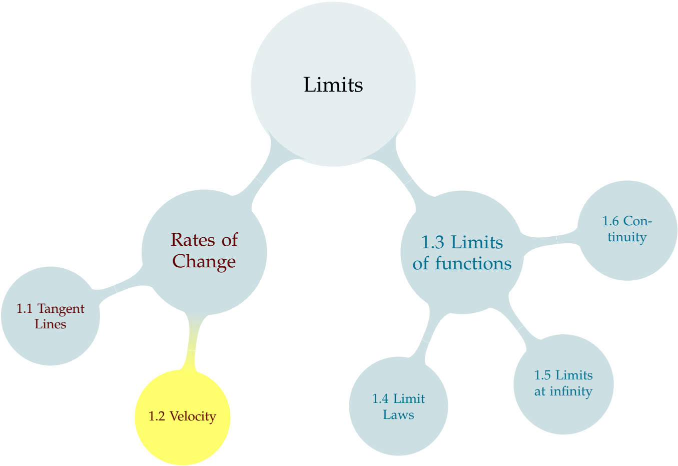
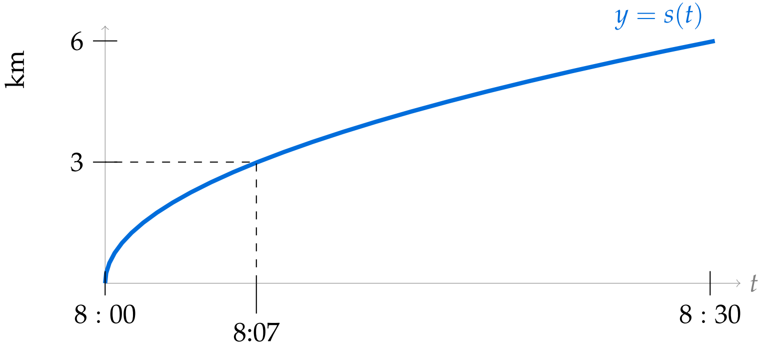
Table of Contents




$y = s(t)$
km
6
3
t
8 : 00
8 : 30


$y = s(t)$
km
6
3
t
8 : 00
8:07
8 : 30

It took $\frac{1}{2}$ hour to bike 6 km. 12 kph represents the:

A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

C. tangent line to $y = s(t)$ at $t = 8:30$

D. slope of the tangent line to $y = s(t)$ at $t = 8:30$

It took $\frac{1}{2}$ hour to bike 6 km. 12 kph represents the:

A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

C. tangent line to $y = s(t)$ at $t = 8:30$

D. slope of the tangent line to $y = s(t)$ at $t = 8:30$

It took $\frac{1}{2}$ hour to bike 6 km. 12 kph represents the:

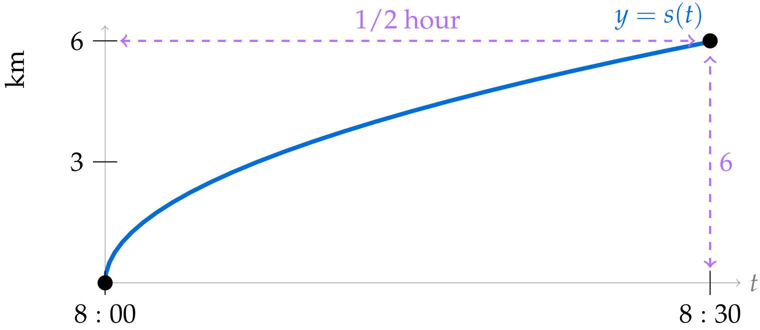
A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

C. tangent line to $y = s(t)$ at $t = 8:30$

D. slope of the tangent line to $y = s(t)$ at $t = 8:30$

ans



It took $\frac{1}{2}$ hour to bike 6 km. 12 kph represents the:

