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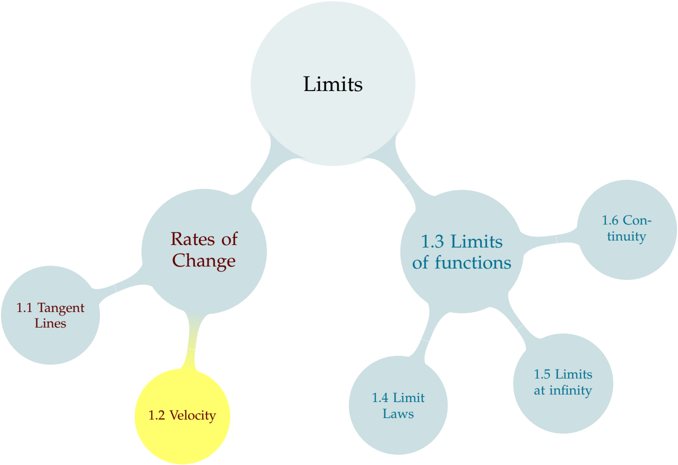
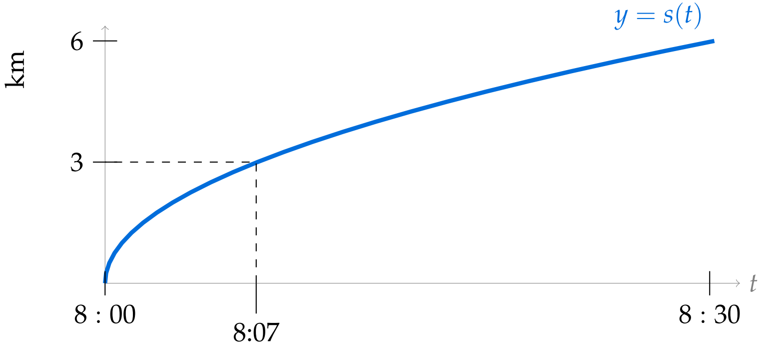



$y = s(t)$
km
6
3
t
8 : 00
8 : 30


$y = s(t)$
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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 $t = 8:30$

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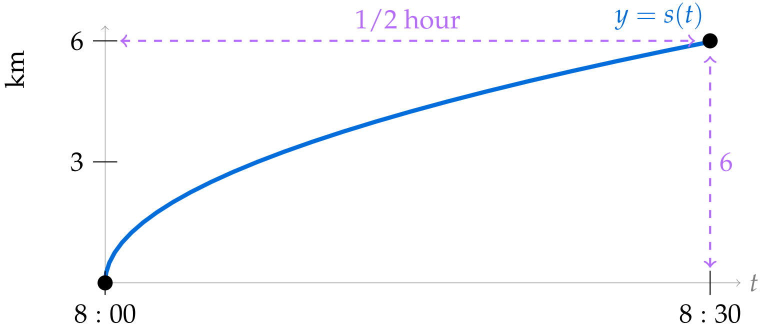

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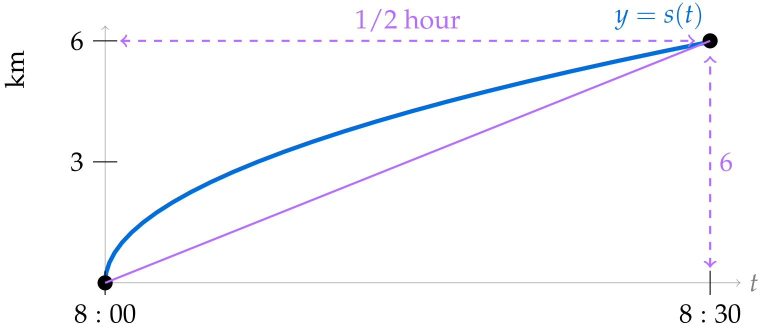

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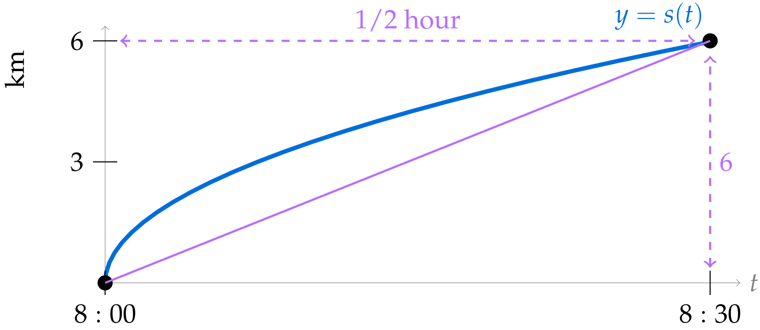

