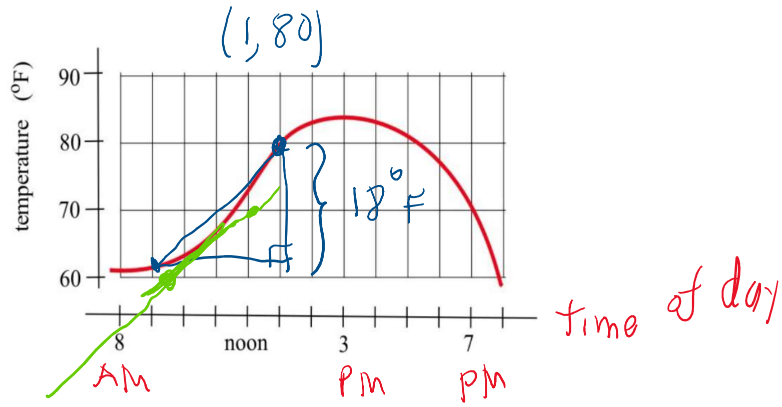
02-05-26 MTH 261

Section 2: The Derivative
page 92: 1, 5, 7, 11, 13, 15, 19, 21, 25

Section 3: Power and Sum Rules for Derivatives
page 105: 1, 3, 7, 9, 11, 12

2.2: 5

5. The graph to the right shows the temperature during a day in Ames.
   (a) What was the average change in temperature from 9 am to 1 pm?
   (b) Estimate how fast the temperature was rising **at** 10 am and **at** 7 pm?



slope =?

(9, 62)

$\underbrace{\qquad}_{4\text{ hr}}$

(a) $\frac{\Delta \text{Temp}}{\Delta \text{time}} \approx \frac{18^\circ}{4\text{ hr}} = \frac{9^\circ F}{2\text{ hr}} = \boxed{\frac{4.5^\circ F}{\text{hr}}}$

(b) slope at 10 AM

$\approx \frac{70^\circ - 60^\circ}{2.5\text{ hr}} = \frac{10^\circ F}{2.5\text{ hr}} = \boxed{\frac{4^\circ F}{\text{hr}}}$

10/2.5=4

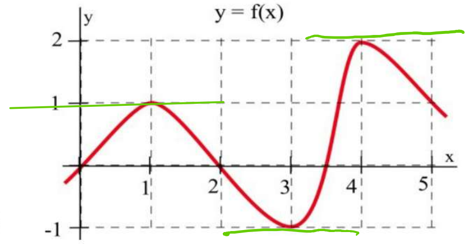
2.2

2.2: 12

12. (a) At what values of x does the graph of f in the graph have a horizontal tangent line?

(b) At what value(s) of x is the value of f the largest? smallest? (local or global?)

(c) Sketch the graph of m(x) = the slope of the line tangent to the graph of f at the point (x,y).



(a) $x = 1, 3, 4$

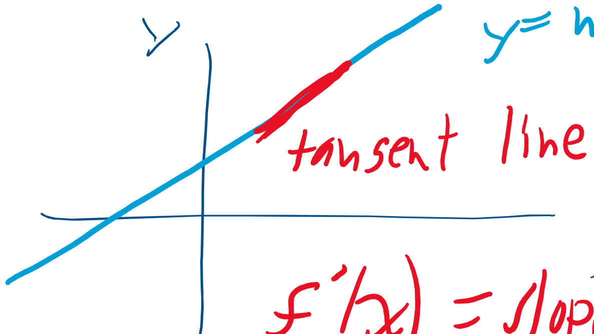
Example 1

Find the derivative of $y = f(x) = mx + b$

This is a linear function, so its graph is its own tangent line! The slope of the tangent line, the derivative, is the slope of the line: $f'(x) = m$

memorize

Rule: The derivative of a linear function is its slope



$y = mx + b = f(x)$

$f'(x) =$ slope of tan line at x

$= m$

Your name MTH 261 Quiz 2

Let $f(x) = mx + b$

use limit of difference quotient to find $f'(x)$

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

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$$\frac{\Delta f}{\Delta x} = \frac{f(x+h) - f(x)}{h}$$