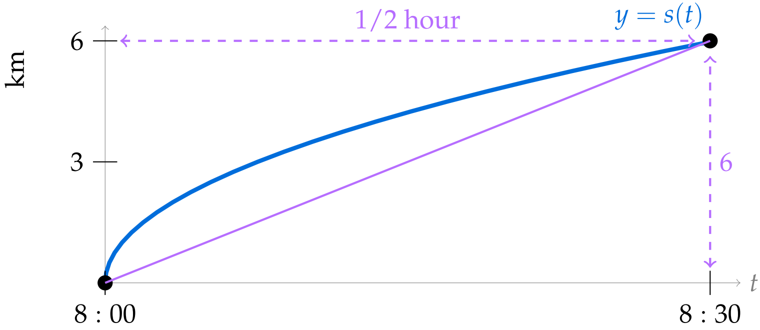
A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

C. tangent line to $y = s(t)$ at $t = 8:30$

D. slope of the tangent line to $y = s(t)$ at $t = 8:30$

ans



It took $\frac{1}{2}$ hour to bike 6 km. 12 kph represents the:

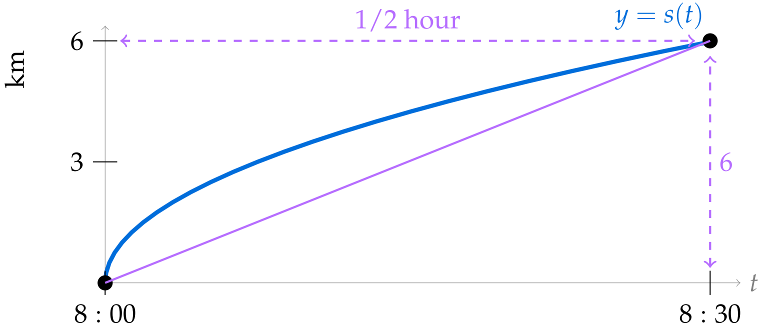
A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

C. tangent line to $y = s(t)$ at $t = 8:30$

D. slope of the tangent line to $y = s(t)$ at $t = 8:30$

ans



It took $\frac{1}{2}$ hour to bike 6 km. 12 kph represents the:

A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:30$

C. tangent line to $y = s(t)$ at $t = 8:30$

D. slope of the tangent line to $y = s(t)$ at $t = 8:30$

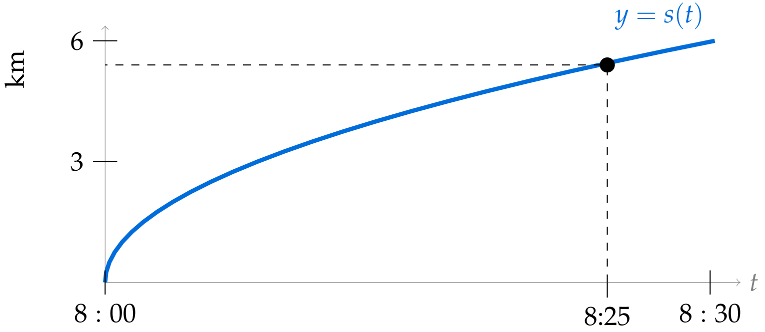
At 8:25, the speedometer on my bike reads 5 kph. 5 kph represents the:

A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$

C. tangent line to $y = s(t)$ at $t = 8:25$

D. slope of the tangent line to $y = s(t)$ at $t = 8:25$



At 8:25, the speedometer on my bike reads 5 kph. 5 kph represents the:

