

**Section 3.4: Chain Rule**

Example: Find the derivative of  $y = (x^3 + 3x^2 + 1)^5$

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**The Chain Rule:** If derivatives  $g'(x)$  and  $f'(x)$  both exist, and  $J(x) = f(g(x))$  then

$$J'(x) =$$

In Leibniz notation:  $y = f(u)$  and  $u = g(x)$ , then  $\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx}$

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Example: Find the following derivatives.

A)  $y = (x^5 + 7x^2 + 6)^8$

B)  $y = e^{x^3+2x+1}$

C)  $y = e^{\sec(5x)}$

D)  $y = a^{f(x)}$  where  $a$  is a number.

E)  $y = 2^{x^2}$

F)  $y = \tan^3(5x)$

G)  $y = 5^{x^2} \sqrt[3]{x^2 + 7}$

$$\text{H) } y = \frac{x^4 + 7}{(x^2 + 1)^3}$$

$$\text{I) } y = \frac{2}{(7x^2 + 5)^3}$$

$$\text{J) } y = \left( \frac{\sin(x)}{x^4 + 3} \right)^5$$

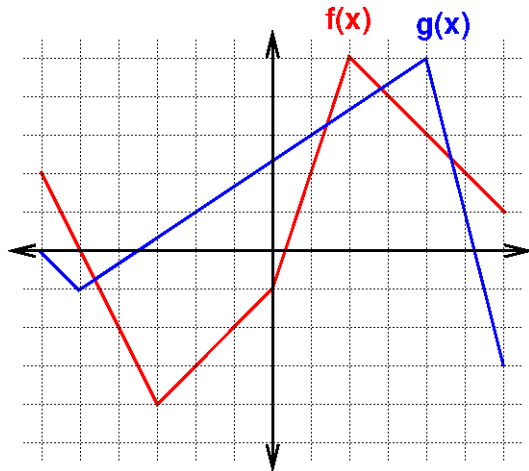
Example: Find the 25th derivative of  $y = \cos(7x)$

Example: Find the values of  $x$  where the tangent line is horizontal for

$$y = (x^2 - 4)^3 e^{x^2}$$

Example: Find the 5th derivative of  $y = xe^{-x}$

Example Use the graph for the following.



A) Find  $H'(-2)$  if  $H(x) = f(g(x))$

B) Find  $R'(1)$  if  $R(x) = (x^2 + 2)f(3x)$