

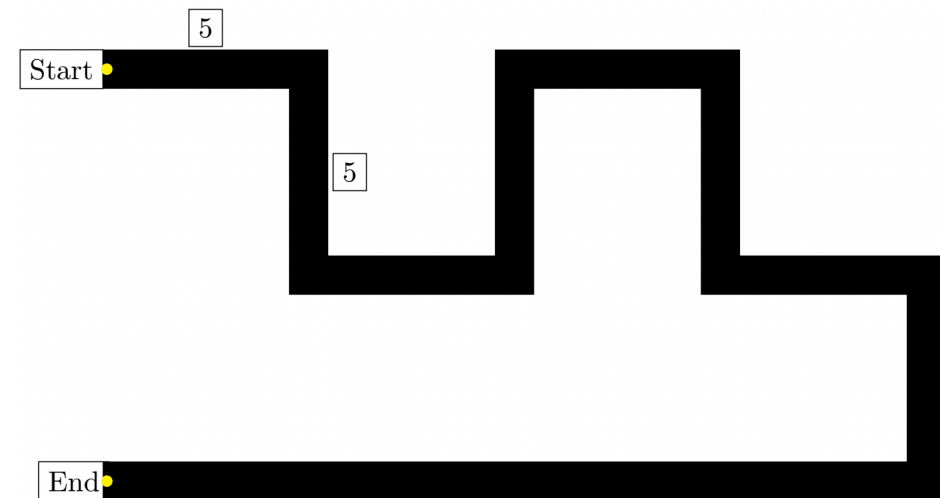
# What is the role of the derivative in the real world?

## Quick Check

1. If you travel 120 miles in 2 hours, then what is your average speed?

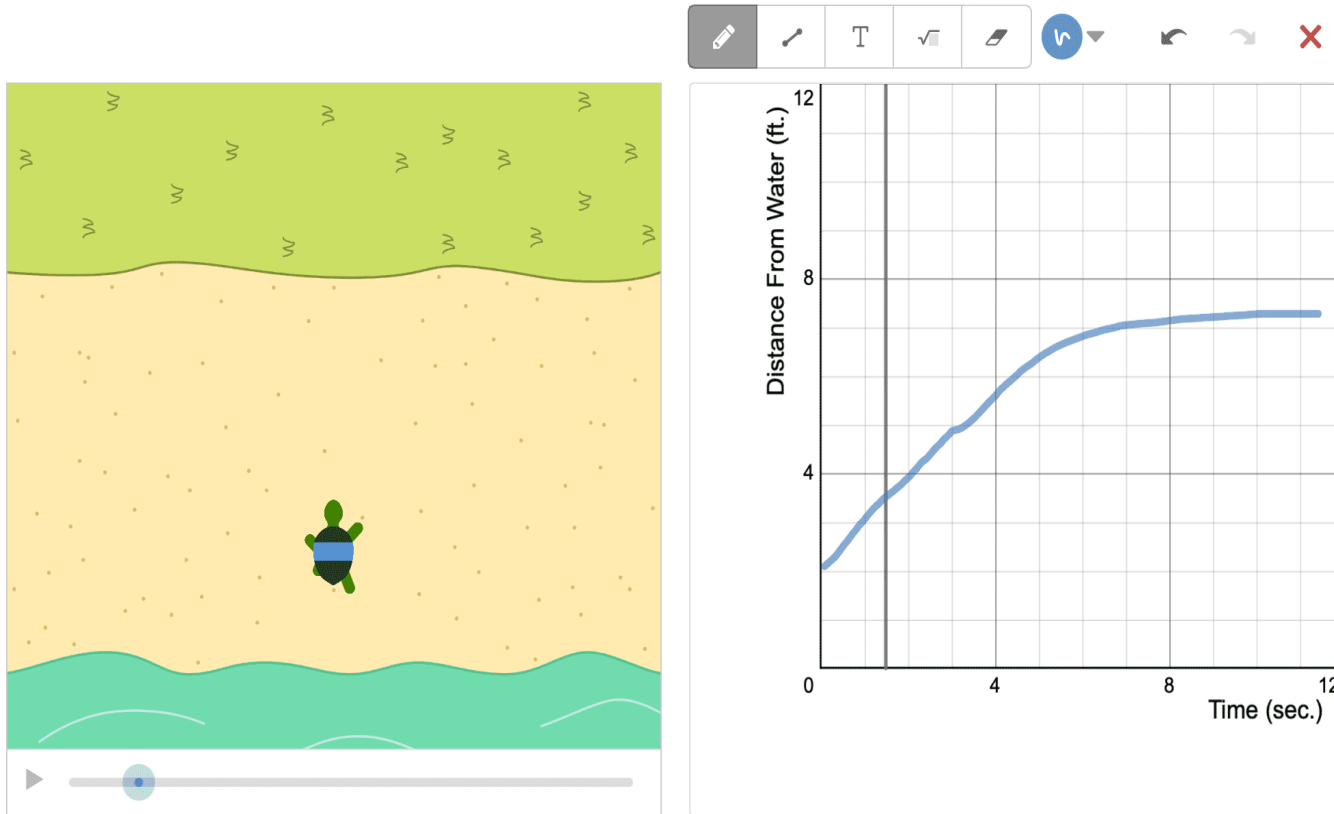
🤔 What does this number mean?

