

2.1 The derivative definition

Obj: define the derivative of a function and all the notations; calculate derivatives and the slope of the tangent

What is differential calculus?

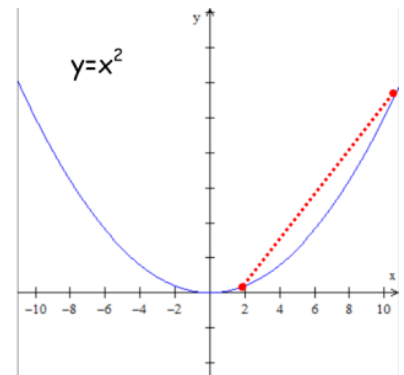
500 bacteria were present at 12 noon. 1000 were counted 4 hours later at 4pm. What is the average rate of change? Use the correct unit of measure.

You drive 500 miles on the autobahn in 4 hours. What was your average speed?

Finding the average rate of change.

Slope of the secant line:

Find the slope of the secant line between in the following intervals:



Could you estimate the exact slope at $x=2$?

Slope of the tangent line is the instantaneous slope at any point along the curve.

Formula:

Definition: If f is defined on the open interval containing a and the limit exists, then the line _____ is the tangent to f at $x=a$. POINT SLOPE FORMULA
Where m is from the derivative!

Example 1. Find the slope of the tangent to f at $x=4$ at $f(x)=x^2+1$

Now write the equation of the tangent line.

You try. Find the slope of the tangent to f at $x=2$ at $f(x)=\sqrt{x-1}$

Now write the equation of the tangent line.

Example 2. Find the equation of the tangent line to the curve at the given point. Also, find an equation for the "normal" line to the graph at the same point.

$$f(x) = \frac{1}{x} \text{ at } x = 2$$

Derivative Notations.

Estimate the instantaneous slope (derivative) from data. Always part of a free response question.

2005 AB3/BC3

Distance x (cm)	0	1	5	6	8
Temperature $T(x)$ ($^{\circ}\text{C}$)	100	93	70	62	55

A metal wire of length 8 centimeters (cm) is heated at one end. The table above gives selected values of the temperature $T(x)$ in degrees Celsius ($^{\circ}\text{C}$), of the wire x cm from the heated end. The function T is decreasing and twice differentiable.

- (a) Estimate $T'(7)$. Show the work that leads to your answer. Indicate units of measure.

You try.

t (minutes)	0	2	5	9	10
$H(t)$ (degrees Celsius)	66	60	52	44	43

As a pot of tea cools, the temperature of the tea is modeled by a differentiable function H for $0 \leq t \leq 10$, where time t is measured in minutes and temperature $H(t)$ is measured in degrees Celsius. Values of $H(t)$ at selected values of time t are shown in the table above.

- (a) Use the data in the table to approximate the rate at which the temperature of the tea is changing at time $t = 3.5$. Show the computations that lead to your answer.

Definition of the derivative as a function.

What is it?

Formula:

Find the derivative of $f(x) = x^2 - 4$

What is Differentiation?

Differentiate: $f(x) = 2x^2 + 5x - 17$

You try: $f(x) = \frac{1}{x}$

Now try it in reverse...What was the original function.

$$\lim_{x \rightarrow h} \frac{(x+h)^2 - 2(x+h) + 3 - x^2 + 2x - 3}{h}$$

$$\lim_{x \rightarrow h} \frac{\cos(x+h) - \cos x}{h}$$

$$\lim_{x \rightarrow h} \frac{\tan\left(\frac{\pi}{3} + h\right) - \sqrt{3}}{h}$$

Alternate form of the derivative: