

The Chain Rule

If f and g are well-behaved functions, then

$$(f \circ g)'(x) = f'(g(x)) g'(x)$$

or

$$(f(g(x)))' = f'(g(x)) g'(x)$$

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Example: Let $h(x) = (x^2 + 2x)^4$. What is $h'(x)$?

Example: $f(x) = \sin(x^2)$. What is $f'(x)$?

Let $f(x) = 2^x$. What is $f'(x)$?

Summary of derivatives we know thus far

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

$$\frac{d}{dx} e^x = e^x$$

$$\frac{d}{dx} \sin(x) = \cos(x)$$

$$\frac{d}{dx} \ln(x) = \frac{1}{x}$$

$$\frac{d}{dx} \cos(x) = -\sin(x)$$

$$(u v)' = u'v + uv'$$

$$\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$$

$$\frac{d}{dx} f(g(x)) = f'(g(x)) \cdot g'(x)$$

Find the derivative of each function

1. $f(x) = (3x^2 + 2)^{14}$

3. $f(x) = x^2 \sin(x^3)$

2. $f(x) = (\sin(x))^3$

4. $f(x) = \sqrt{\ln(x^2 + 2x)}$

Find the derivative of each function

5. $f(x) = \tan(x)$

Hint: $\tan(x) = \frac{\sin(x)}{\cos(x)}$

7. $f(x) = \sec(x)$

Hint: $\sec(x) = \frac{1}{\cos(x)}$

6. $f(x) = \tan(\ln(x))$

8. $f(x) = \ln(\cos(x))$