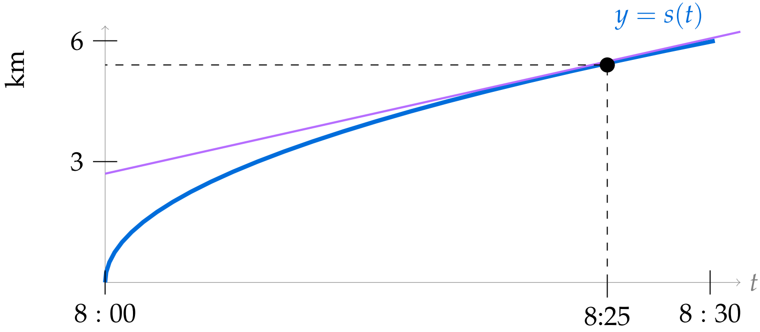
A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$

C. tangent line to $y = s(t)$ at $t = 8:25$

D. slope of the tangent line to $y = s(t)$ at $t = 8:25$

ans



At 8:25, the speedometer on my bike reads 5 kph. 5 kph represents the:

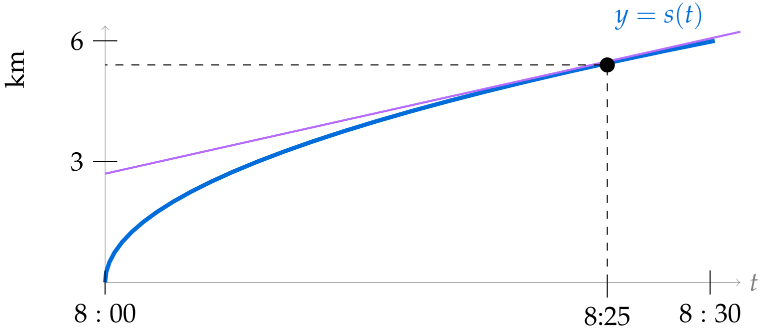
A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$

B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$

C. tangent line to $y = s(t)$ at $t = 8:25$

D. slope of the tangent line to $y = s(t)$ at $t = 8:25$

ans

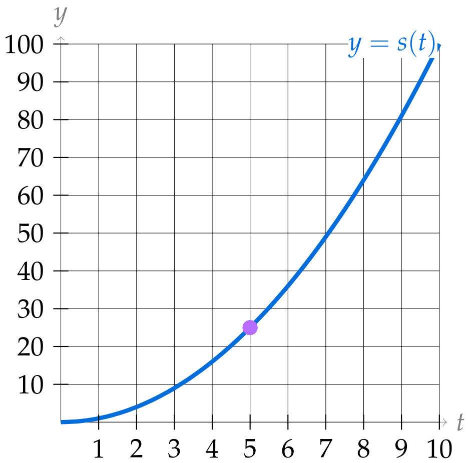


At 8:25, the speedometer on my bike reads 5 kph. 5 kph represents the:

A. secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$
B. slope of the secant line to $y = s(t)$ from $t = 8:00$ to $t = 8:25$
C. tangent line to $y = s(t)$ at $t = 8:25$
D. slope of the tangent line to $y = s(t)$ at $t = 8:25$

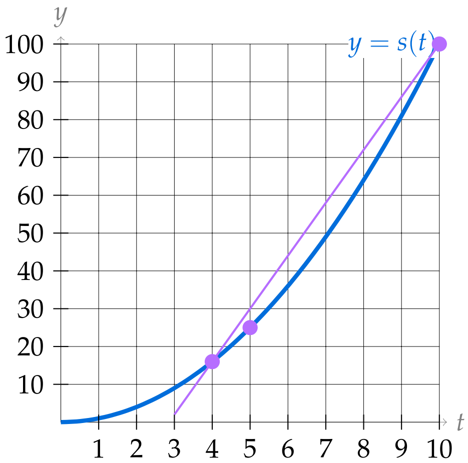
Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.



