

Product Rule and Chain Rule Practice

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Differentiate each function with respect to x .

1) $y = 4x^5(4x^4 - 2)$

2) $y = -2x^5(2x^2 - 3)$

3) $f(x) = (-x^3 - 1)(-x^5 - 1)$

4) $f(x) = (2x^2 + 2)(5x^4 + 4)$

5) $y = (-1 + x^{-4})(-x^5 - 1)$

6) $f(x) = \left(-2x^{\frac{5}{4}} - 1\right)(4x^5 + 1)$

7) $f(x) = (\sqrt[5]{x^2} + 4)(2x^2 + 4)$

8) $y = \left(-4x^{\frac{2}{3}} + 1\right)(3x^5 + 5)$

$$9) \ f(x) = (4x^4 + 3)^2$$

$$10) \ f(x) = (-x^5 - 2)^4$$

$$11) \ y = ((-5x^4 - 2)^5 - 3)^4$$

$$12) \ y = ((-4x + 1)^5 + 3)^4$$

$$13) \ y = ((3x^5 - 5)^5 - 1)^4$$

$$14) \ y = ((-4x + 5)^2 + 1)^4$$

Answers to Product Rule and Chain Rule Practice

1)
$$\begin{aligned}\frac{dy}{dx} &= 4x^5 \cdot 16x^3 + (4x^4 - 2) \cdot 20x^4 \\ &= 144x^8 - 40x^4\end{aligned}$$

3)
$$\begin{aligned}f'(x) &= (-x^3 - 1) \cdot -5x^4 + (-x^5 - 1) \cdot -3x^2 \\ &= 8x^7 + 5x^4 + 3x^2\end{aligned}$$

5)
$$\begin{aligned}\frac{dy}{dx} &= (-1 + x^{-4}) \cdot -5x^4 + (-x^5 - 1) \cdot -4x^{-5} \\ &= 5x^4 - 1 + \frac{4}{x^5}\end{aligned}$$

7)
$$\begin{aligned}f'(x) &= \left(\frac{2}{x^5} + 4\right) \cdot 4x + (2x^2 + 4) \cdot \frac{2}{5}x^{-\frac{3}{5}} \\ &= \frac{24x^{\frac{7}{5}}}{5} + 16x + \frac{8}{5x^{\frac{3}{5}}}\end{aligned}$$

9)
$$\begin{aligned}f'(x) &= 2(4x^4 + 3) \cdot 16x^3 \\ &= 32x^3(4x^4 + 3)\end{aligned}$$

10)
$$\begin{aligned}f'(x) &= 4(-x^5 - 2)^3 \cdot -5x^4 \\ &= -20x^4(-x^5 - 2)^3\end{aligned}$$

11)
$$\begin{aligned}\frac{dy}{dx} &= 4((-5x^4 - 2)^5 - 3)^3 \cdot 5(-5x^4 - 2)^4 \cdot -20x^3 \\ &= -400x^3((-5x^4 - 2)^5 - 3)^3 \cdot (-5x^4 - 2)^4\end{aligned}$$

13)
$$\begin{aligned}\frac{dy}{dx} &= 4((3x^5 - 5)^5 - 1)^3 \cdot 5(3x^5 - 5)^4 \cdot 15x^4 \\ &= 300x^4((3x^5 - 5)^5 - 1)^3 \cdot (3x^5 - 5)^4\end{aligned}$$

2)
$$\begin{aligned}\frac{dy}{dx} &= -2x^5 \cdot 4x + (2x^2 - 3) \cdot -10x^4 \\ &= -28x^6 + 30x^4\end{aligned}$$

4)
$$\begin{aligned}f'(x) &= (2x^2 + 2) \cdot 20x^3 + (5x^4 + 4) \cdot 4x \\ &= 60x^5 + 40x^3 + 16x\end{aligned}$$

6)
$$\begin{aligned}f'(x) &= \left(-2x^{\frac{5}{4}} - 1\right) \cdot 20x^4 + (4x^5 + 1) \cdot -\frac{5}{2}x^{\frac{1}{4}} \\ &= -50x^{\frac{21}{4}} - 20x^4 - \frac{5x^{\frac{1}{4}}}{2}\end{aligned}$$

8)
$$\begin{aligned}\frac{dy}{dx} &= \left(-4x^{\frac{2}{3}} + 1\right) \cdot 15x^4 + (3x^5 + 5) \cdot -\frac{8}{3}x^{-\frac{1}{3}} \\ &= -68x^{\frac{14}{3}} + 15x^4 - \frac{40}{3x^{\frac{1}{3}}}\end{aligned}$$

12)
$$\begin{aligned}\frac{dy}{dx} &= 4((-4x + 1)^5 + 3)^3 \cdot 5(-4x + 1)^4 \cdot -4 \\ &= -80((-4x + 1)^5 + 3)^3 \cdot (-4x + 1)^4\end{aligned}$$

14)
$$\begin{aligned}\frac{dy}{dx} &= 4((-4x + 5)^2 + 1)^3 \cdot 2(-4x + 5) \cdot -4 \\ &= -32((-4x + 5)^2 + 1)^3(-4x + 5)\end{aligned}$$