DERIVATIVES

TAKE THE DERIVATIVES OF THE FOLLOWING:

$f(x) = x^2 + 4x - 6$

1. $f'(x) = 2x + 4$

$f'(x) = 2(x + 2)$

2. $f(x) = x^3 - 5x^2 - 4x + 11$

$f'(x) = 3x^2 - 10x + 4$

$f(x) = (x^6 - x^4 + 2x)$

3. $f'(x) = 6x^5 - 4x^3 + 2$

$f'(x) = 2(3x^5 - 2x^3 + 1)$

$f(x) = (x^{12} + x^7 - x^3 + 2)$

4. $f'(x) = 12x^{11} + 7x^6 - 3x^2$

$f'(x) = x^2(12x^9 + 7x^4 - 3)$

5. $f(x) = (x+1)^2$

$f'(x) = 2(x+1)$

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

$f'(x) = 4(x-5)^3$

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

7. $f'(x) = 5(4x+2)^4 \cdot 4$

$f'(x) = 20 \cdot 2^4(2x+1)^4$

$f(x) = (9x+5)^7$

8. $f'(x) = 7(9x+5)^6 \cdot 9$

$f'(x) = 63(9x+5)^6$

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

9. $f'(x) = 2(4x^3 + 3) \cdot 12x^2$

$f'(x) = 24x^2(4x^3 + 3)$

10. $f(x) = (5x^3 - 2x^2 + 3x)^3$

$f'(x) = 3(5x^3 - 2x^2 + 3x)^2 \cdot (15x^2 - 4x + 3)$

11. $f(x) = (2x^2 + x - 1)^{-2}$

$f'(x) = -2(2x^2 + x - 1)^{-3} \cdot (4x + 1)$

$f(x) = (4x^4 - 3x^2 + 5)^{-6}$

12. $f'(x) = -6(4x^4 - 3x^2 + 5)^{-7} \cdot (16x^3 - 6x)$

$f'(x) = -12x(4x^4 - 3x^2 + 5)^{-7} \cdot (8x^2 - 3)$

$f'(x) = \dfrac{-12x(8x^2 - 3)}{(4x^4 - 3x^2 + 5)^7}$

$f(x) = x^{-3} + 2x^{-4} - 3x^{-1}$

$f'(x) = -3x^{-4} - 8x^{-5} + 3x^{-2}$

13. $f'(x) = x^{-5}(-3x - 8 + 3x^3)$

$f'(x) = \dfrac{(-3x - 8 + 3x^3)}{x^5}$

$f(x) = (2x+3)(4x-5)$

$f(x) = 8x^2 + 2x - 15$

14. $f'(x) = 16x + 2$

$f'(x) = 2(8x+1)$

15.
$$f(x) = (2x-7)(4x+6)$$
$$f(x) = 8x^2 - 16x - 42$$
$$f'(x) = 16x - 16$$
$$f'(x) = 16(x-1)$$

16.
$$f(x) = (5x^2 + 3x - 2)(4x^4 + 2x^2 + 1)$$
$$f(x) = 20x^6 + 12x^5 + 2x^4 + 6x^3 + x^2 + 3x - 2$$
$$f'(x) = 120x^5 + 60x^4 + 8x^3 + 18x^2 + 2x + 3$$

17.
$$f(x) = (4x-5)^2(5x+3)^3$$
$$f'(x) = 2(4x-5)\cdot 4\cdot(5x+3)^3 + 3(5x+3)^2\cdot 5\cdot(4x-5)^2$$
$$f'(x) = (4x-5)(5x+3)^2\left[8(5x+3)+15(4x-5)\right]$$
$$f'(x) = (4x-5)(5x+3)^2(100x-51)$$

18.
$$f(x) = (5x+2)^3(7x-5)^4$$
$$f'(x) = 3(5x+2)^2\cdot 5\cdot(7x-5)^4 + 4(7x-5)^3\cdot 7\cdot(5x+2)^3$$
$$f'(x) = (5x+2)^2(7x-5)^3\left[15(7x-5)+28(5x+2)\right]$$
$$f'(x) = (5x+2)^2(7x-5)^3(245x-19)$$

19.
$$f(x) = (5x^2+5)^5(3x^2-1)^6$$
$$f'(x) = 5(5x^2+5)^4\cdot 10x\cdot(3x^2-1)^6 + 6(3x^2-1)^5\cdot 6x\cdot(5x^2+5)^5$$
$$f'(x) = 2x(5x^2+5)^4(3x^2-1)^5\left[25(3x^2-1)+18(5x^2+5)\right]$$
$$f'(x) = 2x(5x^2+5)^4(3x^2-1)^5(165x^2+65)$$
$$f'(x) = 10x(5x^2+5)^4(3x^2-1)^5(33x^2+13)$$