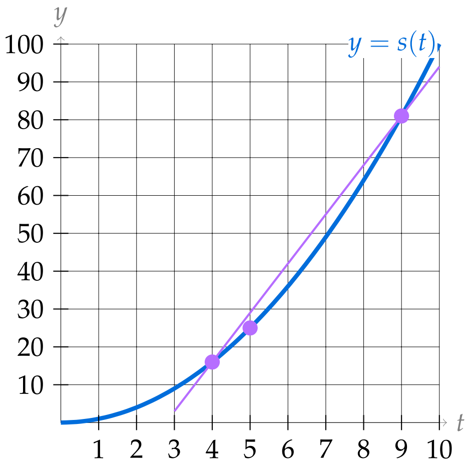
One way: Estimate the slope of the tangent line to the curve

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.



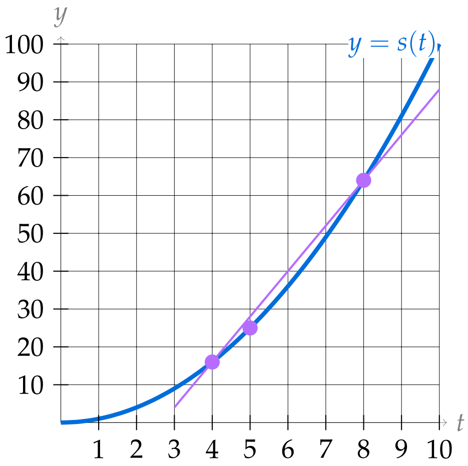
Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.



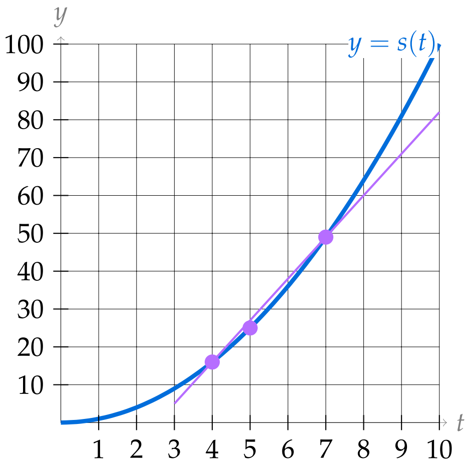
Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.



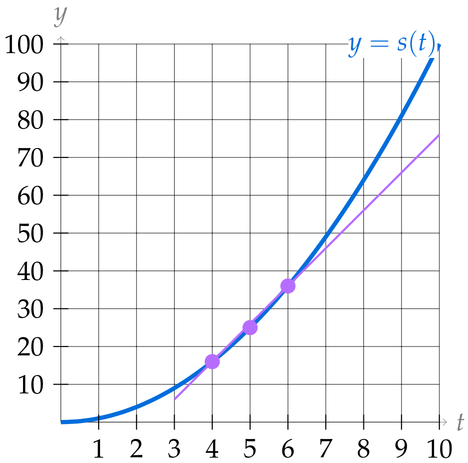
Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.



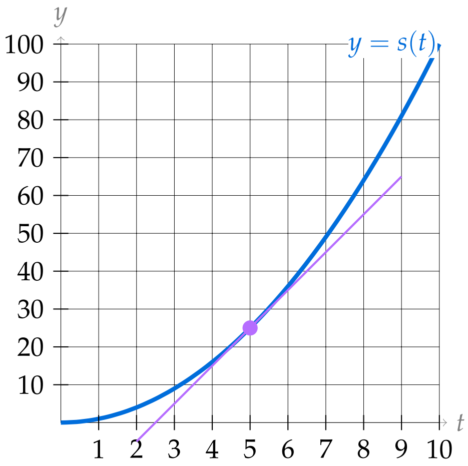
Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.



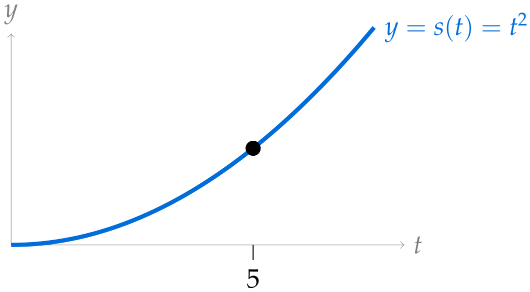
Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.

