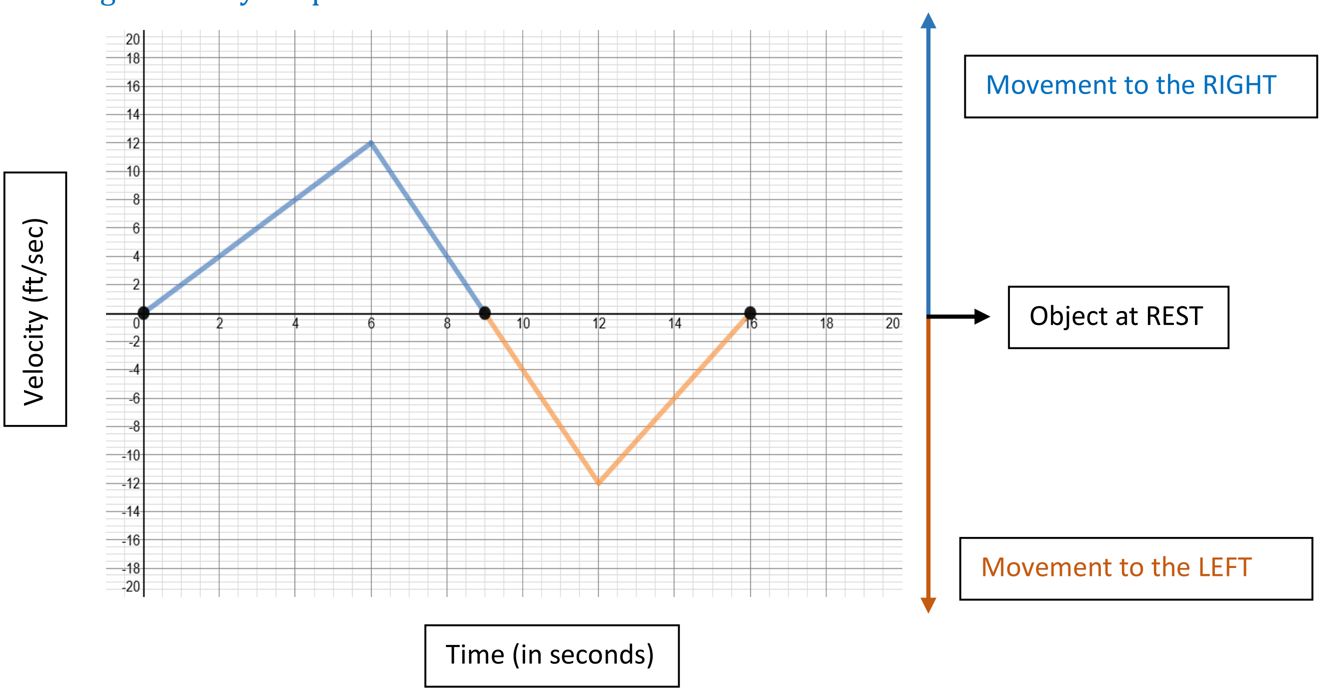
Position, **Velocity**, Acceleration

When dealing with a position graph we were able to determine the speed of an object simply by finding $\frac{\Delta d}{\Delta t} = \frac{change\ in\ distance}{change\ in\ time} = average\ speed$. Simple terms: the average rate of change (slope) on a position graph is speed. $SPEED = |velocity|$

Velocity is speed with direction. Reading a velocity graph is different than reading a position graph. Velocity graphs tell us how fast an object is moving with respect to time. We can also calculate approximate distances and displacement of an object.

Reading a Velocity Graph: Particle on a Horizontal Line



A particle is moving on a horizontal line and its velocity with respect to time is represented by the graph above.

The blue lines indicates the particles movement to the RIGHT → $v(t) > 0$

- The particle is moving to the right on the interval (0,9).

The orange lines indicate the particles movement to the Left → $v(t) < 0$

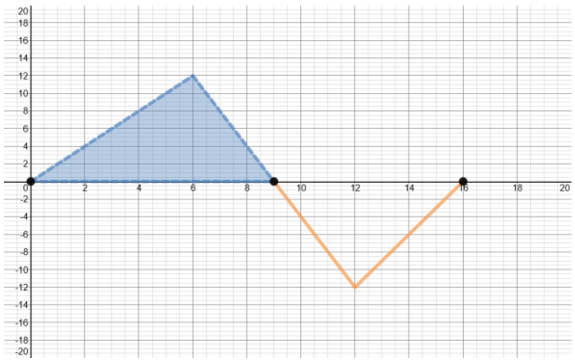
- The particle is moving to the left on the interval (9,16).

