~ Number Line ~

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The DISTANCE between two locations ("positions") is DEFINED to be the TOTAL LENGTH TRAVELED *by* the object we're interested in. It is measured in meters, centimeters, kilometers, etc. (and also feet, inches, miles, etc.). DISTANCE does not tell you about direction.

So, for example, assume that I'm standing at some place we designate as the "0 mark". If I travel east from there for 3 meters and then travel west from there for 5 meters more (thereby ending up 2 meters west of where I started), then I traveled a total DISTANCE of 8 meters.

In contrast, the DISPLACEMENT between two positions is DEFINED to be the DIFFERENCE between the FINAL POSITION and the INITIAL POSITION. Here, direction DOES matter. If we restrict our attention to motion in one dimension (which we will), then direction can be conveyed with + and – signs. It will always be ARBITRARY which direction is positive: we get to CHOOSE which will be called positive and which will be called negative. But notice: DISPLACEMENT is a property between two POINTS in SPACE; it does not matter what route an object took from point A to point B.

In the above example, the total displacement would be the difference between position 0 meters to position 2 meters, that is, –2 – 0 = –2. While the total DISTANCE covered in the above example would be 8 meters, the total DISPLACEMENT would be –2 meters.

Get it? Some observations:

1. DISTANCE is always positive; DISPLACEMENT can be positive or negative (the negative/positive sign indicates direction).
2. The total DISPLACEMENT between two positions is always less than or equal to the total DISTANCE between two positions.
3. DISTANCE is concerned with "how you get from one place to another," but is not concerned with direction. DISPLACEMENT is concerned with direction but is not concerned with "how you get from one place to another".
4. The total DISPLACEMENT for any round trip is 0. Can you see why? If you feel ANY confusion about ANY of the above, look in the text book. You'll find these terms. Use the index.

Now, here's the kicker: As you might know, AVERAGE SPEED is defined to be DISTANCE/TIME.

In contrast, AVERAGE VELOCITY is defined to be DISPLACEMENT/TIME.

So, DISTANCE and SPEED do ***not*** tell you about direction. They are SCALAR quantities.

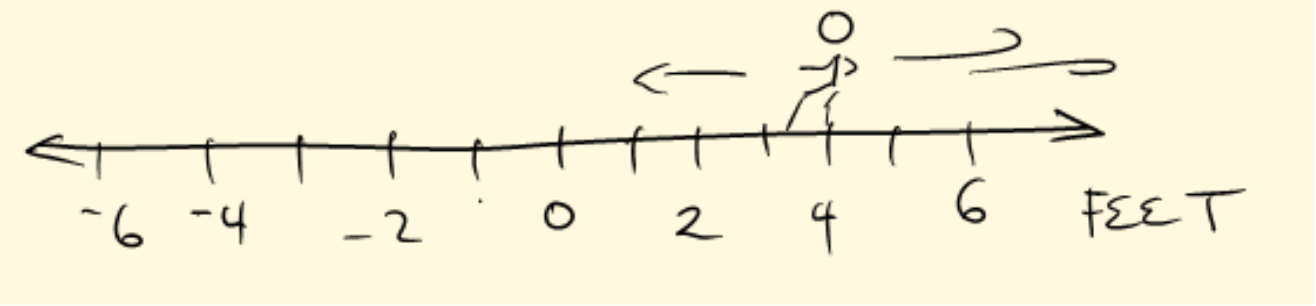
DISPLACEMENT and VELOCITY ***do*** tell you about direction. They are VECTOR quantities.

You now know all you need to know in order to complete the following assignment:

Please complete it on a separate sheet of paper.

* * *

Imagine that on the floor at the front of the classroom there is a long (1-dimensional) number line. It is marked 0 at the middle, has positive integers to the right and negative integers to the left. The space between any two successive integers is one foot. As class progresses, a nameless instructor paces back and forth along the line. His motion is spastic but you are nonetheless able to follow it.



The moment you start paying attention to the instructor's motion is known at Time 0 (t=0). At the moment, the instructor happens to be at the 4 foot mark.

The instructor moves at some CONSTANT speed from the 4 foot mark to the -2 foot mark. This takes him precisely 3 seconds.

The instructor then moves at some (other) CONSTANT speed from the -2 foot mark back to the 4 mark. This takes him precisely 2 seconds.

The instructor then moves at yet some other CONSTANT speed from the 4 mark to the -5 mark. This takes him precisely 3 seconds.

(Problems on the following page.)

Part 1: Segments in Which the Instructor Changes Direction

1) What distance is covered by the instructor in the entire 8 second journey?

2) What displacement is covered by the instructor in the entire 8 second journey?

3) What is the instructor's average speed for the entire 8 second journey?

4) What is the instructor's average velocity for the entire 8 second journey?

5) What is the instructor's average speed for the first 5 seconds of the journey?

6) What is the instructor's average velocity for the first 5 seconds of the journey?

Part 2: Segments in Which the Instructor Does NOT Change Direction

1) What distance is covered by the instructor as he moves from -2 ft. to 4 ft. (middle 2 seconds)?

2) What displacement is covered by the instructor as he moves from -2 ft. to 4 ft.?

3) What is the instructor's average speed as he moves from -2 ft. to 4 ft.?

4) What is the instructor's average velocity as he moves from -2 ft. to 4 ft.?

5) What is the instructor's average speed during the final 3 seconds of his journey?

6) What is the instructor's average velocity during the final 3 seconds of his journey?

Part 3: Problems in Which You Must Think

1) Where is the instructor (at what position) at the 7th second (t=7)?

2) What is the instructor's average velocity for the interval t=3 through t=7 (an intermediary 4 second chunk of the journey)?