

NUMBER LINE

Physics 203, Prof. Daniel A. Martens Yaverbaum
John Jay College of Criminal Justice, the CUNY

The **DISTANCE** between two locations (between 2 'positions') is **DEFINED** to be the **TOTAL LENGTH TRAVELED** by some 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.

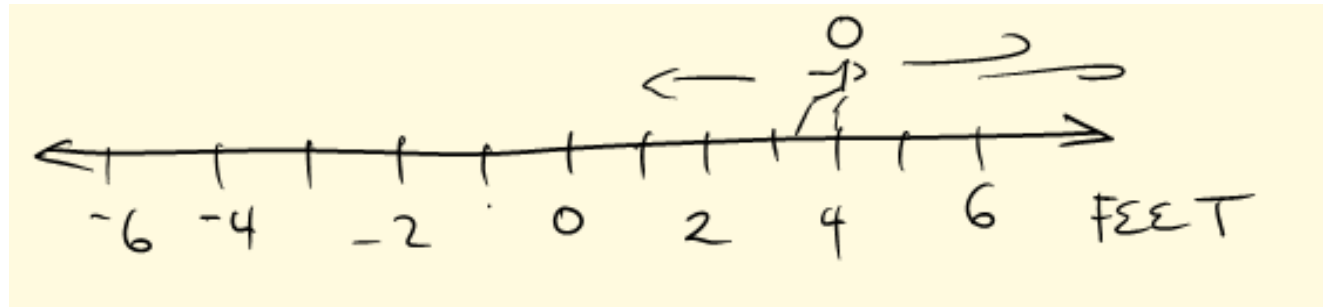
Get it? Some observations:

- 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.

Ghp%a'k'1 na^dbd'K3 l r hnf b andghp% O>K: @>LI >>=b] ^_lg^] rh[^'=BM G<>(MB >'Bj
 \hgtZl r% O>K: @>O>EH<BR b] ^_lg^] rh[^'=BI E: <>F >GM(MB >'"
 Lh%-BM G<>Zg] LI >>=] hghmter hmZ[hmm] k^rthg' M^r Zk^L<: E: K j nZgrtbl''=BI E: <>F >GM
 Zg] O>EH<BR] h mter hmZ[hmm] k^rthg' M^r Zk^O>MHK j nZgrtbl''

Rnighp idghp Zer hmig^] rhidghp lg hk] ^k rh\hf i em'ra^_hæp lg Zl b gf ^gr3
 l eZl ^\hf i em'brngZl i ZkZm'la^nh_i Zi ^k''

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)?

SUBMITTING YOUR WORK:

A) Submit ONE (1) PDF of all your work for this assignment.

You will submit your clear and thorough 'free-response' work to the assignment 'Stream' in your *Google Classroom* account. Look for an assignment entitled **HW1, Part A, Number Line: The Work**.

It can certainly be a scan of handwriting or a series of images put together, but it ultimately must be ONE (1) PDF file.

Make sure each page is labeled clearly with

(i) your name, (ii) a page number, and (iii) a problem number and/or letter clarifying which part of the assignment the work refers to. The problem or problem part.

B) Then, also within the Google Classroom 'Stream', find **HW1, Part B, Number Line: The Short Answers**.

This step is designed to include all elements of the HW which can be easily reduced to short-answer responses (multiple choice and the like).

Refer to the work you did in order to solve the HW problems. You will be asked to enter most of your final answers by placing checkmarks into a grid of rows (questions) and columns (possible answers). For each correct answer you enter, you will earn a 'point'. For anything else (blanks, incorrects), you will simply not earn a point.

Once you have entered everything you can and have checked, hit 'submit' and you will receive immediate feedback regarding the points you earned for correct answers, the questions for which you did not earn points (etc.) and you will be provided with a link to a set of brief solutions. You will not be able to change nor resubmit these answers, but whatever points you earn, you will certainly keep. They will be added to the points you will earn (not immediately, but soon) for process, method and follow-through on Part A.

Through both avenues of thought and evaluation, you will continue to accumulate HW points throughout the semester. You will do each HW once, but you will submit each HW in two distinct ways. You will thereby grow two independent yet simultaneous piles of points. Good job.