2. Image on the right shows the path of a particle. What is the total distance traveled by the particle? What is its displacement?



# Understanding Distance vs Time graphs

Draw a distance vs. time graph to represent a turtle's journey across the sand. Then press play.

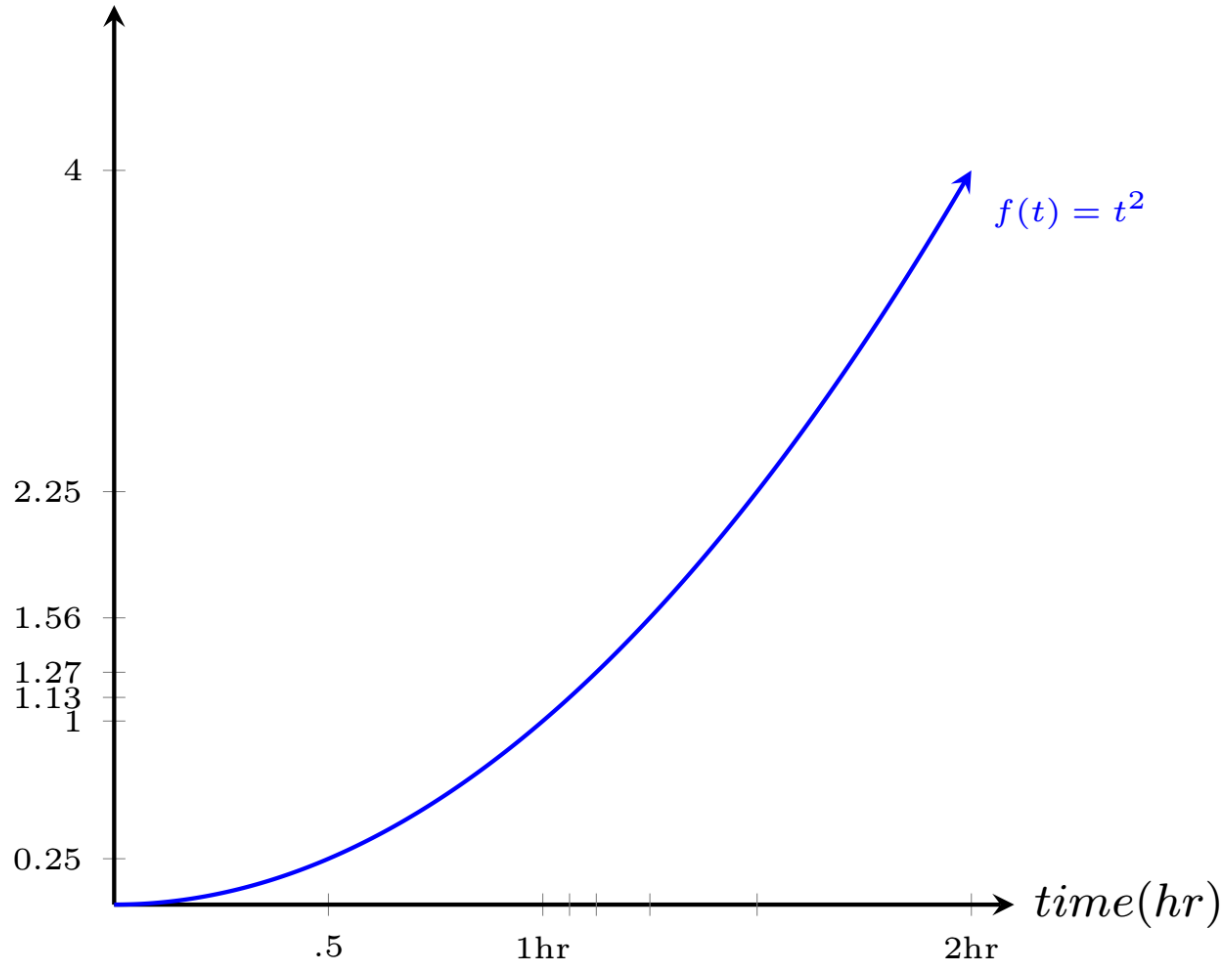


Activities from [Desmos.com](https://www.desmos.com) linked under lesson resources on [primethinker](https://www.primethinker.com).

Test graphs that make the turtle or the object:

- go forward/ backward/ stand still?
- go faster or slower?

