Christopher, Aaron, and Andre, planning a big SI fundraiser, build a 60 meter high-dive platform in the middle of the field. After charging admission for prime bleacher seats, they then “persuade” Mr Murphy to be the first high diver.

Janessa observes Mr Murphy’s “dive” closely enough to form an equation for his height. She finds the equation to be given by:

$$h(t) = 60 - 4.9t^2$$

and the graph is given by...

How can we find Mr. Murphy's velocity at 1 second?

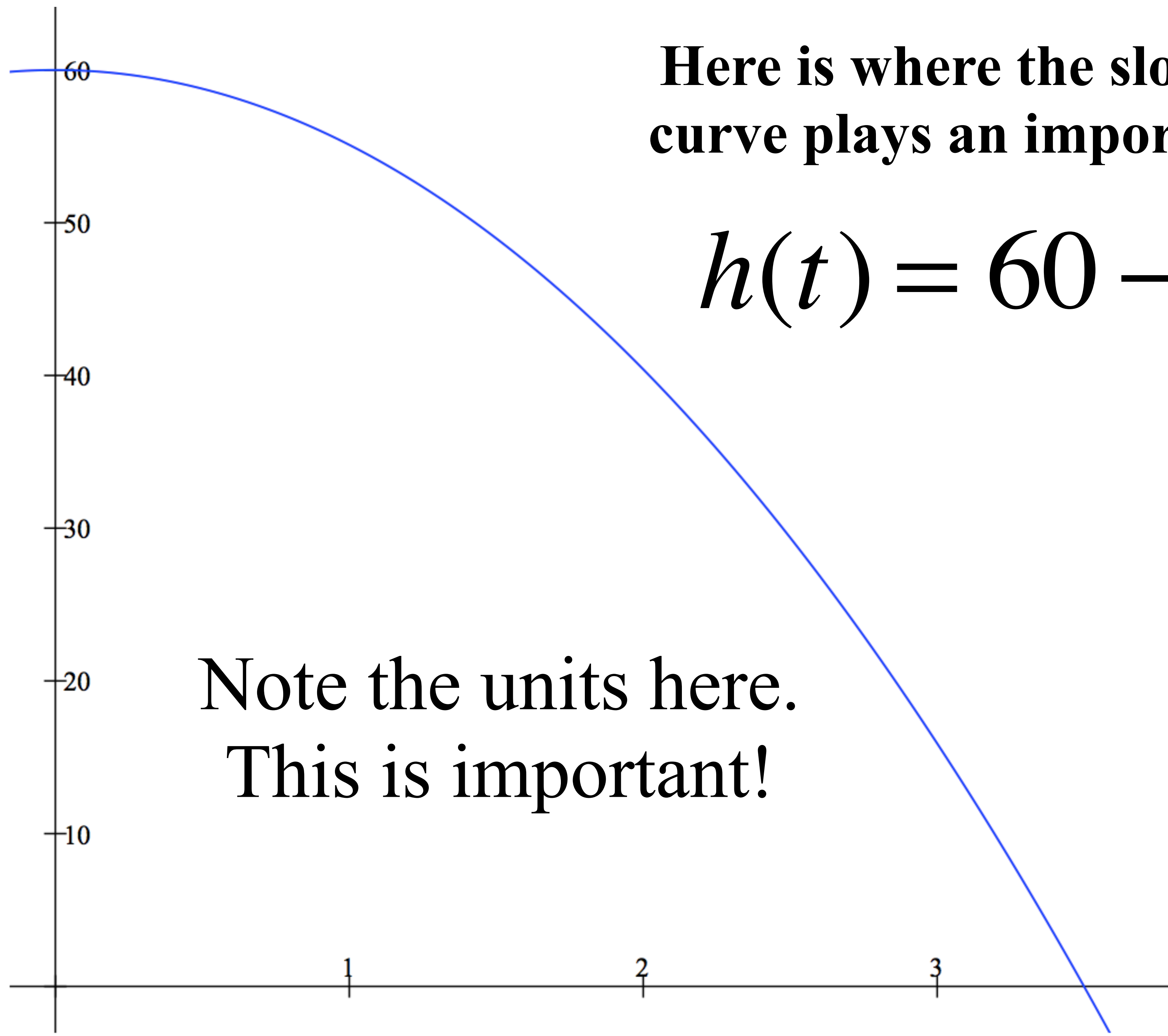
at 2 seconds?

when he hits the water?

