

# Power, Product, Quotient, Chain, Implicit

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

\* power Rule

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

\* product, chain

$$3) f(x) = \frac{3x}{(x-1)^3}$$

quotient, chain

$$4) f(x) = (x^2 - \sqrt{x})^{44}$$

chain

$$5) y = 3xy - y^2$$

implicit, product

\* chain Rule  
\* quotient Rule

$$6) f(x) = 4 \left( \frac{2-3x^2}{x-5x^4} \right)^5$$

out:  $4(\ )^5$   
in:  $\frac{2-3x^2}{x-5x^4}$

$$f'(x) = 20 \left( \frac{2-3x^2}{x-5x^4} \right)^4 \cdot \left[ \frac{\overbrace{(-6x)}^{f'} \cdot \overbrace{(x-5x^4)}^g - \overbrace{(2-3x^2)}^f \cdot \overbrace{(1-20x^3)}^{g'}}{\underbrace{(x-5x^4)^2}_{g^2}} \right]$$

$$1) \quad y = 3(x-1)^2 \quad \left| \quad y = 3(x^2 - 1x - 1x + 1) \quad \left| \quad y = 3x^2 - 6x + 3 \right. \right.$$

$$y = 3(x-1)(x-1) \quad \left| \quad y = 3(x^2 - 2x + 1) \right.$$

$$\boxed{y' = 6x - 6}$$

$$2) \quad y = 3x(x-1)^3$$

chain Rule  
out:  $( )^3$   
in:  $x-1$

$$y' = (3)(x-1)^3 + (3x) \cdot 3(x-1)^2 \cdot (1)$$

$$y' = 3(x-1)^3 + 9x(x-1)^2$$

$$y' = 3(x-1)^2 [x-1 + 3x]$$

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

\* quotient Rule  $\frac{f'g - fg'}{g^2}$

$$3) \quad y = \frac{3x}{(x-1)^3}$$

chain Rule  
out:  $( )^3$   
in:  $x-1$

$$(x-1)^3 \cdot (x-1)^2$$

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

$$y' = \frac{3(x-1)^3 - 9x(x-1)^2}{(x-1)^6}$$

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

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

$$4) y = (x^2 - \sqrt{x})^{14} \quad \text{out: } (\ )^{14}$$

$$\text{in: } x^2 - x^{1/2}$$

$$y' = 14(x^2 - \sqrt{x})^{13} \cdot (2x - \frac{1}{2}x^{-1/2})$$

$$y' = 14(x^2 - \sqrt{x})^{13} (2x - \frac{1}{2x^{1/2}})$$

\* implicit  
\* product Rule

$$5) y = \overbrace{3xy}^{f \cdot g} - y^2$$

$$1 \left( \frac{dy}{dx} \right) = \overbrace{(3)}^{f'} \cdot \overbrace{(y)}^g + \overbrace{(3x)}^f \cdot \overbrace{1 \left( \frac{dy}{dx} \right)}^{g'} - 2y \left( \frac{dy}{dx} \right)$$

$$1 \left( \frac{dy}{dx} \right) - 3x \left( \frac{dy}{dx} \right) + 2y \left( \frac{dy}{dx} \right) = 3y$$

$$\frac{dy}{dx} (1 - 3x + 2y) = 3y$$

$$\frac{dy}{dx} = \frac{3y}{1 - 3x + 2y}$$

#6 (continued)

$$f'(x) = 20 \cdot \frac{(2-3x^2)^4}{(x-5x^4)^4} \cdot \frac{-6x^2+30x^5-2+40x^3+3x^2-60x^5}{-6x^2+30x^5-(2-40x^3-3x^2+60x^5)}$$

$$f'(x) = \frac{20(2-3x^2)^4(-30x^5+40x^3-3x^2-2)}{(x-5x^4)^6}$$