*Distance(m)*



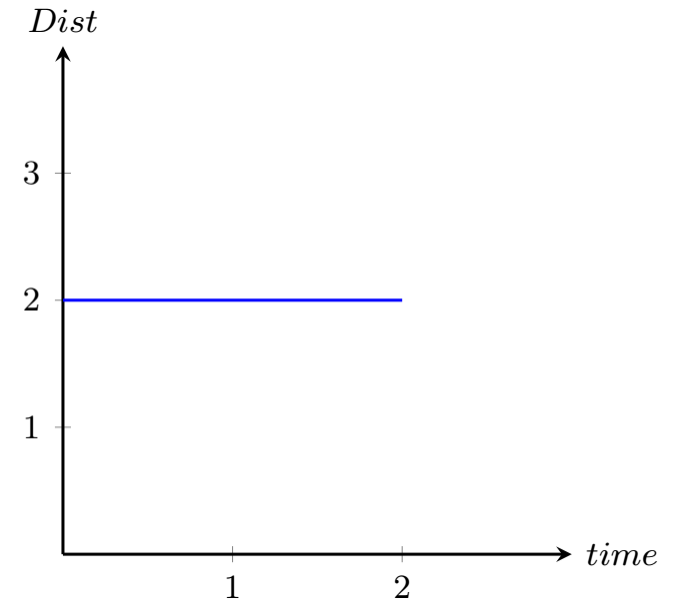
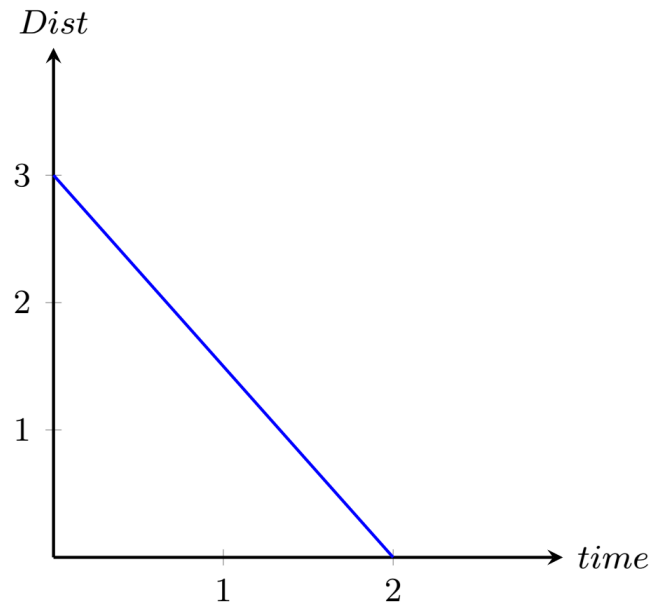
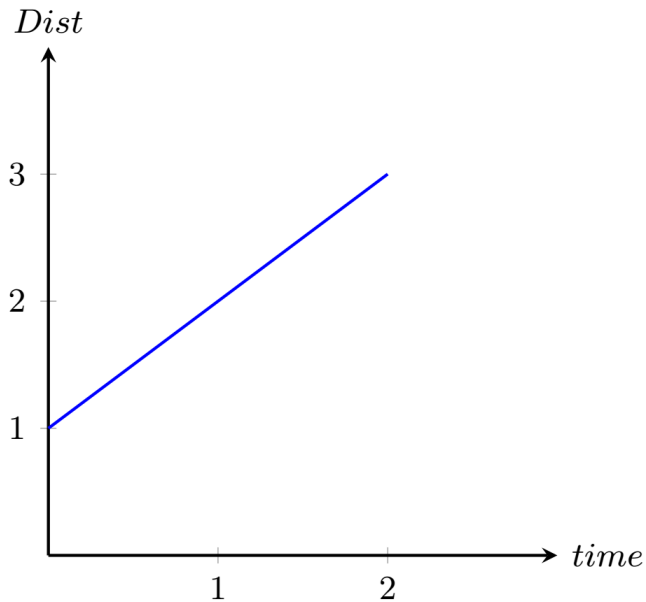
## Average vs 'Instantaneous' rate

Suppose we take a car trip and record the distance that we travel every second.

1. What is the average speed of the car between 1pm and 2pm?
2. What would be the meaning of instantaneous speed at 1pm? How would you compute it?