20.
$$f(x) = (3x^4-6)^3(5x+4)^{-3}$$
$$f'(x) = 3(3x^4-6)^2\cdot 12x^3\cdot(5x+4)^{-3} + (-3)(5x+4)^{-4}\cdot 5\cdot(3x^4-6)^3$$
$$f'(x) = 3(3x^4-6)^2(5x+4)^{-4}\left[12x^3(5x+4)-5(3x^4-6)\right]$$
$$f'(x) = 3(3x^4-6)^2(5x+4)^{-4}(45x^4+48x^3+20)$$
$$f'(x) = \frac{3(3x^4-6)^2(45x^4+48x^3+20)}{(5x+4)^4}$$

21.
$$f(x) = (4x^2+3)^{-2}(x^3+1)^{-4}$$
$$f'(x) = -2(4x^2+3)^{-3}\cdot 8x\cdot(x^3+1)^{-4} + (-4)(x^3+1)^{-5}\cdot 3x^2\cdot(4x^2+3)^{-2}$$
$$f'(x) = -4x(4x^2+3)^{-3}(x^3+1)^{-5}\left[4(x^3+1)+3x(4x^2+3)\right]$$
$$f'(x) = -4x(4x^2+3)^{-3}(x^3+1)^{-5}(16x^3+9x+4)$$
$$f'(x) = \frac{-4x(16x^3+9x+4)}{(4x^2+3)^3(x^3+1)^5}$$

22. $f(x)=\ln(4x)$

$f'(x)=\dfrac{1}{4x}\cdot 4=\dfrac{1}{x}$

23. $f(x)=\ln(5x^3)$

$f'(x)=\dfrac{1}{5x^3}\cdot 15x^2=\dfrac{3}{x}$

24. $f(x)=(\ln(6x))^2$

$f'(x)=2(\ln(6x))\cdot\dfrac{1}{6x}\cdot 6=\dfrac{2}{x}(\ln(6x))$

25. $f(x)=\ln(6x)^2$

$f'(x)=\dfrac{1}{(6x)^2}\cdot 2(6x)\cdot 6=\dfrac{2}{x}$

26. $f(x)=(2x+1)\ln\ x$

$f'(x)=2\ln x+\dfrac{1}{x}(2x+1)$

27. $f(x)=\ln x^2\cdot(5x+2)^3$

$f'(x)=\dfrac{1}{x^2}\cdot 2x\cdot(5x+2)^3+3(5x+2)^2\cdot 5\cdot\ln x^2$

$f'(x)=\dfrac{2}{x}\cdot(5x+2)^3+15(5x+2)^2\cdot\ln x^2$

28. $f(x)=\ln[(4x-2)^2(5x+2)^3]$

$f'(x)=\dfrac{1}{[(4x-2)^2(5x+2)^3]}\cdot\left[2(4x-2)\cdot(5x+2)^3+3(5x+2)^2\cdot 5\cdot(4x-2)^2\right]$

$f'(x)=\dfrac{1}{[(4x-2)^2(5x+2)^3]}\cdot(4x-2)(5x+2)^2\left[2(5x+2)+15(4x-2)\right]$

$f'(x)=\dfrac{2(35x-13)}{[(4x-2)(5x+2)^2]}=\dfrac{2(35x-13)}{[2(2x-1)(5x+2)^2]}=\dfrac{(35x-13)}{(2x-1)(5x+2)^2}$

29. $f(x)=\ln(3x^4+2x^2-5)^3$

$f'(x)=\dfrac{1}{(3x^4+2x^2-5)^3}\cdot 3\cdot(3x^4+2x^2-5)^2\cdot(12x^3+4x)$

$f'(x)=\dfrac{12x(3x^2+1)}{(3x^4+2x^2-5)^2}$

30. $f(x)=4^{3x}$

$f'(x)=4^{3x}\cdot\ln 4\cdot 3$

31. $f(x)=5^{(3x^2+2x-5)}$

$f'(x)=5^{(3x^2+2x-5)}\cdot\ln 5\cdot(6x+2)$

$f'(x)=5^{(3x^2+2x-5)}\cdot\ln 5\cdot 2(3x+1)$

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

32. $f^l(x) = 6^{(4x+5)^2(6x-1)} \cdot \ln 6 \cdot \left[2(4x+5) \cdot 4 \cdot (6x-1) + 6(4x+5)^2 \right]$

$f^l(x) = 6^{(4x+5)^2(6x-1)} \cdot \ln 6 \cdot 2 \cdot (4x+5)(48x+26)$

$f^l(x) = 6^{(4x+5)^2(6x-1)} \cdot \ln 6 \cdot 4 \cdot (4x+5)(24x+13)$

$f(x) = 4^{(5x^2-2x+1)}$

33. $f^l(x) = 4^{(5x^2-2x+1)} \cdot \ln 4 \cdot (10x-2)$

$f^l(x) = 4^{(5x^2-2x+1)} \cdot \ln 4 \cdot 2(5x-1)$

34. $f(x) = e^{(2x)}$

$f^l(x) = e^{(2x)} \cdot 2$

$f(x) = 5^{(2x+3)} \ln(2x+3)$

35. $f^l(x) = 5^{(2x+3)} \cdot \ln 5 \cdot 2 \cdot \ln(2x+3) + \dfrac{1}{(2x+3)} \cdot 2 \cdot 5^{(2x+3)}$