Here is where the slope of the curve plays an important role.

$$h(t) = 60 - 4.9t^2$$

$h(t)$ where h represents height off of the ground in meters

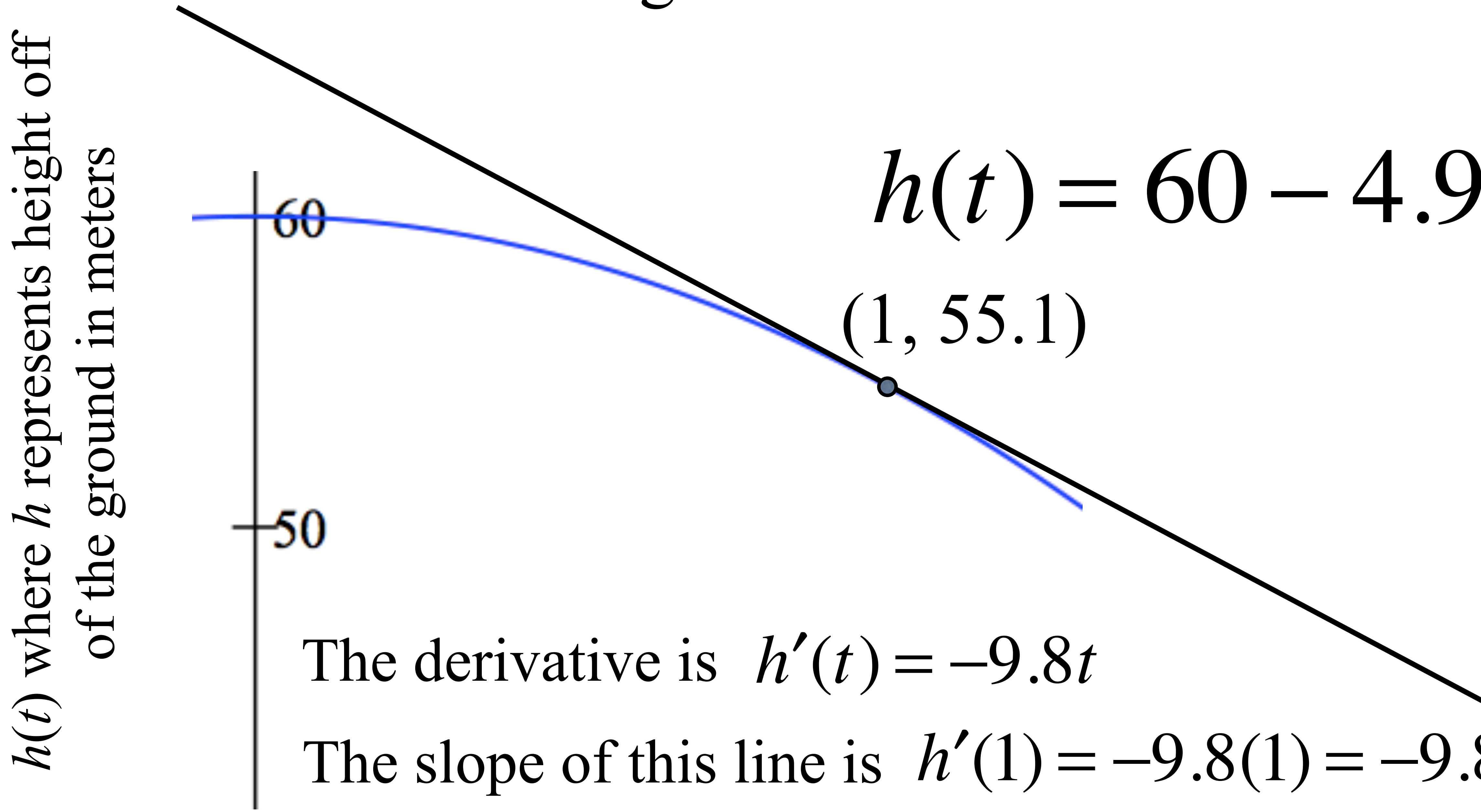


Note the units here. This is important!

t = time in seconds

Remember that we can now find the slope of this curve at any point using the derivative

