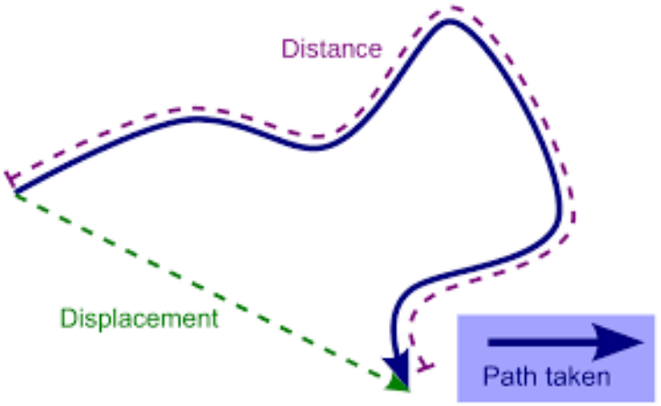
Scalar -

Vector -

Several examples of each



Distance – scalar (total path)
Displacement – vector (from start directly to end.



Adding Scalars

Adding Vectors

Resultant: (Vector Sum) A single vector which has the same effect as the combined effects of the vectors being added.

A car moves 40. m North and then 30. m East. Find the total (resultant) displacement of the car.

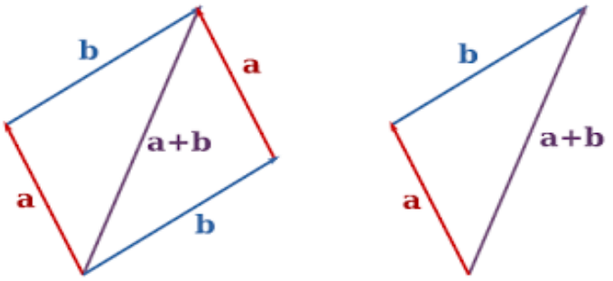
Adding vectors:

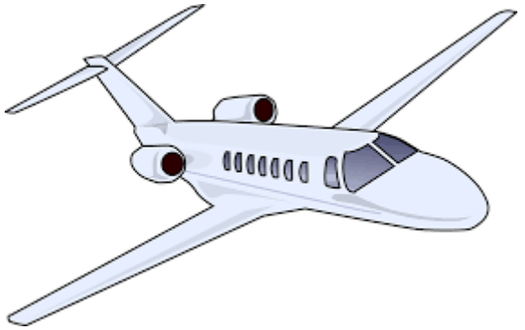
1. Using some convenient scale, draw the first vector as an arrow.

2. Starting at the head of the previous vector, draw the next one to the same scale.

3. Repeat step 2 if necessary.

4. The resultant is drawn from the tail of the first vector to the head of the last vector.





An airplane heads due North. Its air speed is 60. mi/hr. The wind is from the west at 20. mi/hr. Find the resultant ground speed and direction of the plane.

A car travels 30. miles West and then 20. miles North. Find the resultant displacement of the car.

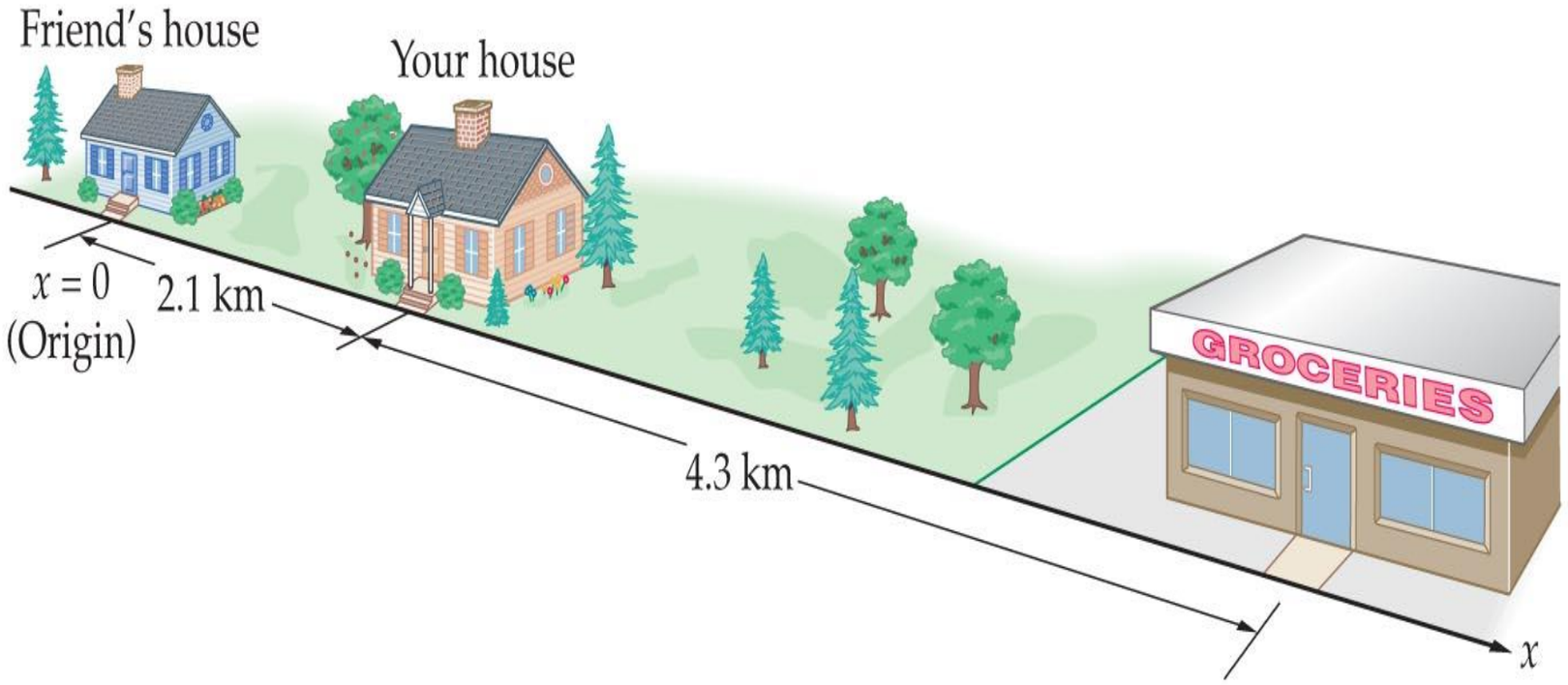
Speed = distance/time
Velocity = displacement/time

