

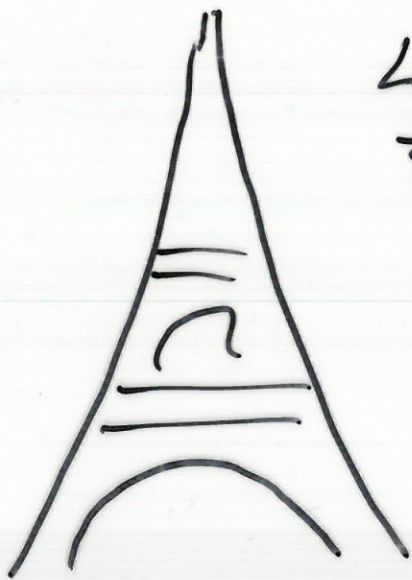
# Calculus

## Topics

- 1) Functions & Continuity
- 2) Rates of change
- 3) Differential Equations

Test: Stewart's "Calculus"

Quick Introduction to (1) & (2)



La Tour  
Eiffel

↓ Stone falls  
 $y$  metres  
in  $t$  seconds

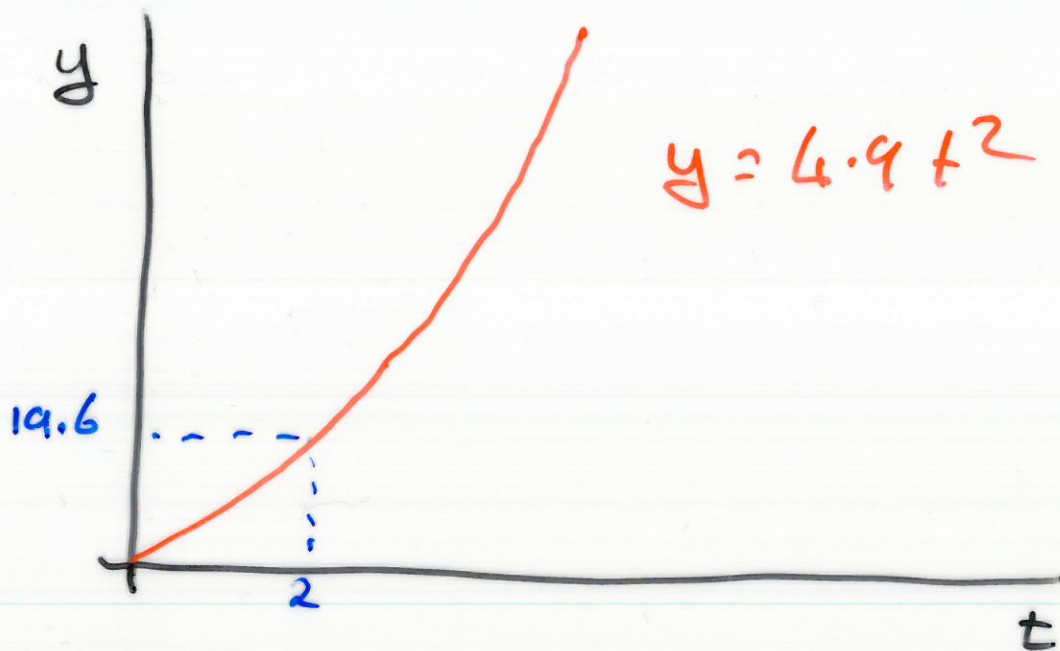
Experiments suggest

$$y = 4.9t^2$$

We'll say that  $y$  is a function  
of  $t$ . This means:

For each value of  $t$  there is one corresponding value of  $y$ .

Functions are represented by their graph



Question What is the average speed of the stone between  $t=2$  and  $t=3$  secs?

Soln

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time}}$$

$$= \frac{y(3) - y(2)}{1}$$

$$= \frac{4.9(9 - 4)}{1}$$

$$= 24.5 \text{ m/sec.}$$

Question what is the speed at time  $t = 2$ ?

Soln  
The speed at time  $t = 2$  is

$$v(2) = \lim_{h \rightarrow 0} \frac{y(2+h) - y(2)}{h}$$

$$v(2) = \lim_{h \rightarrow 0} \frac{4.9(2+h)^2 - 4.9(2)^2}{h}$$

$$v(2) = \lim_{h \rightarrow 0} 4.9 \left( \frac{4 + 4h + h^2 - 4}{h} \right)$$

$$v(2) = \lim_{h \rightarrow 0} 4.9 \left( \frac{(4+h)h}{h} \right)$$

$$v(2) = \lim_{h \rightarrow 0} 4.9(4+h)$$

$$v(2) = 19.6 \text{ m/sec.}$$