

## **4.9 Combining Differentiation Rules**

## 4.9 Combination of Differentiation Rules

### Learning Target:

SWBAT find the derivative using the combination of several differentiation rules.



Ex. 1 Find the derivative of the following:

$$f(x) = (x^2 + 1)^3 (2 - 3x)^4$$

Product Rule

$$f'(x) = \underbrace{(x^2 + 1)^3 \cdot 4(2 - 3x)^3(-3)} + \underbrace{(2 - 3x)^4 \cdot 3(x^2 + 1)^2 \cdot 2x}$$

$$f'(x) = -12(x^2 + 1)^3(2 - 3x)^3 + 6x(x^2 + 1)^2(2 - 3x)^4$$

$$= 6(x^2 + 1)^2(2 - 3x)^3 \left[ \overset{\text{GCF } -2x^2 - 2}{\cancel{-2(x^2 + 1)}} + \overset{+2x - 3x^2}{\cancel{x(2 - 3x)}} \right]$$

$$= 6(x^2 + 1)^2(2 - 3x)^3(-5x^2 + 2x - 2)$$

$$b) f(x) = \sqrt{x^2 - 1} (3x^3 + 2)$$

$$f(x) = \underbrace{(x^2 - 1)^{1/2}} \underbrace{(3x^3 + 2)}$$

$$f'(x) = (x^2 - 1)^{1/2} \cdot 9x^2 + (3x^3 + 2) \cdot (x^2 - 1)^{-1/2} \cdot 2x$$

$$\frac{(x^2 - 1)^{1/2} 9x^2 (x^2 - 1)^{1/2} + \frac{x(3x^3 + 2)}{(x^2 - 1)^{1/2}}}{(x^2 - 1)^{1/2}}$$

$$= \frac{9x^4 - 9x^2 + 3x^4 + 2x}{(x^2 - 1)^{1/2}} = \frac{12x^4 - 9x^2 + 2x}{(x^2 - 1)^{1/2}}$$

Ex.2 Find the derivative of the following:

$$s = \left( \frac{2t-1}{t+2} \right)^6$$

$$s' = 6 \left[ \frac{2t-1}{t+2} \right]^5 \left[ \frac{(t+2)(2) - (2t-1)(1)}{(t+2)^2} \right]$$
$$= 6 \frac{(2t-1)^5}{(t+2)^5} \left[ \frac{\cancel{2t} + 4 - \cancel{2t} + 1}{(t+2)^2} \right]$$

$$= \frac{30(2t-1)^5}{(t+2)^7} \checkmark$$

Ex.3 Find the derivative of the following:

$$y = \frac{2x^4}{\sqrt{3x-1}} = \frac{2x^4}{(3x-1)^{1/2}}$$

$$y' = (3x-1)^{1/2} \cdot 8x^3 - 2x^4 \cdot \frac{1 \cdot 3 \cdot (3x-1)^{-3/2}}{2(3x-1)^{1/2}}$$

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$$= \frac{2(3x-1)^{1/2} (3x-1)^1}{2(3x-1)^{3/2}} - \frac{6x^4}{2(3x-1)^{3/2}} = \frac{48x^4 - 16x^3 - 6x^4}{2(3x-1)^{3/2}}$$

$$= \frac{\cancel{4}2x^4 - \cancel{1}6x^3}{\cancel{2}(3x-1)^{3/2}}$$

$$= \frac{2x^4 - 8x^3}{(3x-1)^{3/2}}$$



$$y = \frac{2x-1}{\sqrt{4x-3}} = \frac{2x-1}{(4x-3)^{1/2}}$$

$$y' = (4x-3)^{1/2} (2) - (2x-1) \frac{1 \cdot 2}{2(4x-3)^{3/2}}$$

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$$y' = \frac{(4x-3)^{1/2} (2) (4x-3) - (2x-1) \cdot 2}{(4x-3)^{3/2}} = \frac{8x-6-4x+2}{(4x-3)^{3/2}} = \frac{4x-4}{(4x-3)^{3/2}}$$

$$y = \frac{\sqrt{x}}{2x+1}$$

Ex.4 Find the derivative of the following:

$$y = \frac{\sqrt{x+3}}{(x^2+2)^2}$$

# Assignment

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#'s 5,6,9,10,12,13,14,15,18

