Basic Differentiation Rules
Day 3

Warm Up

- Rewrite using rational exponents.

1. $\frac{-2}{x}$

2. $\sqrt{x-5}$

3. $\sqrt[3]{8+4x}$

4. $\frac{5}{\sqrt[4]{x^3}}$

- 5. Find the slope intercept equation of the line parallel to y = 3x + 1 through the point (4, 5).

- 6. Use the limit definition to find the derivative of: $g(x)=\sqrt{3x}$

- 7. The derivative of a function is the same thing as _____. (HINT: see Day 1 Notes)

Warm Up ANSWERS

- Rewrite using rational exponents.

1. $\frac{-2}{x}$ $-2x^{-1}$

2. $\sqrt{x-5}$ $(x-5)^{\frac{1}{2}}$

3. $\sqrt[3]{8+4x}$ $(8+4x)^{\frac{1}{3}}$

4. $\frac{5}{\sqrt[4]{x^3}}$ $5x^{-\frac{3}{4}}$

- 5. Find the slope intercept equation of the line parallel to y = 3x + 1 through the point (4, 5).

$point-slope:\ \ y-5=3(x-4)$ $Slope-int:\ \ y=3x-7$

- 6. Use the limit definition to find the derivative of: $g(x)=\sqrt{3x}$ $\frac{3}{2\sqrt{3x}}$

- 7. The derivative of a function is the same thing as the SLOPE of a function at a point.

HW Questions????

Notes Day 3
Basic Differentiation Rules

Intro– Do you see the pattern?

$$f(x) = 7 \qquad f'(x) = 0$$

$$g(x) = x^3 \qquad g'(x) = 3x^2$$

$$h(x) = 2x^4 \qquad h'(x) = 8x^3$$

$$f(x) = -3x^5 - 2x^3 \qquad f'(x) = -15x^4 - 6x^2$$

The Power Rule

- If n is a rational number, then the function $f(x) = x^n$ is differentiable and

$$\frac{d}{dx}\left[x^n\right] = nx^{n-1}$$

$$Ex: \quad f(x) = 5x^3$$

$$\frac{d}{dx} f(x) = 15x^2$$

Differentiable means you can take the derivative!

The Constant Rule

- The derivative of a constant function is 0. That is, if c is a real number, then

$$\frac{d}{dx}[c] = 0$$

$$Ex: f(x) = -4$$

$$f'(x) = 0$$

- What type of lines do constants make?

  Constants are horizontal lines – and their slope is zero. Remember, derivatives come from slope. ☺

Examples

Write answers with only **positive whole** exponents and radicals!

- Find each derivative using the power rule.

1. $f(x) = -4x^2$

2. $f(x) = 3x^6 + 7$

3. $f(x) = \dfrac{2}{x^2}$

4. $f(x) = -\dfrac{7}{x^3}$

5. $g(x) = 3\sqrt{x}$

6. $f(x) = 2\sqrt[3]{x^4}$

Examples ANSWERS

Write answers with only **positive whole** exponents and radicals!

- Find each derivative using the power rule.

1. $f(x) = -4x^2$ $= -8x$

2. $f(x) = 3x^6 + 7$ $= 18x^5$

3. $f(x) = \frac{2}{x^2}$ $= \frac{-4}{x^3}$

4. $f(x) = -\frac{7}{x^3}$ $= \frac{21}{x^4}$

5. $g(x) = 3\sqrt{x}$ $= \frac{3}{2\sqrt{x}}$

6. $f(x) = 2\sqrt[3]{x^4}$ $= \frac{8x^{\frac{1}{3}}}{3}$

The Sum and Difference Rules

- The sum (and difference) of two differentiable functions is differentiable
and is the sum (or difference) of their derivatives.

$$\frac{d}{dx}\left[f(x) + g(x) \right] = f'(x) + g'(x)$$

$$\frac{d}{dx}\left[f(x) - g(x) \right] = f'(x) - g'(x)$$

Find each derivative:

Write answers with only **positive whole** exponents and radicals!

7. $f(x) = 3x^4 - 2x^3$

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

9. $f(x) = -\frac{x^4}{2} + 3x^3 - 2x$

10. $f(x) = x^4 - 2x^3 + 4\sqrt{x}$

Find each derivative ANSWERS:

Write answers with only **positive whole** exponents and radicals!

7. $f(x) = 3x^4 - 2x^3$

$= 12x^3 - 6x^2$

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

$= 3x^2 - 4$

9. $f(x) = -\frac{x^4}{2} + 3x^3 - 2x$

$= -2x^3 + 9x^2 - 2$

10. $f(x) = x^4 - 2x^3 + 4\sqrt{x}$

$= 4x^3 - 6x^2 + \frac{2}{\sqrt{x}}$

What does the derivative tell us?

- The equation for the slope of the line tangent to the curve. ← Write this down!
- Is the slope of the line the same as we go across a curve?
- We can substitute in different x-values for our derivative equation to find the slope at specific points.