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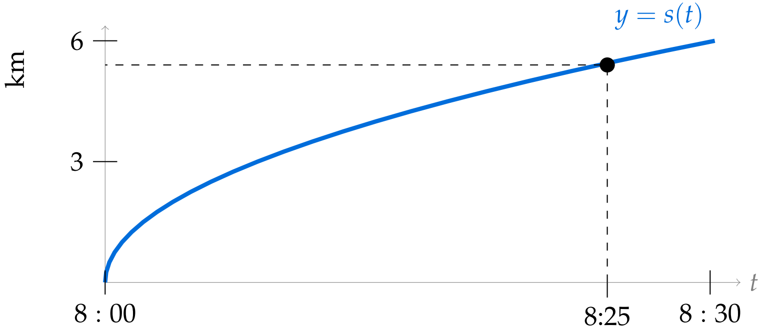

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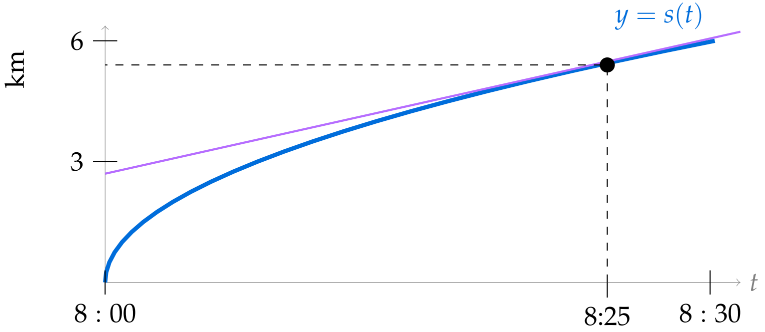

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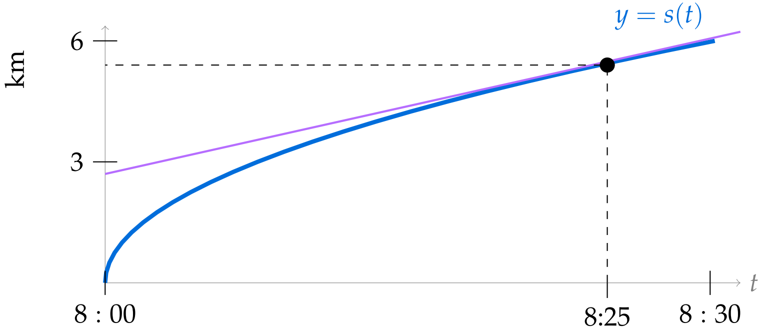

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Suppose the distance from the ground s (in meters) of a helium-filled balloon at time t over a 10-second interval is given by $s(t) = t^2$. Try to estimate how fast the balloon is rising when $t = 5$.

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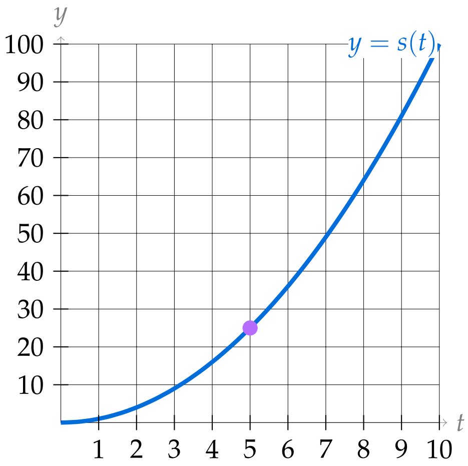

One way: Estimate the slope of the tangent line to the curve

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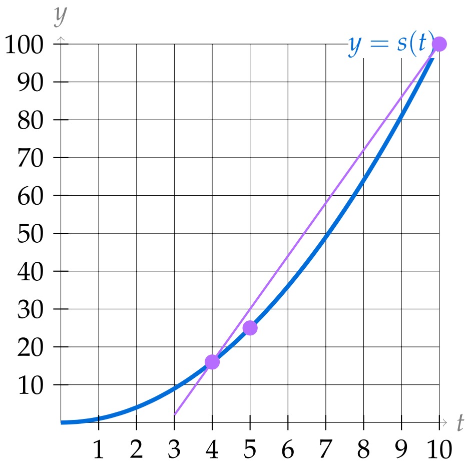

Another way: Calculate average rate of change for intervals around 5 that get smaller and smaller.

