Date: 11/6/18

Chp: Chp. 3:3 → Rules for Differentiation

Obj: Apply the rules to differentiate.

Rule 1: Constant Rule

$$\frac{d}{dx}(c) = 0 \quad \therefore c = \text{constant}$$

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

Rule 2: Power Rule

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

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

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

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

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

Rule 3: Constant Multiple Rule

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

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

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

Rule 4: Sum & Difference Rule

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

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

$y = x^4 - 2x^2 + 2$

$y' = 4x^3 - 4x$ $=$

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 $f(x) = \frac{x^2-1}{x^2+1}$ (u / v)

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

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

Higher-Order Derivatives

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

- Ex: Find the first 3 derivatives 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)