Let's draw the tangent line at $t = 1$ second



$$h(t) = 60 - 4.9t^2$$

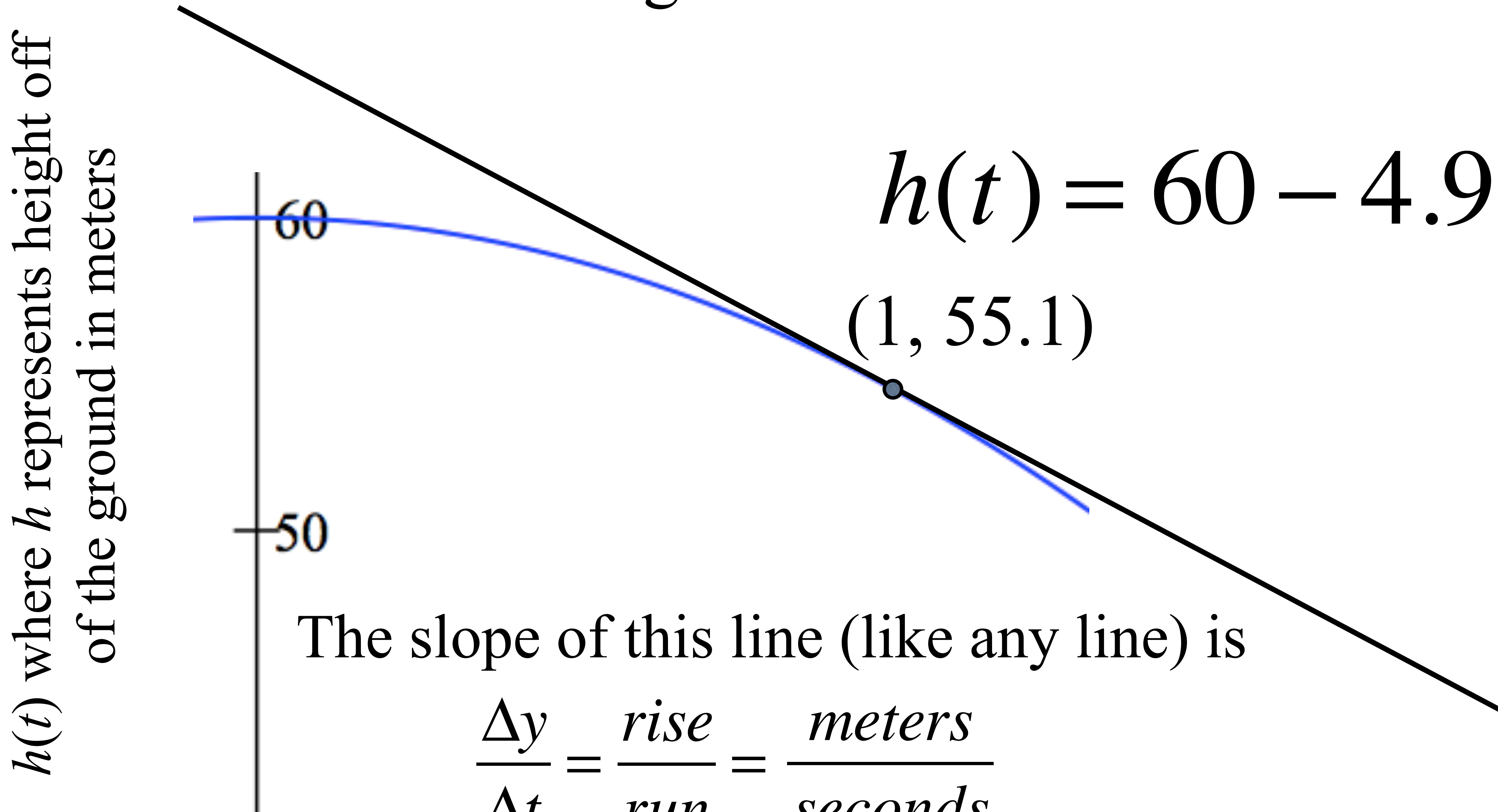
The derivative is $h'(t) = -9.8t$

The slope of this line is $h'(1) = -9.8(1) = -9.8$

Remember that we can now find the slope of this curve at any point using the derivative

