

## Differentiating More Difficult Functions

*Differentiate these for fun, or practice, whichever you need. The given answers are not simplified.*

1.  $f(x) = 4x^5 - 5x^4$

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

3.  $f(x) = (x^4 + 3x)^{-1}$

4.  $f(x) = 3x^2(x^3 + 1)^7$

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

6.  $f(x) = \frac{x}{1 + x^2}$

7.  $f(x) = \frac{x^2 - 1}{x}$

8.  $f(x) = (3x^2)(x^{\frac{1}{2}})$

9.  $f(x) = \ln(xe^{7x})$

10.  $f(x) = \frac{2x^4 + 3x^2 - 1}{x^2}$

11.  $f(x) = (x^3)\sqrt[5]{2 - x}$

12.  $f(x) = 2x - \frac{4}{\sqrt{x}}$

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## Answers

Absolutely not simplified ... you should simplify more.

1.  $f'(x) = 20x^4 - 20x^3$
2.  $f'(x) = e^x \cos x + (\sin x)e^x$
3.  $f'(x) = -1(x^4 + 3x)^{-2}(4x^3 + 3)$
4.  $f'(x) = 3x^2 \cdot 7(x^3 + 1)^6(3x^2) + (x^3 + 1)^7 \cdot 6x$
5.  $f'(x) = 4(\cos x)^3(-\sin x) - 4x$
6.  $f'(x) = \frac{(1+x^2)(1) - x(2x)}{(1+x^2)^2}$
7.  $f'(x) = 1 + x^{-2}$  (*Simplify f first.*)
8.  $f'(x) = 3 \cdot \frac{5}{2} x^{\frac{3}{2}}$  (*Simplify f first.*)
9.  $f'(x) = \frac{1}{x} + 7$  (*Simplify f first.*)
10.  $f'(x) = 4x + 0 + 2x^{-3}$  (*Simplify f first.*)
11.  $f'(x) = x^3 \cdot \frac{1}{5}(2-x)^{-\frac{4}{5}}(-1) + (2-x)^{\frac{1}{5}}(3x^2)$
12.  $f'(x) = 2 + 2x^{-\frac{3}{2}}$

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$$13. f(x) = \frac{4(3x-1)^2}{x^2+7^x}$$

$$14. f(x) = \sqrt{x^2+8}$$

$$15. f(x) = \frac{x}{\sqrt{1-(\ln x)^2}}$$

$$16. f(x) = \frac{6}{(3x^2-\pi)^4}$$

$$17. f(x) = \frac{(3x^2-\pi x)^4}{6}$$

$$18. f(x) = \frac{x}{(x^2+\sqrt{3x})^5}$$

$$19. f(x) = (xe^x)^\pi$$

$$20. f(x) = [\arctan(2x)]^{10}$$

$$21. f(x) = (e^{2x}+e)^{\frac{1}{2}}$$

$$22. f(x) = (x^6+1)^5(4x+7)^3$$

$$23. f(x) = (7x+\sqrt{x^2+3})^6$$

$$24. f(x) = \frac{\frac{1}{x}+\frac{1}{x^2}}{x-1}$$

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$$\begin{aligned} 13. f'(x) &= \frac{(x^2 + 7^x)[4 \cdot 2(3x - 1)(3)] - 4(3x - 1)^2(2x + 7^x \ln 7)}{(x^2 + 7^x)^2} & 14. f'(x) &= \frac{1}{2}(x^2 + 8)^{-\frac{1}{2}}(2x) \\ 15. f'(x) &= \frac{(1 - (\ln x)^2)^{\frac{1}{2}}(1) - x \cdot \frac{1}{2}(1 - (\ln x)^2)^{-\frac{1}{2}}(-2(\ln x) \cdot \frac{1}{x})}{1 - (\ln x)^2} & 16. f'(x) &= -24(3x^2 - \pi)^{-5}(6x) \\ 17. f'(x) &= \frac{1}{6}[4(3x^2 - \pi x)^3(6x - \pi)] & 18. f'(x) &= \frac{(x^2 + \sqrt{3x})^5(1) - x[5(x^2 + \sqrt{3x})^4(2x + \frac{1}{2}(3x)^{-\frac{1}{2}} \cdot 3)]}{(x^2 + \sqrt{3x})^{10}} \\ 19. f'(x) &= \pi(xe^x)^{(\pi-1)}[xe^x + e^x] & 20. f'(x) &= 10[\arctan(2x)]^9 \cdot \frac{1}{1 + (2x)^2} \cdot 2 \\ 21. f'(x) &= \frac{1}{2}(e^{2x} + e)^{-\frac{1}{2}}(e^{2x} \cdot 2 + 0) & 22. f'(x) &= (x^6 + 1)^5[3(4x + 7)^2(4)] + (4x + 7)^3[5(x^6 + 1)^4(6x^5)] \\ 23. f'(x) &= 6(7x + \sqrt{x^2 + 3})^5(7 + \frac{1}{2}(x^2 + 3)^{-\frac{1}{2}} \cdot 2x) & 24. f'(x) &= \frac{(x - 1)(-x^{-2} - 2x^{-3}) - (x^{-1} + x^{-2})(1)}{(x - 1)^2} \end{aligned}$$