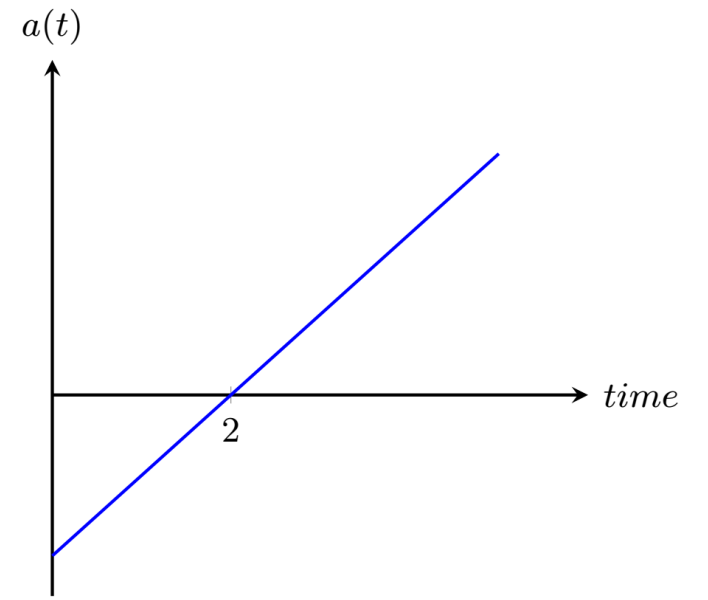
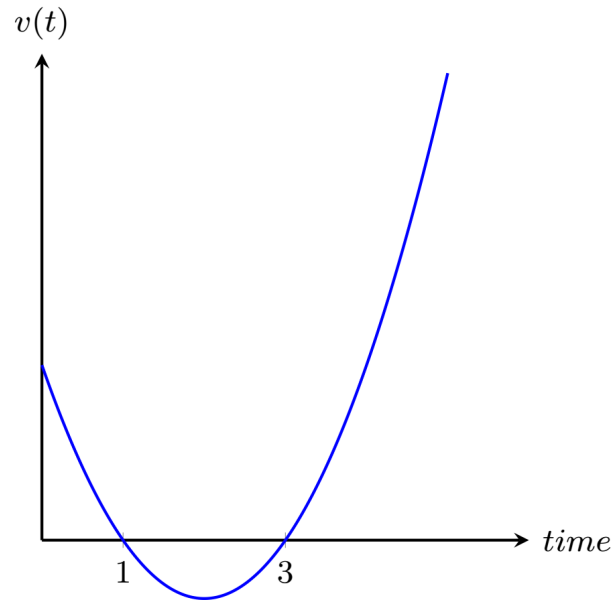
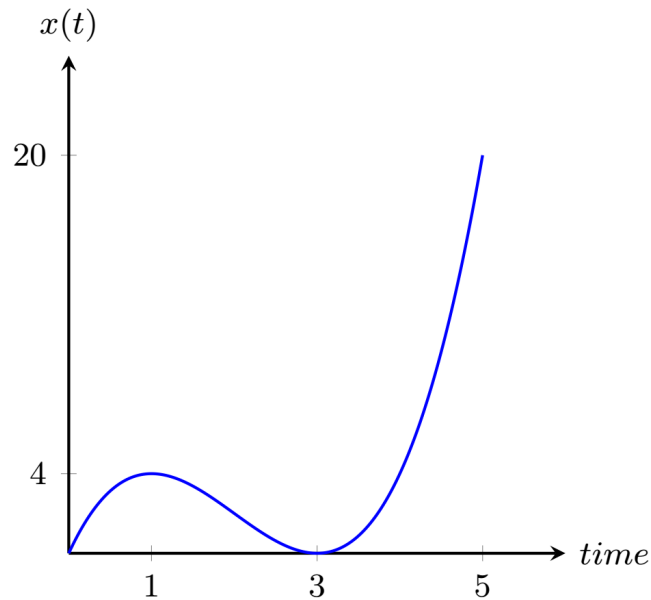
# Velocity and right/left motion along a straight line

What can you interpret about an objects movement from the following graphs?



🤔 What is the difference between speed and velocity?

# Acceleration (Slowing Down/ Speeding Up)



What information does each graph give us easily? How can we combine the understanding from each to get a good understanding of the motion of a particle?

## Motion along a straight line summary

Position:  $x(t)$

Velocity:  $v(t) = x'(t)$

Acceleration:

$$a(t) = v'(t) = x''(t)$$

Speed:  $|v(t)|$

At rest means:  $v(t) = 0$

$$\text{Average Velocity} = \frac{\Delta x}{\Delta t} = \frac{\text{change in position}}{\text{change in time}}$$

$$\text{Average Acceleration} = \frac{\Delta v}{\Delta t} = \frac{\text{change in velocity}}{\text{change in time}}$$

Total Distance = Sum of distances covered in going forwards and backwards

Displacement = change in position (final - initial position)

## Practice

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The position of a particle is given by  $x(t) = t^3 - 6t^2 + 9t$  where  $t$  is measures in seconds and  $x$  in meters.

1. Find the velocity at any time  $t$ . After  $2\text{ s}$  and  $5\text{ s}$ .
2. When is the particle at rest?
3. When is the particle moving forward? When is it moving backward?
4. What is the total distance travelled by the particle during the first 5 seconds?
5. What is the acceleration of the particle at time  $t$ ? After  $4\text{ s}$ .
6. When is the particle speeding up? slowing down?