Position, Velocity and Acceleration

What is the relationship between position, velocity and acceleration

Position: Velocity: Acceleration:

Velocity problems: Average Velocity: Instantaneous Velocity:

V > 0 means:

V < 0 means:

Speed means:

Example 1: Given position $s(t) = \dfrac{\sin(t)}{t} \quad t \geq 0$

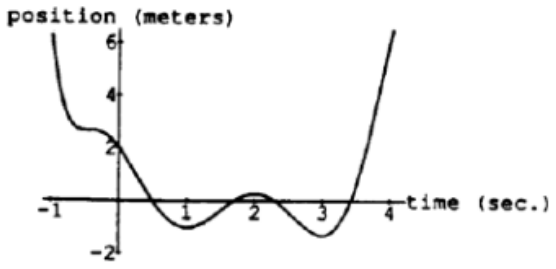
What is the velocity at $\dfrac{\pi}{2}$?

Which direction is the particle traveling then?

What is the speed at $\dfrac{\pi}{2}$?

Reading a Graph of position:

1. The position $p(t)$ of a particle moving along a line is given by the graph below (and the coordinates of some of its points are given in the table to the right of it. We only know about the behavior of this particle during times from -1 to 4. (2 points per part)



t	$p(t)$
-1	6
0	2
1	-1
2	$\frac{1}{2}$
3	$-1\frac{1}{2}$
4	6

a. Find the average velocity of the particle between times $t = -1$ and $t = 3$.
b. Find the equation of the secant line of $p(t)$ between $t = -1$ and $t = 3$.
c. For what intervals is the particle's velocity positive? For what intervals is its velocity negative?

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Sketch a velocity graph: A mouse runs north on an electric line for 30 seconds, stops for 10 seconds and then runs south for 20 seconds.

Acceleration: Average acceleration: Instantaneous acceleration:

Example 2: A ball is thrown straight down from the top of a 220 foot building with an initial velocity of -22 ft/sec. Use appropriate units.

a. Write the position function, the velocity function and the acceleration function.

b. What is the average velocity over the first 3 secs?

c. What is the velocity at 3 seconds? why is it negative?

e. What is the acceleration at t=3?

f. What is the speed at t=3?

g. Is the ball speeding up or slowing down at t=3?

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The relationship of speed to acceleration and velocity. A little push goes a long way...
Depends on sign of V and A
If the signs are the same:

If the signs are opposite:

Putting it all together: Motion along a line.

Motion along a line implies direction as well. x particles travel left and right, y particles travel up and down. A particle will change direction only if v(t) changes sign which means it has to stop (v=0) and turn around! We use a sign chart.

Example 3: The position of a particle moving along a horizontal line is given by
$x(t) = t^3 - \frac{15}{2}t^2 + 12t \qquad t \geq 0$ for t in seconds and x(t) in feet.

Is the particle moving left or right at t = 2?

When does the particle change direction?

What is the acceleration at t=2?

When is the particle speeding up?

When is the particle slowing down?

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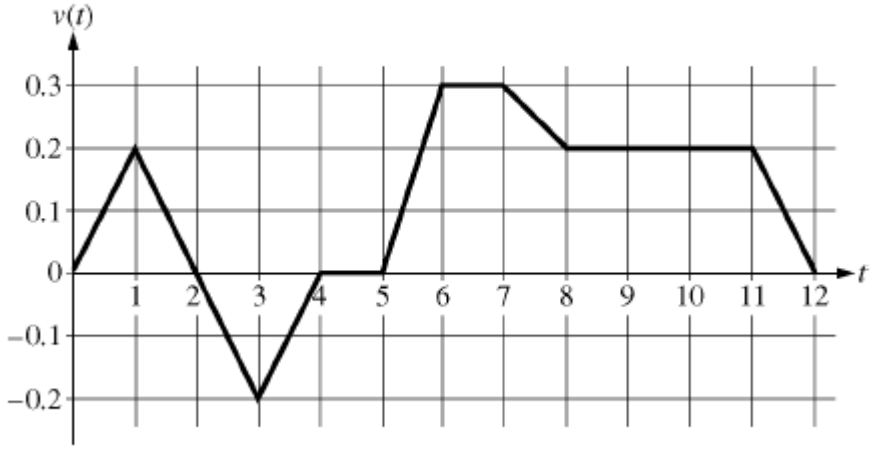
Reading a velocity graph

Caren rides her bike along a straight road from home to school, starting at home at time t=0 minutes and arriving at school at time t=12 min. During the time interval [0,12], her velocity v(t), in miles/min, is modeled by the piecewise linear graph.



a. Find the acceleration of Caren's bike at time t=7.5. Indicate units of measure.

b. Shortly after leaving home , Caren realizes she left her calculus homework at home, and she returns to get it. At what time does she turn around to go back home? Give a reason for your answer.

c. What is her Velocity at t= 8?

d. When is she stopped?

e. When is her acceleration =0?

f. When is she speeding up?

g. When is she slowing down?