$$= \frac{[m(x+h)+b] - [mx+b]}{h}$$

$$= \frac{\cancel{mx} + mh + \cancel{b} - \cancel{mx} - \cancel{b}}{h}$$

$$= \frac{m\cancel{h}}{\cancel{h}}$$

$$\boxed{\frac{\Delta f}{\Delta x} = m}$$

$$f'(x) = \lim_{h \to 0} m = \boxed{m}$$

memorize

Rule: The derivative of a constant is zero

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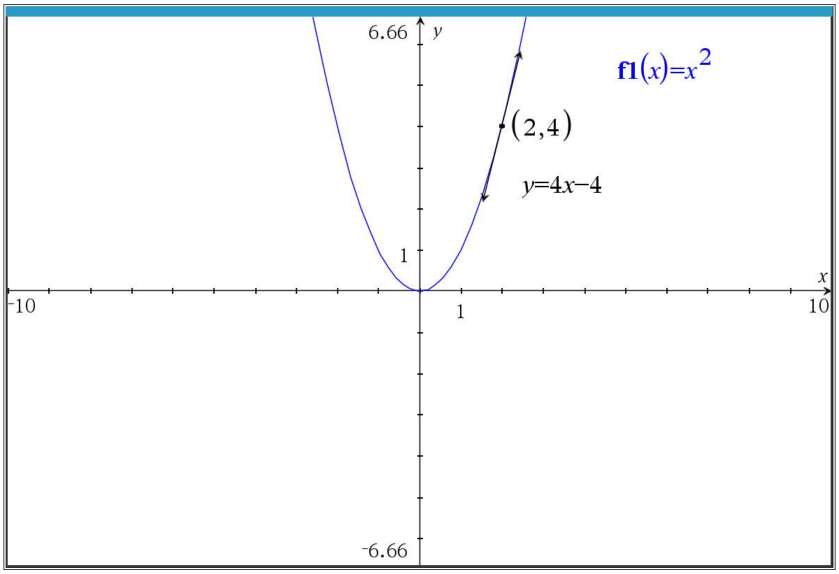
TI-Nspire found drew and found the equation of the tangent line at x =2



TI-84: 2nd Draw + tan + enter 2

Memorize

Power Rule: The derivative $f(x) = x^n$ is $f'(x) = nx^{n-1}$

$f(x) = x^2$

$\Rightarrow f'(x) = 2x^{2-1} = 2x^1 = 2x$

$f(x) = x^{10}$

$\Rightarrow f'(x) = 10x^9$

$f'(x) = \frac{df}{dx} = \frac{dy}{dx}$

memorize

Derivative Rules: Building Blocks

In what follows, f and g are differentiable functions of x.

(a) **Constant Multiple Rule:** $\frac{d}{dx}(kf) = kf'$

(b) **Sum (or Difference) Rule:** $\frac{d}{dx}(f+g) = f' + g'$ **(or** $\frac{d}{dx}(f-g) = f' - g'$**)**

(c) **Power Rule:** $\frac{d}{dx}(x^n) = nx^{n-1}$

Special cases: $\frac{d}{dx}(k) = 0$ (because $k = kx^0$)

memorize

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Special cases: $\frac{d}{dx}(k) = 0$ (because $k = kx^0$)

$\frac{d}{dx}(x) = 1$ (because $x = x^1$)

(d) **Exponential Functions:** $\frac{d}{dx}(e^x) = e^x$

$\frac{d}{dx}(a^x) = \ln a \cdot a^x$

(e) **Natural Logarithm:** $\frac{d}{dx}(\ln x) = \frac{1}{x}$

$f(x) = 3x^2 - 5x + 4$

$f'(x) = \frac{df}{dx} = \frac{d}{dx}(3x^2 - 5x + 4)$

$= \frac{d}{dx}(3x^2) + \frac{d}{dx}(-5x) + \frac{d}{dx}(4)$ [sum rule]

$= 3\frac{d}{dx}(x^2) - 5\frac{d}{dx}(x) + \frac{d}{dx}(4)$ [constant multiple rule]

$= (3)(2x) - 5(1) + 0$ [deriv of constant $= 0$]

$$\boxed{f'(x) = 6x - 5}$$

Let $y = f(x)$

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$$\frac{df}{dx} = \frac{dy}{dx} = f'(x) = y'(x)$$

$$\frac{d}{dx}\left(f(x)\right)$$