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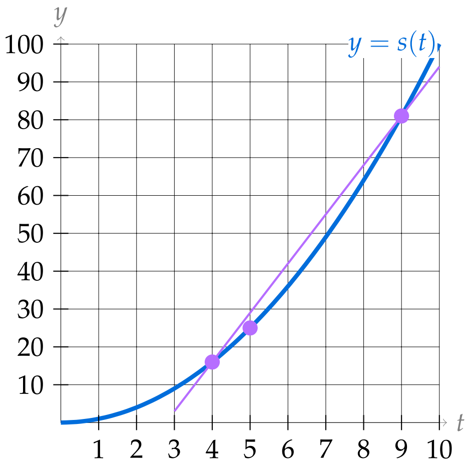

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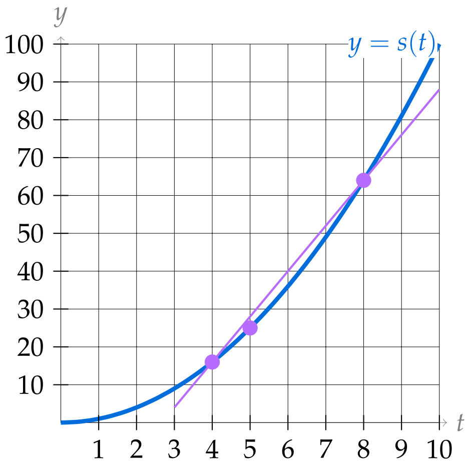

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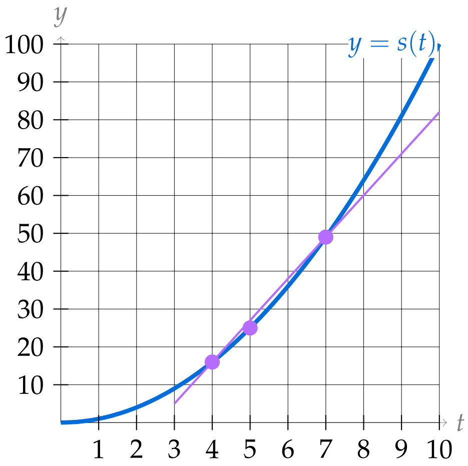

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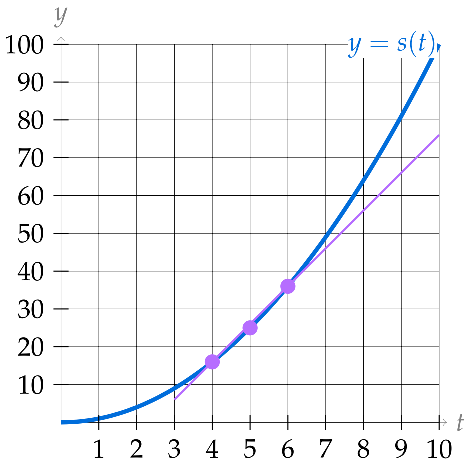

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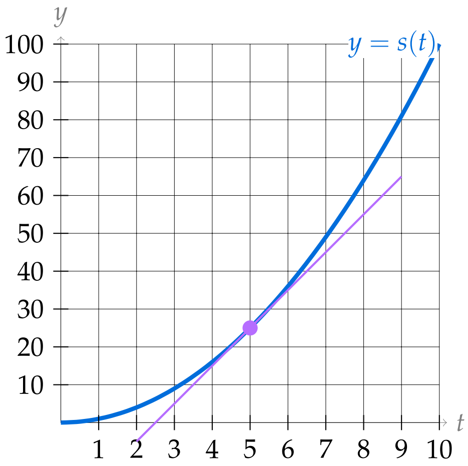