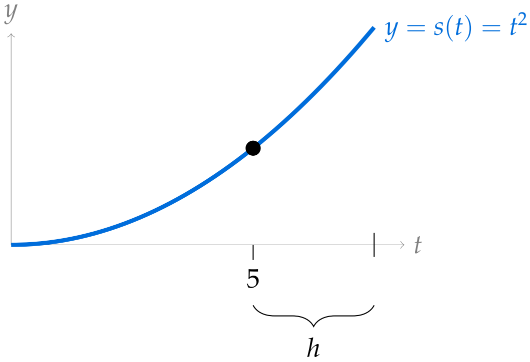


Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

Let's look for an algebraic way of determining the velocity of the balloon when $t = 5$.

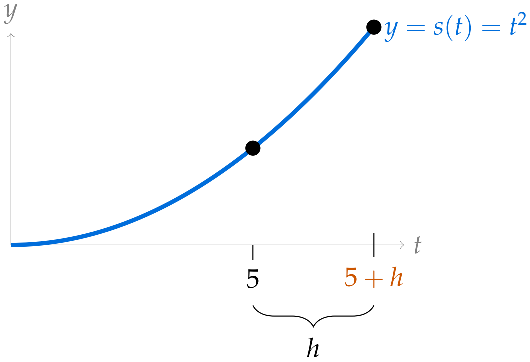


Suppose the interval $[5, \quad]$ has length h. What is the right endpoint of the interval?

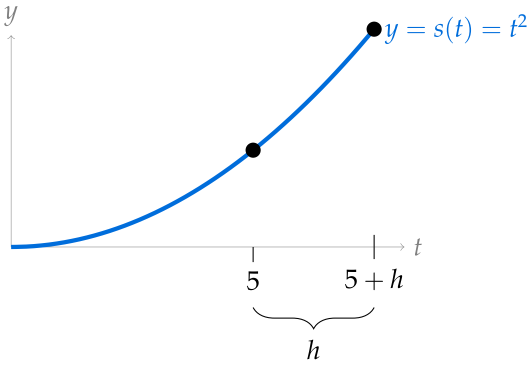


ans

Suppose the interval $[5, \quad]$ has length h. What is the right endpoint of the interval?

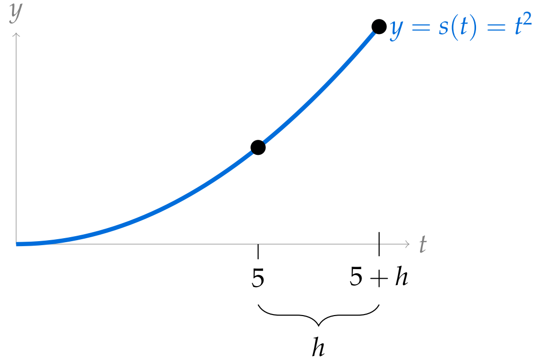


Write the equation for the average (vertical) velocity from $t = 5$ to $t = 5 + h$.



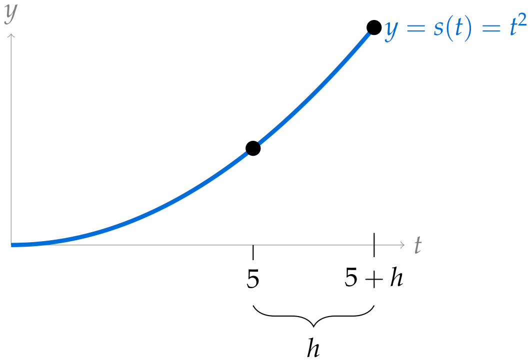
ans

Write the equation for the average (vertical) velocity from $t = 5$ to $t = 5 + h$.



$$\text{vel} = \frac{\Delta\text{ height}}{\Delta\text{ time}} = \frac{s(5+h) - s(5)}{(5+h) - 5} = \frac{(5+h)^2 - 5^2}{h}$$

