

Date: 11/6/18

Chp: Chp. 3:3 → Rules for
Differentiation

Obj: Apply the rules to differentiate.

Rule 1: Constant Rule

$$\frac{d}{dx}(c) = 0 \quad ; \quad c = \text{constant}^a$$

- Ex: $\frac{d}{dx}(3) = 0$

Rule 2: Power Rule

$$\frac{d}{dx} (x^n) = nx^{n-1}$$

$$\text{- Ex: } \frac{d}{dx} x = 1x^0 = \textcircled{1}$$

$$\text{- Ex: } \frac{d}{dx} x^4 = \textcircled{4x^3}$$

$$\text{- Ex: } \frac{d}{dx} x^2 = \textcircled{2x^1}$$

$$\text{- Ex: } \frac{d}{dx} x^{-5} = \textcircled{-5x^{-6}}$$

Rule 3: Constant Multiple Rule

$$\frac{d}{dx}(cu) = c\left(\frac{du}{dx}\right)$$

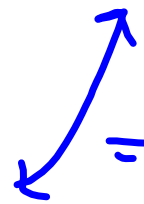
$$\text{-Ex: } \frac{d}{dx} 7x^4 = \textcircled{28x^3}$$

$$\text{-Ex: } \frac{d}{dx} 5x^2 = \textcircled{10x}$$

Rule 4: Sum & Difference Rule

$$\frac{d}{dx} (u \pm v) = \frac{d}{dx} u \pm \frac{d}{dx} v$$

-EX: $\frac{d}{dx} (x^4 - 2x^2 + 2) = 4x^3 - 4x$

$$\begin{aligned} y &= x^4 - 2x^2 + 2 \\ y' &= 4x^3 - 4x \end{aligned}$$


Rule 5: The Product Rule

$$\frac{d}{dx}(uv) = v\left(\frac{du}{dx}\right) + u\left(\frac{dv}{dx}\right)$$
$$\rightarrow u'v + v'u$$

- Ex: Find y' of $y = \overset{u}{(x^2+1)}\overset{v}{(x^3+3)}$

$$(2x)(x^3+3) + (3x^2)(x^2+1)$$

$$2x^4 + 6x + 3x^4 + 3x^2$$

$$\boxed{5x^4 + 6x + 3x^2}$$

Rule 6: Quotient Rule

$$\frac{d}{dx} \left(\frac{u}{v} \right) = \frac{v \left(\frac{du}{dx} \right) - u \left(\frac{dv}{dx} \right)}{v^2}$$

$$\frac{u'v - v'u}{v^2}$$

- Ex: Find $f'(x)$ if $f(x) = \frac{x^2-1}{x^2+1}$ $\begin{matrix} u \\ v \end{matrix}$

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

$$\frac{\cancel{2x^3} + 2x - \cancel{2x^3} + 2x}{(x^2+1)^2} = \frac{4x}{(x^2+1)^2}$$

Higher-Order Derivatives

- $y'_{f'(x)}$ or $\frac{dy}{dx} = 1^{\text{st}}$ derivative
- $y''_{f''(x)}$ or $\frac{d^2 y}{dx^2} = 2^{\text{nd}}$ derivative
- $y'''_{f'''(x)}$ or $\frac{d^3 y}{dx^3} = 3^{\text{rd}}$ derivative

- Ex: Find The first 3 derivatives

$$\text{of } f(x) = x^4 - 5x^2 + 3x + 2$$

$$f'(x) = 4x^3 - 10x + 3$$

$$f''(x) = 12x^2 - 10$$

$$f'''(x) = 24x$$

homework:

p.124 (# 1-29 odds, 30, 31-41 odds)