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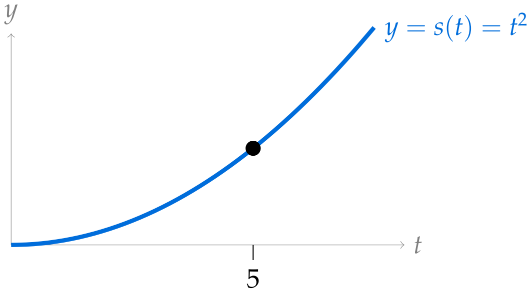
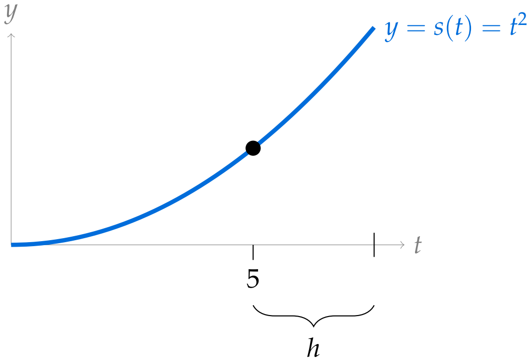
Let's look for an algebraic way of determining the velocity of the balloon when $t = 5$.



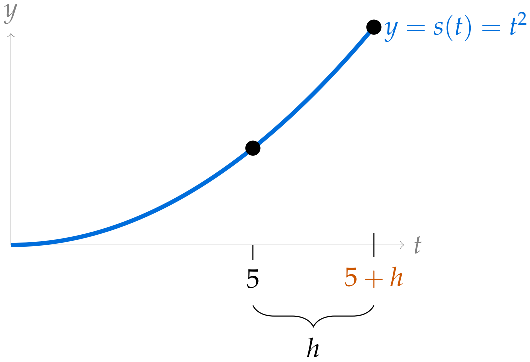
Suppose the interval $[5, \quad]$ has length h. What is the right endpoint of the interval?



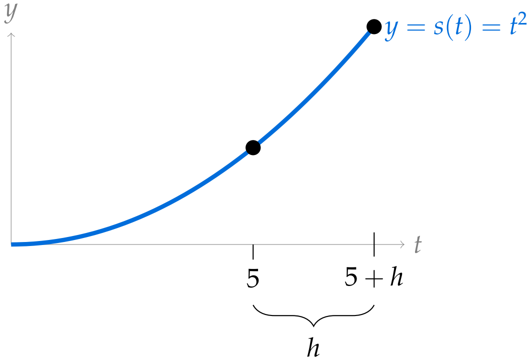
Q

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 $t = 5 + h$.



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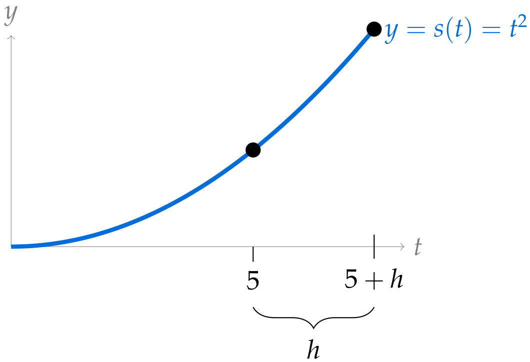
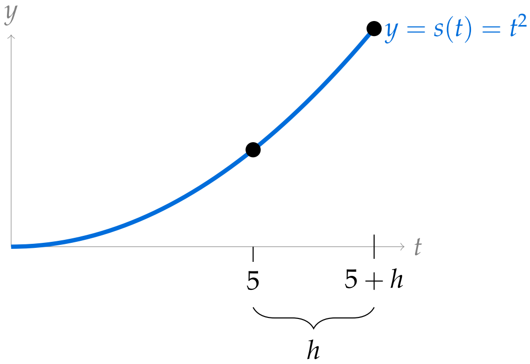


$$\text{vel} = \frac{\Delta\ \text{height}}{\Delta\ \text{time}} = \frac{s(5+h) - s(5)}{(5+h) - 5} = \frac{(5+h)^2 - 5^2}{h}$$

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



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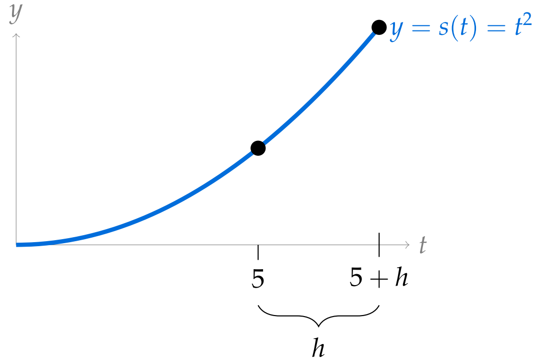
$$= 10 + h \text{ when } h \neq 0$$

When h is very small,

$$\approx 10$$

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



Our First Limit

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

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Limit Notation

We write:

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

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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

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