What happens to the velocity when h is very, very small?



$$\text{vel} = \frac{\Delta \text{ height}}{\Delta \text{ time}} = \frac{s(5+h) - s(5)}{(5+h) - 5} = \frac{(5+h)^2 - 5^2}{h}$$

What happens to the velocity when h is very, very small?

$$\text{vel} = \frac{\Delta\text{ height}}{\Delta\text{ time}} = \frac{s(5+h)-s(5)}{(5+h)-5} = \frac{(5+h)^2-5^2}{h}$$

Q

ans

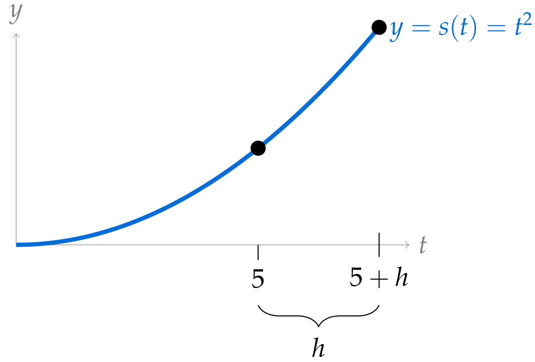
What happens to the velocity when h is very, very small?

$$\text{vel} = \frac{\Delta \text{ height}}{\Delta \text{ time}} = \frac{s(5+h) - s(5)}{(5+h) - 5} = \frac{(5+h)^2 - 5^2}{h}$$
$$= 10 + h \text{ when } h \neq 0$$

When h is very small,

$$\approx 10$$

What do you think is the slope of the <u>tangent</u> line to the graph when $t = 5$?



OUR FIRST LIMIT

Average Velocity, $t = 5$ to $t = 5 + h$:

$$\frac{\Delta s}{\Delta t} = \frac{s(5+h) - s(5)}{h}$$

Our First Limit

Average Velocity, $t = 5$ to $t = 5 + h$:

$$\frac{\Delta s}{\Delta t} = \frac{s(5+h) - s(5)}{h}$$
$$= \frac{(5+h)^2 - 5^2}{h}$$

Our First Limit

Average Velocity, $t = 5$ to $t = 5 + h$:

$$\begin{aligned}
\frac{\Delta s}{\Delta t} &= \frac{s(5+h) - s(5)}{h} \\
&= \frac{(5+h)^2 - 5^2}{h} \\
&= 10 + h \qquad \text{when } h \neq 0
\end{aligned}$$

Our First Limit

Average Velocity, $t = 5$ to $t = 5 + h$:

$$\begin{aligned}\frac{\Delta s}{\Delta t} &= \frac{s(5+h) - s(5)}{h} \\ &= \frac{(5+h)^2 - 5^2}{h} \\ &= 10 + h \qquad \text{when } h \neq 0\end{aligned}$$

When h is very small,

Our First Limit

Average Velocity, $t = 5$ to $t = 5 + h$:

$$\begin{aligned}\frac{\Delta s}{\Delta t} &= \frac{s(5+h) - s(5)}{h} \\ &= \frac{(5+h)^2 - 5^2}{h} \\ &= 10 + h \qquad \text{when } h \neq 0\end{aligned}$$

When h is very small,

$$\text{Vel} \approx 10$$

Limit Notation

We write:

$$\lim_{h\to 0}(10+h)=10$$

Limit Notation

We write:

$$\lim_{h \to 0}(10 + h) = 10$$

We say: "The limit as h goes to 0 of $(10 + h)$ is 10."

Limit Notation

We write:

$$\lim_{h \to 0} (10 + h) = 10$$

We say: “The limit as h goes to 0 of $(10 + h)$ is 10.”

It means: As h gets extremely close to 0, $(10 + h)$ gets extremely close to 10.

Included Work