Know the difference!

- Question 1:

  Slope of a graph at a ***specific point, c***.
  → Find the derivative (**difference quotient**) then **substitute in c for x** and simplify.

- Question 2:

  Finding a ***formula*** for the slope at ***any*** **point** on the graph → Find the derivative

- Question 3:

  Finding the ***equation of the tangent line*** for at a ***specific*** **point** on the graph → Use

$$y - y_1 = \frac{dy}{dx}(x - x_1)$$

Find the slope at a point

- Find the slope of the graph of $f(x)=x^4$ when:

a. $x=-1$	b. $x=0$	c. $x=1$
$f'(x)=$	$f'(x)=$	$f'(x)=$
a. $f'(-1)=$	b. $f'(0)=$	c. $f'(1)=$

Remember a derivative is slope!

Find the slope at a point ANSWERS

- Find the slope of the graph of $f(x)=x^4$ when:

a. $x=-1$	b. $x=0$	c. $x=1$
$f'(x)= 4x^3$	$f'(x)= 4x^3$	$f'(x)= 4x^3$
a. $f'(-1)= -4$	b. $f'(0)= 0$	c. $f'(1)= 4$

Remember a derivative is slope!

Writing Equations of Tangent Lines

Given $f(x) = 3x^2 + 5x$. Write the equation of the tangent line at $x = 2$.

- First, find f'(x).
- Then, find f'(2).

- In other words, the derivative of f(x) is _____. The slope of the tangent line at $x = 2$ is ____.

- Can you find the equation of the tangent line??

  *Substitute the x-value into the original equation to find y!!
  You need (x_1, y_1) or $(x_1, f(x_1))$

Equations of Tangent Lines ANSWERS

Given $f(x) = 3x^2 + 5x$. Write the equation of the tangent line at $x = 2$.

- We could say $f'(x) = 6x + 5$.
- So we could say $f'(2) = 17$.

- In other words, the derivative of $f(x)$ is $6x + 5$. The slope of the tangent line at $x = 2$ is 17.

- Can you find the equation of the tangent line??

  *Substitute the x-value into the original equation to find y!!
  You need (x_1, y_1) or $(x_1, f(x_1))$

$$y - 22 = 17(x - 2)$$

$$y = 17x - 12$$

How to find equation of tangent line when not given a point:

1. **Find the coordinate point.** (x_1, y_1)
   Substitute the given x-value into the ORIGINAL function to find the y-value of the point
2. **Find the slope of the line.** **m = slope**
   Take the derivative of the function. Then substitute the given x-value into the derivative to find the slope at that point.
3. **Use point-slope formula** with the slope and point that you found! $y - y_1 = m(x - x_1)$ **where your point is** (x_1, y_1) **and your m = slope**

Find the equation of the tangent line to the graph of $f(x) = -2x^2 + 9x + 1$ at $x = 3$.

First, find the coordinate pair.

Next, find the derivative of the function.

$$f(x) = -2x^2 + 9x + 1$$

Next, find the slope of the tangent line at $x = 3$.

Finally, find the equation of the tangent line at the point (3, ___).

Find the equation of the tangent line to the graph of $f(x) = -2x^2 + 9x + 1$ at $x = 3$. ANSWERS

First, find the derivative of the function.

$f(x) = -2x^2 + 9x + 1$

$f'(x) = -4x + 9$

Next, find the slope of the tangent line at $x = 3$.

$f'(3) = -4(3) + 9 \qquad m = -3$

Finally, find the equation of the tangent line at the point (3, 10).

$y - 10 = -3(x - 3)$

$y = -3x + 19$

You Try: Equation of a Tangent Line

Ex. Find an equation of the tangent line to the graph of $f(x) = x^2$ when $x = -2$.

Remember to write an equation of a line we need slope and a point!

You Try: Equation of a Tangent Line ANSWERS

Ex. Find an equation of the tangent line to the graph of $f(x) = x^2$ when $x = -2$.

- $f'(x) = 2x$

$m = -4$

*Substitute the x value into the original equation to find y!!

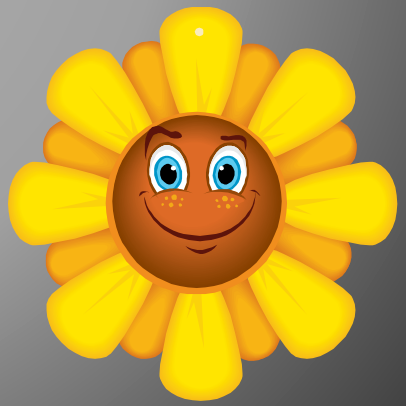
Write this down! $f(-2) = 4$

$$y - 4 = -4(x + 2)$$

Remember to write an equation of a line we need slope and a point!

Homework: p.4-5

- Have a great day!



Old slides up next

Not used Fall ‘18