Warm-up

(1) Find the slope between (-2,5) and (-7,12).

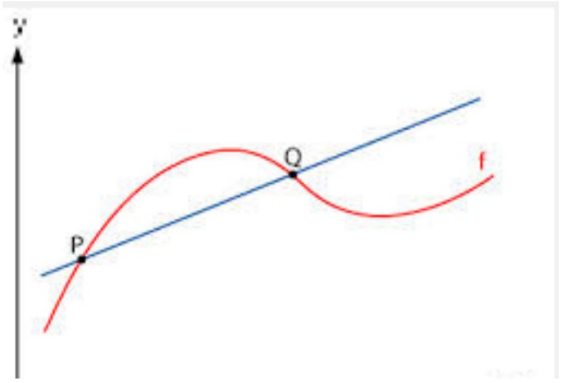
(2) Write the equation of a line in point-slope form that goes through the coordinate in #1.

(3) Write the equation in slope-intercept form that is perpendicular to the points in #1 and goes through the coordinate (10,-4).

Definition of a Derivative

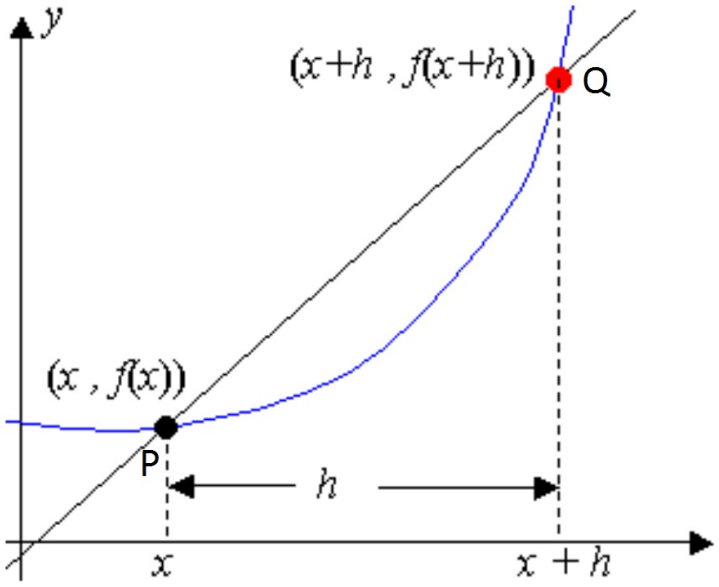
Objective:
-Find the derivative of a function
-Determine the qualifications for differentiability

A line through two points on a curve is called a *secant to the curve* or secant line.

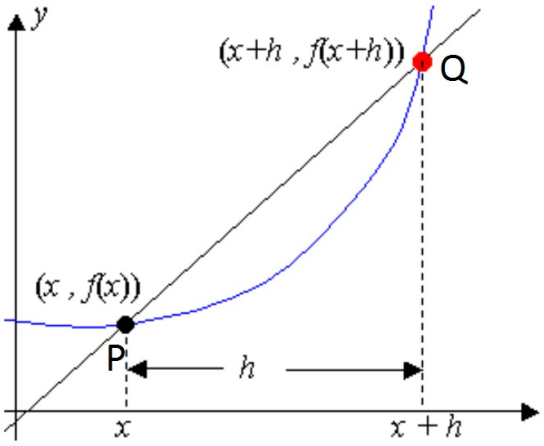


The average rate of change is also the slope of the secant line through two points.

Find the slope between P and Q.



What would the slope be just a point P?
(a line tangent to the curve a P)



If we move Q closer and closer to P by making h become smaller and smaller, we get....

2.6 Slope of a Tangent Line
The formula for the slope of the tangent line to y = f(x) at the point (a, f(a)) is

$$m = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

$$m = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

We can generalize this formula for all possible values of x!

push me

Definition of **Derivative**

f prime

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

the derivative of f

y_2 y_1

$x_2 - x_1$

If f'(x) exists, we say that f has a derivative or is differentiable.