Let's draw the tangent line at t = 1 second

$$h(t) = 60 - 4.9t^2$$



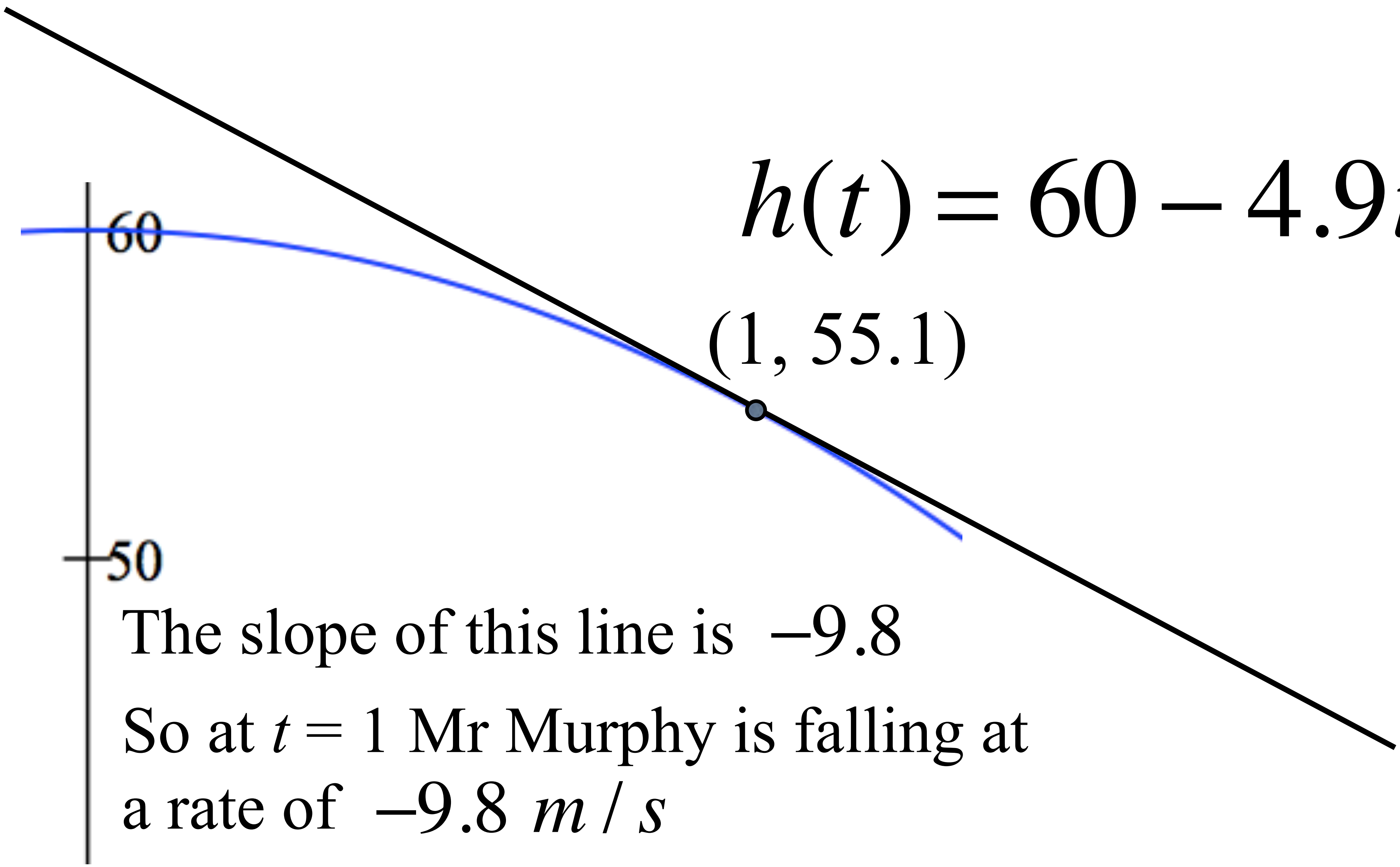
The slope of this line (like any line) is

$$\frac{\Delta y}{\Delta t} = \frac{rise}{run} = \frac{meters}{seconds}$$

t = time in seconds

$\frac{meters}{seconds}$ or meters per second are the units for **Velocity!!!**

$$h(t) = 60 - 4.9t^2$$



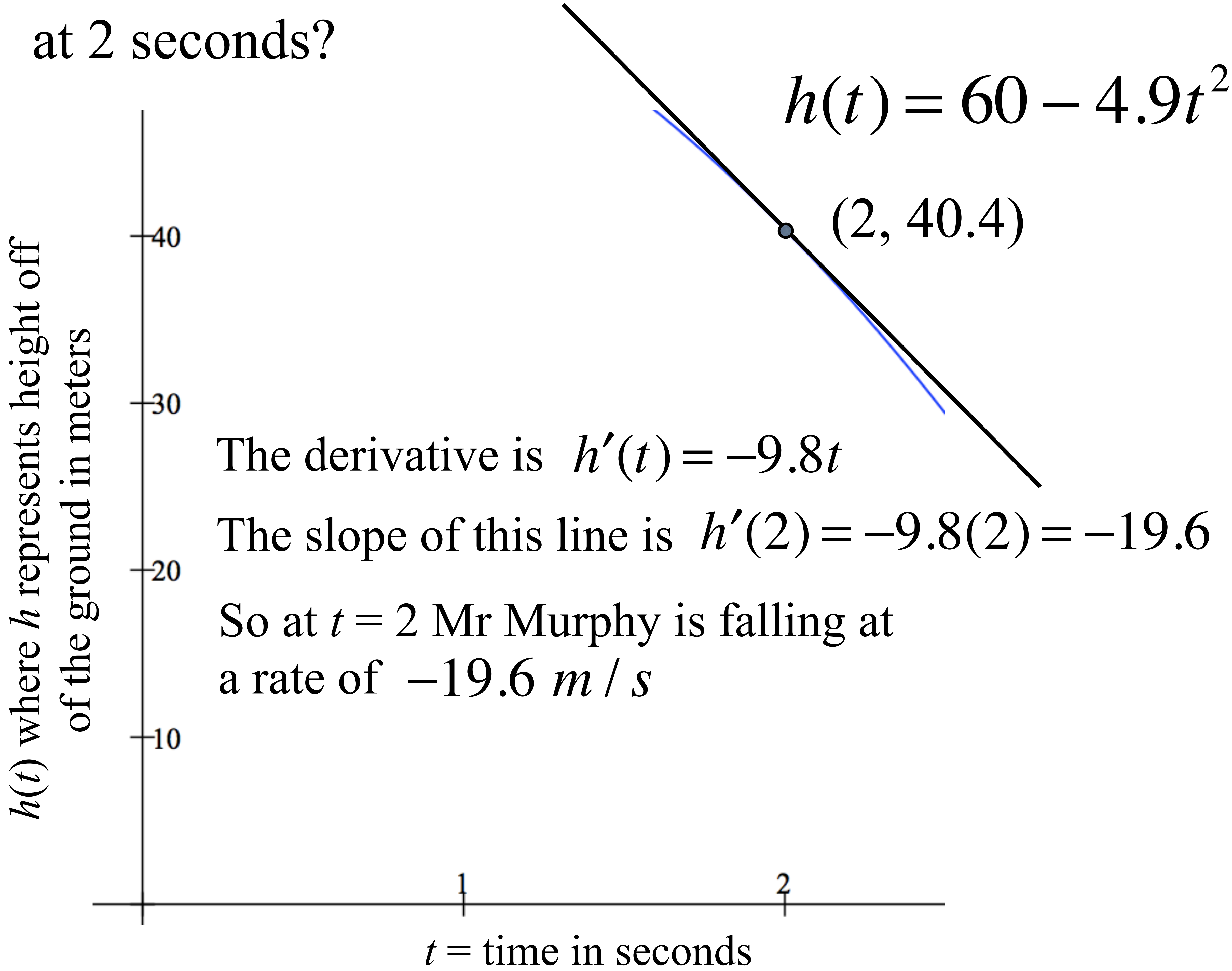
The slope of this line is -9.8

So at $t = 1$ Mr Murphy is falling at a rate of $-9.8\ m/s$

$h(t)$ where h represents height off of the ground in meters

t = time in seconds

at 2 seconds?



