Opener

If f is a differentiable function, then $f'(a)$ is given by which of the following?

I. $\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}$

II. $\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$

III. $\lim_{x\to a}\frac{f(x+h)-f(x)}{h}$

(A) I only (B) II only (C) I and II only (D) I and III only (E) I, II, and III

Oct 4-8:17 AM

Show that the derivative of $\frac{1}{3x^2}$ is $-\frac{2}{3x^3}$

Jan 10-6:57 PM

Show that the derivative of $5x^2-10x$ is $10x-10$

Jan 10-7:01 PM

Who thinks they know the shortcut for finding derivatives?

$8x^2$ $16x$

$12x^5$ $60x^4$

$4x^2-3x$ $8x-3$

$\frac{5}{x}=5x^{-1}$ $-\frac{5}{x^2}$

Jan 10-7:08 PM

3-3 Rules for Differentiation

Learning Objectives:

I can use the Power Rule to find derivatives.

I can use the product and quotient rule to find derivatives.

I can find second and higher order derivatives.

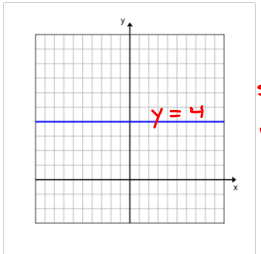
Sep 21-12:38 PM

Derivatives of a Constant Function

$f(x)=c$

$f'(x)=0$

$f(x)=4$



slope of any horizontal line is always 0

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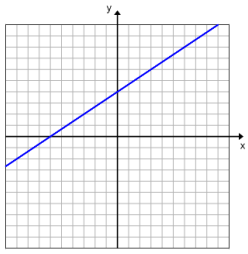
Derivatives of a Linear Function

f(x) = mx + b
= 2x + 3

f'(x) = m
= 2



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Power Rule

$f(x) = x^n$ $\quad f(x) = 8x^5$

$f'(x) = n \cdot x^{n-1}$ $\quad f'(x) = 40x^4$

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Ex1. Find the derivative of the following functions

1.) $y = x^8$
$y' = 8x^7$

2.) $y = 4x^5$
$y' = 20x^4$

3.) $g(x) = 4x^3 + 6x^2 - 5x + 8$
$g'(x) = 12x^2 + 12x - 5$

4.) $f(x) = \sqrt{x} = x^{1/2}$
$f'(x) = \frac{1}{2}x^{-1/2} = \frac{1}{2\sqrt{x}}$

5.) $f(x) = \frac{3}{x^2} = 3x^{-2}$
$f'(x) = \frac{-6}{x^3}$

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Ex2. Does the function have any horizontal tangent lines? If so, where are they?

$g(x) = \frac{1}{3}x^3 + \frac{1}{2}x^2 - 6x + 8$

$g'(x) = x^2 + x - 6$

Slope formula

$x^2 + x - 6 = 0$
$(x+3)(x-2) = 0$
$-3, 2$

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The Product Rule

$$h(x) = f(x) \cdot g(x)$$

$$h'(x) = f' \cdot g + f \cdot g'$$

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Ex3. Find the derivative of the following functions

1.) $f(x) = (2x+3)(x^2+5x-7)$

$f(x) = 2x+3$ $\quad g(x) = x^2+5x-7$
$f'(x) = 2$ $\quad g'(x) = 2x+5$

$(2x+3)(2x+5) + 2(x^2+5x-7)$
$4x^2 + 16x + 15 + 2x^2 + 10x - 14$
$= 6x^2 + 26x + 1$

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Oct 7-10:50 AM

2.) $y=(3x+8)\left(\frac{2}{x}-\sqrt{x}-5\right)$

$f(x)=3x+8$ $\quad g(x)=\frac{2}{x}-\sqrt{x}-5=2x^{-1}-x^{1/2}-5$

$f'(x)=3$ $\quad g'(x)=-2x^{-2}-\frac{1}{2}x^{-1/2}$

$=-\frac{2}{x^2}-\frac{1}{2\sqrt{x}}$

$y'=(3x+8)\left(-\frac{2}{x^2}-\frac{1}{2\sqrt{x}}\right)+3\left(\frac{2}{x}-\sqrt{x}-5\right)$

$y'=-\frac{6x}{x^2}-\frac{3x}{2\sqrt{x}}-\frac{16}{x^2}-\frac{8}{2\sqrt{x}}+\frac{6}{x}-3\sqrt{x}-15$

$y'=-\frac{3\sqrt{x}}{2}-\frac{16}{x^2}-\frac{4}{\sqrt{x}}-3\sqrt{x}-15$

$=-4.5\sqrt{x}-\frac{16}{x^2}-\frac{4}{\sqrt{x}}-15$

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The Quotient Rule

$$h(x)=\frac{f(x)}{g(x)}$$

$$h'(x)=\frac{f'\cdot g-f\cdot g'}{g^2}$$

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Ex4. Find the derivative of the following functions

1.) $f(x)=\frac{3x^2-5}{2x+1}$ $\qquad \frac{f'\cdot g-f\cdot g'}{g^2}$

$f(x)=3x^2-5$ $\quad g(x)=2x+1$

$f'(x)=6x$ $\quad g'(x)=2$

$y'=\frac{6x(2x+1)-2(3x^2-5)}{(2x+1)^2}$

$=\frac{6x^2+6x+10}{(2x+1)^2}$

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2.) $f(x)=\frac{x^2-1}{x^2+1}$

$f'(x)=2x$

$g'(x)=2x$

$\frac{2x(x^2+1)-2x(x^2-1)}{(x^2+1)^2}$

$\frac{2x^3+2x-2x^3+2x}{(x^2+1)^2}$

$\frac{4x}{(x^2+1)^2}=y'$

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Second and Higher Order Derivatives

$y=x^6-3x^5-2x^4+2x^3+x^2-8x+1$

$y'=6x^5-15x^4-8x^3+6x^2+2x-8$

$y''=30x^4-60x^3-24x^2+12x+2$

$y'''=120x^3-180x^2-48x+12$

$y''''=360x^2-360x-48$

$y'''''=720x-360$

$y''''''=720$ $\qquad y^{(7)}=0$

$y^{(7)}=$

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Notation for Higher Order Derivatives

First Derivative	Second Derivative	Third Derivative
$f'(x) =$ $y' =$ $\frac{dy}{dx}$	$f''(x) =$ $y'' =$ $\frac{d^2y}{dx^2}$	$f'''(x) =$ $y''' =$ $\frac{d^3y}{dx^3}$
The rate at which the function is changing	The rate at which the rate of change of the function is changing	The rate at which the rate of change of the rate of change of the function is changing

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Homework

pg 124 #5, 6, 7, 9, 11, 15-21 odd, 23, 25, 27, 33, 35, 37-40,46,52

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