A function is differentiable at $x = c$, if:

(1) The function is continuous at $x = c$

$$\lim_{x \to c} f(x) = f(c)$$

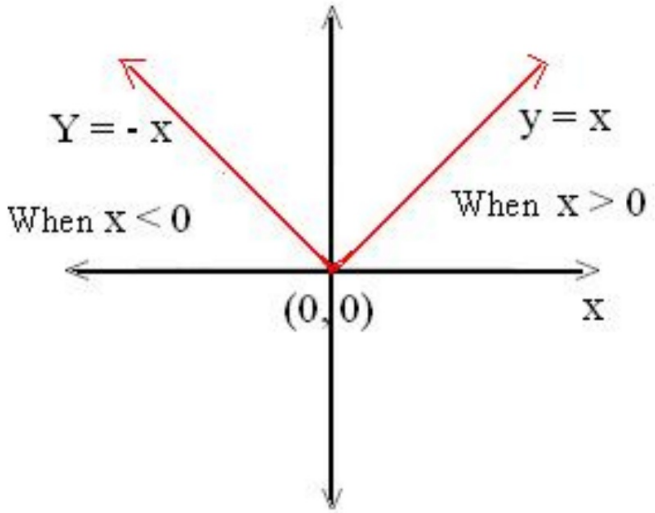
AND

(2) $\lim_{x \to c^-} f'(x) = \lim_{x \to c^+} f'(x)$

When is a function NOT differentiable?

1. a *corner* where the one-sided derivatives differ.

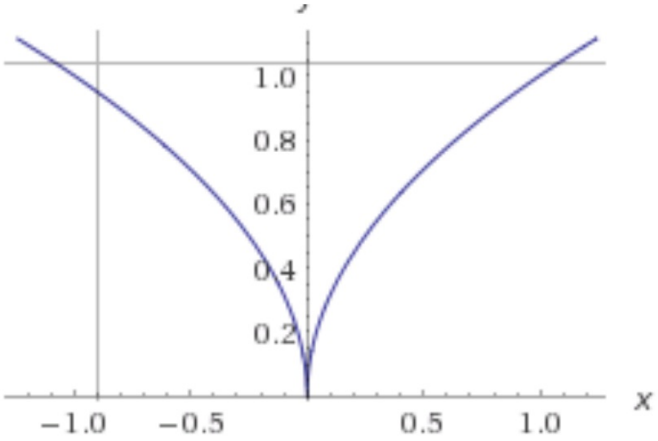
Ex: f(x) = |x|



When is a function NOT differentiable?

2. a *cusp*, an extreme case of a corner

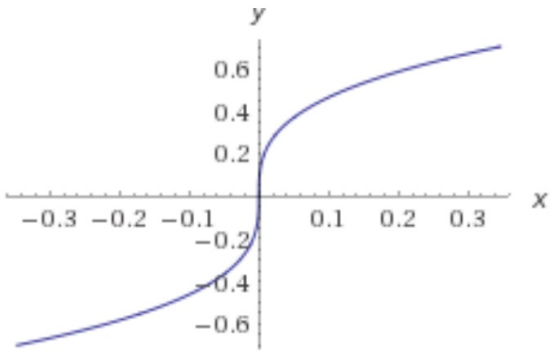
Ex: $f(x) = \sqrt{|x|}$



When is a function NOT differentiable?

3. a *vertical tangent line*, where the slope of the secant line approaches either ∞ or -∞ from both sides

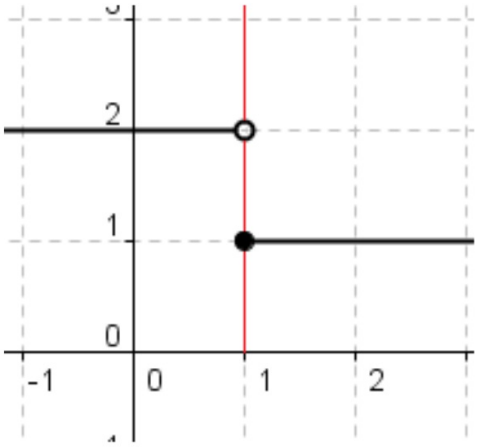
Ex: $f(x) = \sqrt[3]{x}$



When is a function NOT differentiable?

4. a *discontinuity*, either one or both sides of the one-sided derivatives is non-existent

Ex:



Notation symbol	you say:	it means:
y'	"y prime"	nice and brief doesn't always mean independent variable
$\frac{dy}{dx}$	"dy dx" or "derivative of y with respect to x"	names both variables and used d for derivative
$\frac{d}{dx} f(x)$	"d dx of f at x"	emphasizes the idea that differentiation is an operation performed on *f*

$f(x) = 3x - 2$

$f(x) = x^2 - x$

$f(x) = x^3 + 6$

Find the slope of the tangent line of $f(x) = x^2 + 2x$ when $x = 3$.

$$f(x) = \frac{2}{x-3}$$

$$f(x) = \sqrt{x-1}$$