A car travels 30. miles West and then 20. miles North. It took him 2.0 hours.
(A)Find the resultant displacement of the car.
(B) Find the speed of the car.
(C) Find the velocity of the car.

He then returned to the starting place using the same route. Find his average velocity for the entire trip.

Here is a real good problem which should make you think.

Two owners of a dog start 10. m apart. They move toward each other. One is moving 1.3 m/s East and the other 1.3 m/s West. The dog runs back and forth between the owners and stops when they meet. How far did he run? The dog is running at 3.0 m/s. (page 67 # 71)



You start at your house and walk to the grocery store and then to your friend's house.

(A) What distance did you cover?

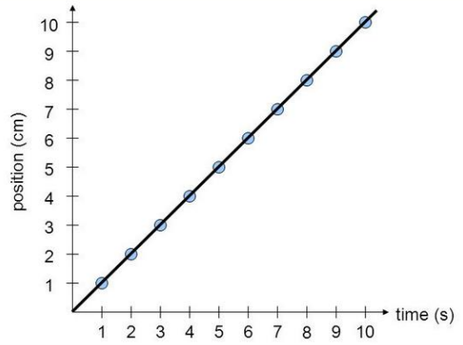
(B) What is your final displacement (assuming the direction from your friend's house to the grocery store is due North)?

Question: In a question about movement, is it possible for the displacement to be less than the distance?

Is it possible for the distance to be less than the displacement?

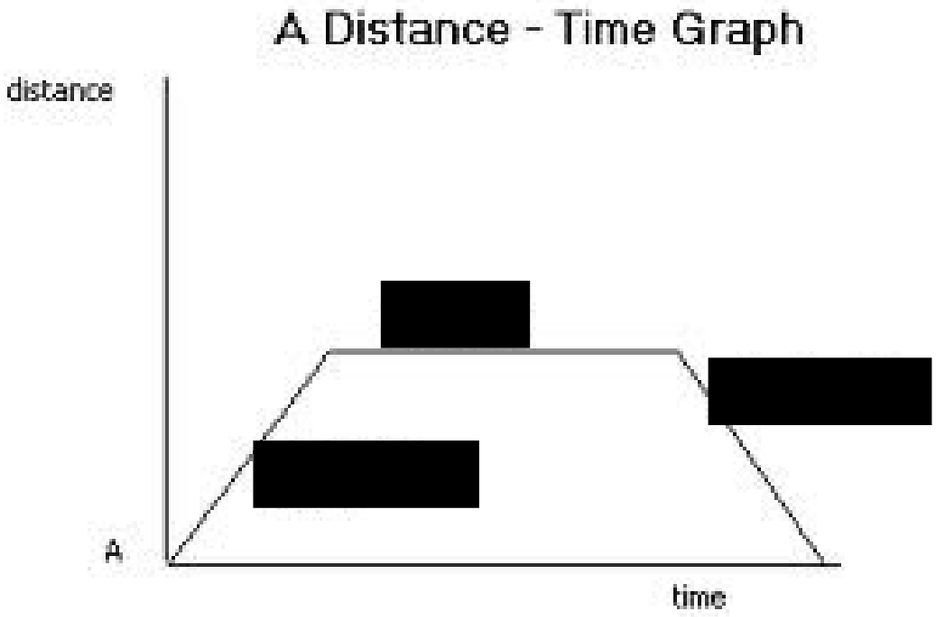
Is it possible for the distance and the displacement to be equal?