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$$25. f(x) = \sqrt[3]{x^2} - \frac{1}{\sqrt{x^3}}$$

$$26. f(x) = \sqrt{\frac{2x+5}{7x-9}}$$

$$27. f(x) = \frac{\sin x}{\cos x}$$

$$28. f(x) = e^x(x^2 + 3)(x^3 + 4)$$

$$29. f(x) = \frac{5x^2 - 7x}{x^2 + 2}$$

$$30. f(x) = [\ln(5x^2 + 9)]^3$$

$$31. f(x) = \ln(5x^2 + 9)^3$$

$$32. f(x) = \cot(6x)$$

$$33. f(x) = \sec^2 x \cdot \tan x$$

$$34. f(x) = \arcsin(2^x)$$

$$35. f(x) = \tan(\cos x)$$

$$36. f(x) = [(x^2 - 1)^5 - x]^3$$

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## Answers

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$$25. f'(x) = \frac{2}{3}x^{-\frac{1}{3}} + \frac{3}{2}x^{-\frac{5}{2}}$$

$$26. f'(x) = \frac{1}{2} \left( \frac{2x+5}{7x-9} \right)^{-\frac{1}{2}} \left[ \frac{(7x-9)(2) - (2x+5)(7)}{(7x-9)^2} \right]$$

$$27. f'(x) = \sec^2 x$$

$$28. f'(x) = [e^x(x^2+3)](3x^2) + (x^3+4)[e^x(2x) + (x^2+3)e^x]$$

$$29. f'(x) = \frac{(x^2+2)(10x-7) - (5x^2-7x)(2x)}{(x^2+2)^2}$$

$$30. f'(x) = 3[\ln(5x^2+9)]^2 \cdot \frac{1}{5x^2+9}(10x+0)$$

$$31. f'(x) = \frac{1}{(5x^2+9)^3} \cdot [3(5x^2+9)^2(10x+0)]$$

$$32. f'(x) = -\csc^2(6x) \cdot 6$$

$$33. f'(x) = \sec^2 x(\sec^2 x) + \tan x[2 \cdot \sec x(\sec x \tan x)]$$

$$34. f'(x) = \frac{1}{\sqrt{1-(2^x)^2}} \cdot 2^x \ln 2$$

$$35. f'(x) = (\sec^2(\cos x))(-\sin x)$$

$$36. f'(x) = 3[(x^2-1)^5 - x]^2 (5(x^2-1)^4 \cdot 2x - 1)$$

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37.  $f(x) = \sec x \cdot \sin(3x)$

38.  $f(x) = \frac{(x-1)^3}{x(x+3)^4}$

39.  $f(x) = \log_5(3x^2 + 4x)$

In problems 40 – 42, find  $\frac{dy}{dx}$ . Assume  $y$  is a differentiable function of  $x$ .

40.  $3y = xe^{5y}$

41.  $xy + y^2 + x^3 = 7$

42.  $\frac{\sin y}{y^2 + 1} = 3x$

If  $f$  and  $g$  are differentiable functions such that  $f(2) = 3$ ,  $f'(2) = -1$ ,  $f'(3) = 7$ ,  $g(2) = -5$  and  $g'(2) = 2$ , find the numbers indicated in problems 43 – 48.

43.  $(g - f)'(2)$

44.  $(fg)'(2)$

45.  $\left(\frac{f}{g}\right)'(2)$

46.  $(5f + 3g)'(2)$

47.  $(f \circ f)'(2)$

48.  $\left(\frac{f}{f+g}\right)'(2)$

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Absolutely not simplified ... you should simplify more.

$$37. f'(x) = \sec x (\cos(3x) \cdot 3) + \sin(3x) (\sec x \tan x)$$

$$38. f'(x) = \frac{x(x+3)^4 [3(x-1)^2(1)] - (x-1)^3 [x \cdot 4(x+3)^3(1) + (x+3)^4(1)]}{x^2(x+3)^8}$$

$$39. f'(x) = \frac{1}{(3x^2 + 4x) \cdot \ln 5} \cdot (6x + 4)$$

$$40. \frac{dy}{dx} = \frac{e^{5y}}{3 - 5xe^{5y}}$$

$$41. \frac{dy}{dx} = \frac{-3x^2 - y}{x + 2y}$$

$$42. \frac{dy}{dx} = \frac{3(y^2 + 1)^2}{(y^2 + 1)(\cos y) - 2y \sin y}$$

$$43. 3$$

$$44. 11$$

$$45. \frac{-1}{25}$$

$$46. 1$$

$$47. -7$$

$$48. \frac{-1}{4}$$