The derivative is $h'(t) = -9.8t$

The slope of this line is $h'(2) = -9.8(2) = -19.6$

So at $t = 2$ Mr Murphy is falling at a rate of $-19.6\ m/s$

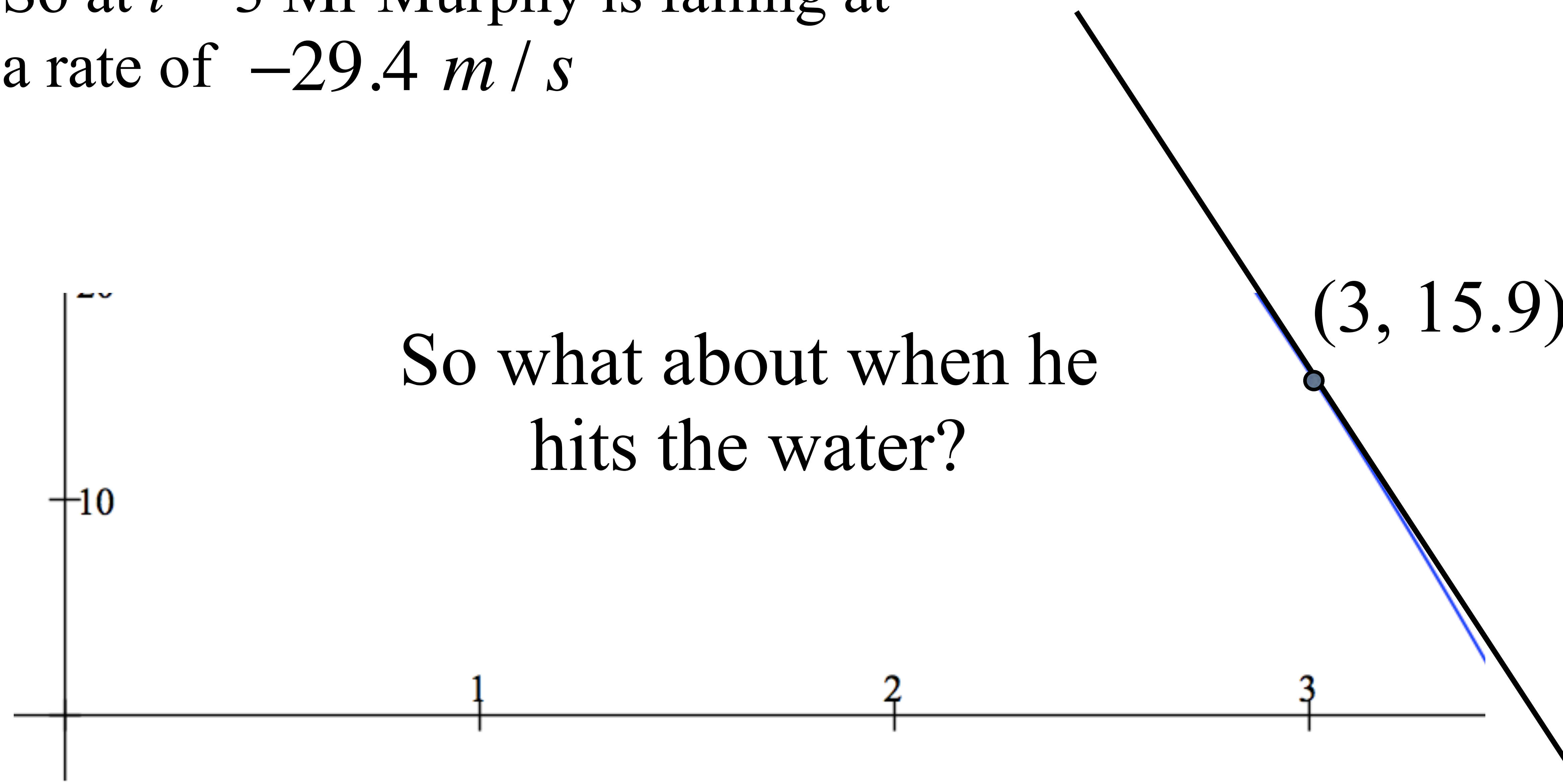
at 3 seconds?

$$h(t) = 60 - 4.9t^2$$

The derivative is $h'(t) = -9.8t$

The slope of this line is $h'(3) = -9.8(3) = -29.4$

So at $t = 3$ Mr Murphy is falling at a rate of $-29.4\ m/s$



So what about when he hits the water?

So the lesson here is:

Velocity is the first derivative of position

$$\frac{meters}{seconds}$$

$$h'(t) = v(t)$$

What about the second derivative? (Hint: What are the units on a velocity graph?)

Acceleration is the second derivative of position

$$\frac{meters}{(seconds)^2}$$

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