Subject for this video: Sum Rule, Constant Multiple Rule, Power Rule

Reading:

- **General:** Section 2.5, Basic Differentiation Properties
- **More specifically:** middle of p. 148 – middle of p. 150, Parts of Examples 4,5

Homework:

Sum Rule, Constant Multiple Rule, Power Rule (2.5 # 35,37,39)

Recall the Derivative Rules that we learned about in the previous video.

The Constant Function Rule

This rule is used for finding the derivative of a *constant* function.

Two equation form: If $f(x) = c$ then $f'(x) = 0$.

Single equation form: $\frac{d}{dx}c = 0$

The Power Rule

This rule is used for finding the derivative of a *power* function.

Two equation form: If $f(x) = x^n$ then $f'(x) = nx^{n-1}$.

Single equation form: $\frac{d}{dx}x^n = nx^{n-1}$

In this video, we will learn just one new Derivative rule

The Sum and Constant Multiple Rule

If $f(x)$ and $g(x)$ are functions and a, b are constants, then

$$\frac{d}{dx}\big(af(x) + bg(x)\big) = a\frac{d}{dx}f(x) + b\frac{d}{dx}g(x)$$

Using prime notation, we could write

$$\big(af(x) + bg(x)\big)' = af'(x) + bg'(x)$$

We will do three basic examples involving the use of this new rule.

[Example 1] (similar to 2.5#35) Find $f'\cancel{(5) \text{ if } f(5) = -3t^2 + 12t + 15.}$

$$f'(t) \text{ if } f(t) = -3t^2 + 12t + 15$$

$$f'(t) = \frac{d}{dt}\left(\underbrace{-3}\,\underbrace{t^2} + \underbrace{12}\,\underbrace{t} + \underbrace{15}\right)$$

Apply the Sum and Constant Multiple Rule

$$= \underbrace{-3}\frac{d}{dt}t^2 + \underbrace{12}\frac{d}{dt}\,t + \frac{d}{dt}\underbrace{15}$$

n=1

Constant function rule

Power Rule with n=2 Power Rule with n=1

Power Rule

n=2

$$\frac{d}{dt}t^2 = 2\cdot t^{2-1}$$

$$= -3\left(2\cdot t^{2-1}\right) + 12\left(1\cdot t^{1-1}\right) + 0$$

$$= -6\cdot t^1 + 12\cdot t^0$$

$$= -6t + 12$$

Remark: A couple of videos ago we found the derivative of $f(x) = -3x^2+12x+15$ using the <u>Definition of the Derivative</u>. (much harder) We found $f'(x) = -6x+12$

[Example 2] (similar to 2.5#37) Find y' for $y = 5x^{3/5} - 7x^{-13} + 15$.

Solution: $y'(x) = \frac{d}{dx}\left(y(x)\right) = \frac{d}{dx}\left(5x^{3/5} - 7x^{-13} + 15\right)$

Apply the Sum and Constant Multiple rule

$$= 5\frac{d}{dx}x^{3/5} \leftarrow n=\tfrac{3}{5} \quad - 7\frac{d}{dx}x^{-13} \leftarrow n=-13 \quad + \underbrace{\frac{d}{dx}15}_{\text{Constant function rule}}$$

$$= \cancel{5}\left(\frac{3}{\cancel{5}}\cdot x^{\frac{3}{5}-1}\right) - 7\left(-13x^{-13-1}\right) + \overbrace{0}$$

Simplify

$$= 3x^{-2/5} + 91x^{-14}$$

Convert to positive exponent form

$$= \frac{3}{x^{2/5}} + \frac{91}{x^{14}}$$

[Example 3] (similar to 2.5#38) Find $\cancel{\frac{d}{du} 6u^{1.5} - 8x^{-0.5}}$ typo

find $\frac{d}{du} 6u^{1.5} - 8u^{-0.5}$

We should name the function $g(u) = 6u^{1.5} - 8u^{-0.5}$

We are being asked to find $g'(u)$

$$g'(u) = \frac{d}{du} 6u^{1.5} - 8u^{-0.5}$$

use the Sum and constant multiple rule

$$= 6\frac{d}{du} u^{1.5} \leftarrow n=1.5 \quad - 8\frac{d}{du} u^{-0.5} \leftarrow n=-0.5$$

Power Rule with n=1.5 Power Rule with n=-0.5

$$= 6(1.5u^{1.5-1}) - 8(-0.5u^{-0.5-1})$$

Simplify

$$= 9u^{0.5} + 4u^{-1.5}$$

convert to positive exponent form

$$= \boxed{9u^{0.5} + \frac{4}{u^{1.5}}}$$

End of Example

End of Video.