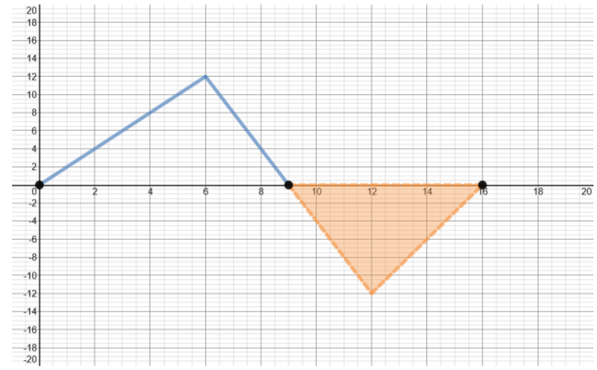
The **black dots** indicate when the particle is at rest → $\boldsymbol{v(t) = 0}$

- The particle is at rest at $t = 0, 9, and\ 16$.

Notice that the particle is at rest on the x-axis this means that x-intercept are really significant values; equation may been needed to accurately identify the x-intercepts. This means you will have to take the equation and set it equal to 0. Since these are linear just solve for x.

Finding the distance travelled by the particle.





Notice that the shaded blue area is above the x-axis; by finding the area between the graph and the x-axis we find the distance the particle has travelled to the right. Here is why.

$$A = \frac{1}{2}bh = \frac{1}{2}(time)(velocity) = \frac{1}{2}\left(\frac{seconds}{1}\right)\left(\frac{feet}{seconds}\right)$$

The seconds on tops cancels the seconds on bottom leaving just the feet which is a measure of distance.

The areas you will be working with can easy be calculated using squares, rectangles, trapezoids, and triangles mostly.

BIG IDEA: Average rate of change or average speed was calculated through division of the units of measure this is the basic idea behind a derivative. Finding the area is calculated through multiplication of the units of measure and this is the basic idea of integration.

So how far did the particle travel to the RIGHT

$$A = \frac{1}{2}bh = \frac{1}{2}(9)(12) = 54\ feet\ to\ the\ right$$

So how far did the particle travel to the LEFT

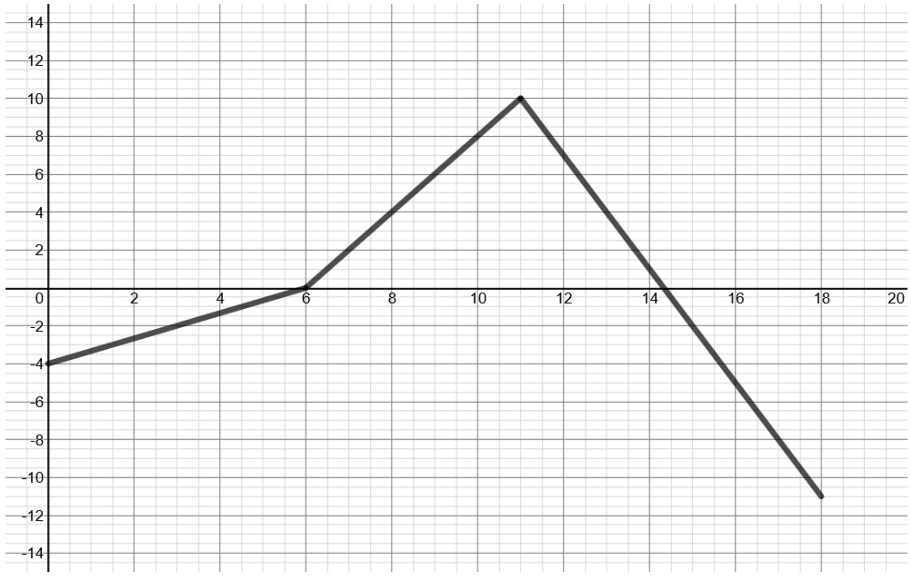
$$A = \frac{1}{2}bh = \frac{1}{2}(7)(12) = 42\ feet\ to\ the\ left$$

Therefore the particle travelled a **total distance** of 96 feet in 16 seconds.

The **displacement** of the particle is the distance from its initial position to its terminal (or final) position.

The particle travelled 54 feet right and then 42 feet left. $54 - 42 = 12$. Since it moved farther right it is 12 feet from its initial position.

A particle is moving on a horizontal line and the graph below represents its velocity (m/sec) in term of time (sec). Use the graph to answer the following questions.



- Determine the velocity at $t = 10$? What does this mean in the context of the situation?
- For what value of t is $v(t)$ =-2? What does this mean in the context of the situation?
- Write a piecewise function to represent $v(t)$.
- State the interval where the particle is;
    - Moving to the right:
    - Moving to the left:
    - At rest:
- How far did the particle move to the right?
- How far did the particle move to the left?
- What is the particles total distance?
- What is the particles total displacement?
- As a coordinate point what is the absolute maximum velocity? What does this represent in the context of the situation?
- How far did the particle travel on the interval [12,16]?