Position-Time Graphs



Each axis has a label
Each scale is linear

What is happening in each interval?



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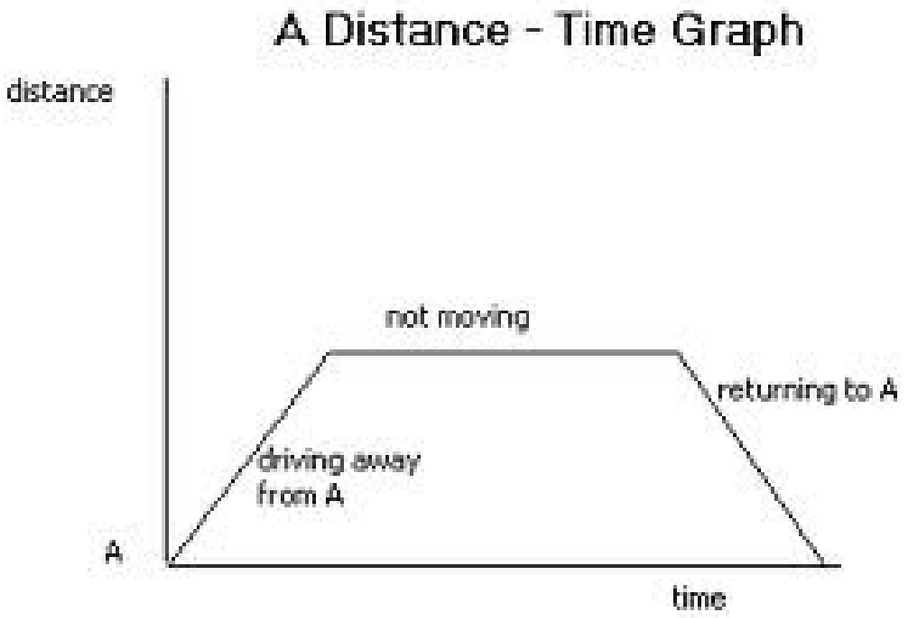
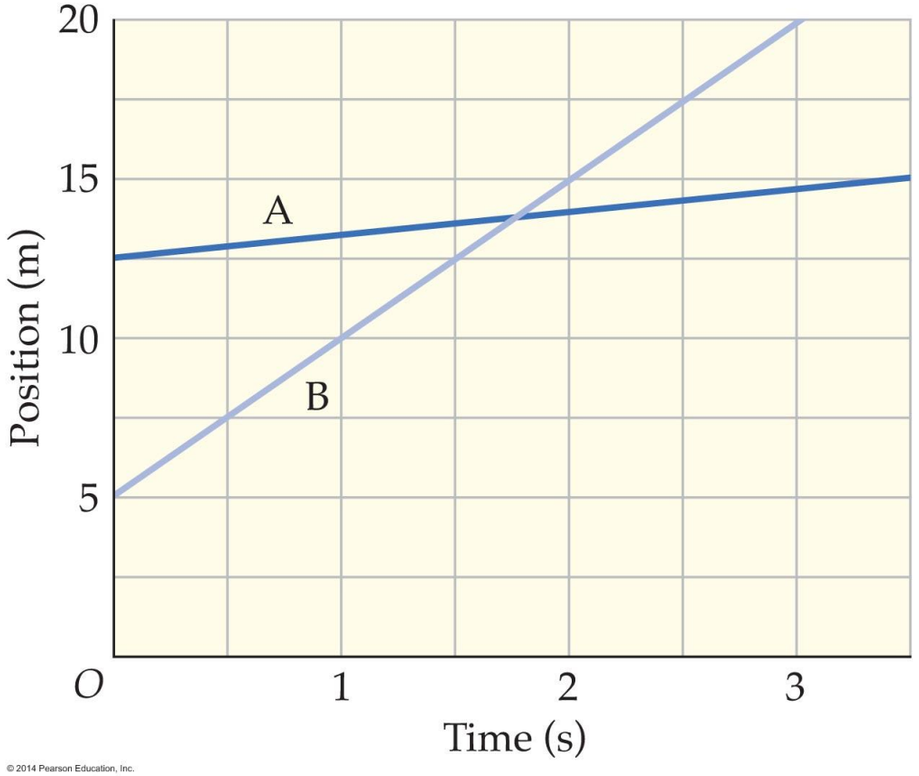


Slope = (change in distance)/(change in time)

But that is the definition of speed

So: the slope of the d/t graph represents the speed!



Describe the motion of car A
Describe the motion of car B
How do they differ?
What happens when the lines intersect?