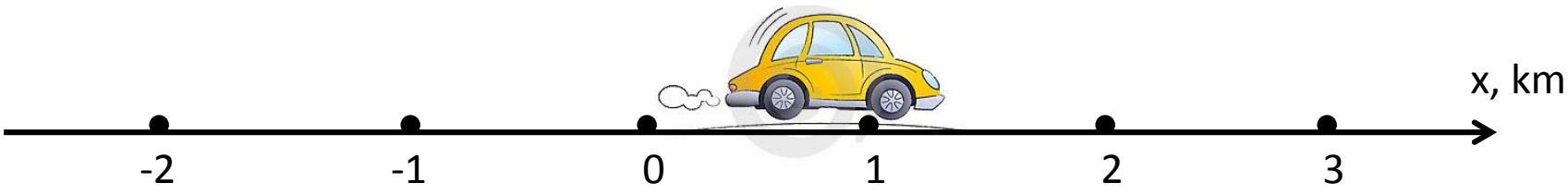
Instantaneous Velocity and Speed



Earlier, we defined ***Average velocity:*** between times t_i and t_f:

$$v = \frac{\Delta x}{\Delta t}$$

$x_i \rightarrow$ Initial position $\quad x_f \rightarrow$ Final position

$\Delta x = x_f - x_i \rightarrow$ Displacement

$\Delta t = t_f - t_i \rightarrow$ Travel time

Instantaneous velocity tells you how fast an object moves *right now* , at specific time t. The formula is the same as above, but **Δt must be as small as possible.** Similarly, we can define ***instantaneous speed***.

Homework

Problem 1.

The picture shows the path of an ant that it covered in 1 minute. Find its average speed. You will need to come up with a creative way to measure the distance travelled. Please describe it. Use anything you want.

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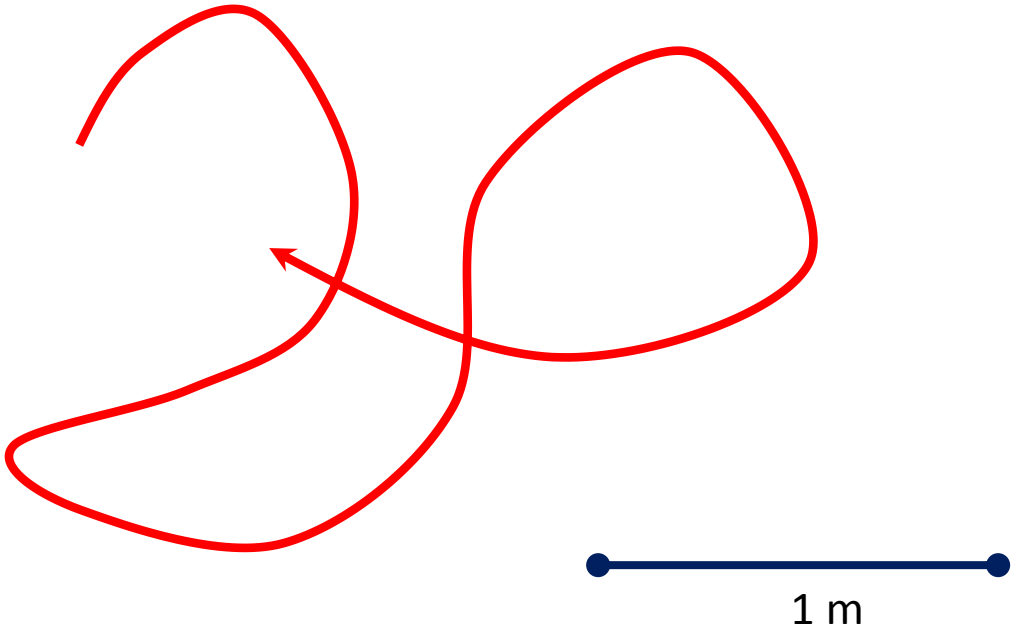
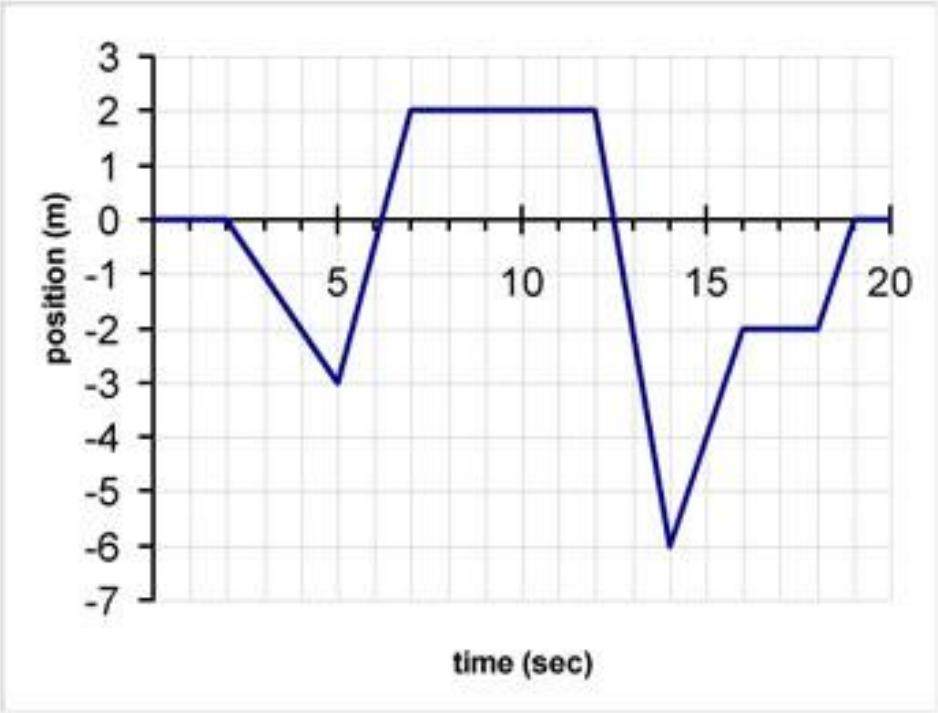


Can you think of a way to find its average velocity?

Problem 2.

The figure below shows the position of a sloth crawling back and forth along a straight line. Find its instantaneous speed and velocity at each time interval and fill the table on the right. Also, find the average speed and velocity of the robot (you'll need to figure out the total distance travelled for this).



Time interval ,s	Speed, m/s	Velocity, m/s
0-2		
2-5		
5-7		
7-12		
12-14		
14-16		
16-19		
19-20		
20-21		
Average (0-21)		

Bonus problem.

Two speed climbers are racing an Audi car to the top of a mountain. The climbers can go in a straight line from the bottom to the top of the mountain, which has a height of 1,200ft. The climbers average a speed of 0.17ft/s. The car has to go through narrow sinuous roads, so its average speed in the race is 29.3mph. The road to the top of the mountain is 60 miles long. Who will win the race, the climbers or the car? By how much?

Once you have made your prediction, you can watch the race take place at https://www.youtube.com/watch?v=xKLsBk5CijQ