$f^l(x) = 5^{(2x+3)} \cdot 2\left[\ln 5 \cdot \ln(2x+3) + \dfrac{1}{(2x+3)} \right]$

$f(x) = \ln(5x-3)^2 e^{(3x-5)}$

$f^l(x) = \dfrac{1}{(5x-3)^2} \cdot 2(5x-3) \cdot 5 \cdot e^{(3x-5)} + e^{(3x-5)} \cdot 3 \cdot \ln(5x-3)^2$

36. $f^l(x) = \dfrac{1}{(5x-3)} \cdot 2 \cdot 5 \cdot e^{(3x-5)} + e^{(3x-5)} \cdot 3 \cdot \ln(5x-3)^2$

$f^l(x) = e^{(3x-5)}\left[\dfrac{10}{(5x-3)} + 3 \cdot \ln(5x-3)^2 \right]$

$f(x) = (3x+2)^2(5x-1)^3(x+6)^2$

37. $f^l(x) = 2 \cdot (3x+2) \cdot 3(5x-1)^3(x+6)^2 + 3(5x-1)^2 \cdot 5(3x+2)^2(x+6)^2 + 2(x+6)(3x+2)^2(5x-1)^3$

$f^l(x) = (3x+2)(5x-1)^2(x+6)\left[6(5x-1)(x+6) + 15(3x+2)(x+6) + 2(5x-1)(3x+2) \right]$

38.

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

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

$$f^l(x)=2\left(5x+2\right)\left(4x+1\right)^{-2}\left[5\left(4x+1\right)-2\left(5x+2\right)\right]$$

$$f^l(x)=\frac{2\left(5x+2\right)\left(10x+1\right)}{\left(4x+1\right)^2}$$

39.

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

$$f^l(x)=4\cdot\left(5x^3+2x-5\right)^3\cdot\left(15x^2+2\right)\left(4x^2+3\right)^{-2}+-2\left(4x^2+3\right)^{-3}\cdot 8x\cdot\left(5x^3+2x-5\right)^4$$

$$f^l(x)=4\left(5x^3+2x-5\right)^3\left(4x^2+3\right)^{-3}\left[\left(15x^2+2\right)\left(4x^2+3\right)-4x\left(5x^3+2x-5\right)\right]$$

$$f^l(x)=\frac{4\left(5x^3+2x-5\right)^3\left(40x^4+45x^2+20x+6\right)}{\left(4x^2+3\right)^3}$$

40.

$$f(x)=\frac{\ln\left(5x-2\right)^3}{5^{5x-1}}$$

$$f^l(x)=\frac{\frac{1}{\left(5x-2\right)^3}\cdot 3\left(5x-2\right)^2\cdot 5\cdot 5^{5x-1}-5^{5x-1}\cdot\ln 5\cdot 5\cdot\ln\left(5x-2\right)^3}{\left[5^{5x-1}\right]^2}$$

$$f^l(x)=\frac{5^{5x-1}\cdot 5\left[\frac{3}{\left(5x-2\right)}-\ln 5\cdot\ln\left(5x-2\right)^3\right]}{\left[5^{5x-1}\right]^2}=\frac{5\left[\frac{3-\left(5x-2\right)\ln 5\cdot\ln\left(5x-2\right)^3}{\left(5x-2\right)}\right]}{5^{5x-1}}$$

$$f^l(x)=\frac{5\left[3-\left(5x-2\right)\ln 5\cdot\ln\left(5x-2\right)^3\right]}{\left(5x-2\right)5^{5x-1}}$$

$$f(x)=\frac{3^{x^3+2x}}{e^{\ln x}}$$

$$f^l(x)=\frac{3^{x^3+2x}\cdot\ln 3\cdot(2x^2+2)e^{\ln x}-e^{\ln x}\cdot\frac{1}{x}\cdot 3^{x^3+2x}}{\left[e^{\ln x}\right]^2}$$

41.

$$f^l(x)=\frac{3^{x^3+2x}\cdot e^{\ln x}\left[\ln 3\cdot(2x^2+2)-\frac{1}{x}\right]}{\left[e^{\ln x}\right]^2}=\frac{3^{x^3+2x}\left[\frac{x\ln 3\cdot(2x^2+2)-1}{x}\right]}{e^{\ln x}}$$

$$f^l(x)=\frac{3^{x^3+2x}\left[x\ln 3\cdot(2x^2+2)-1\right]}{x\cdot e^{\ln x}}$$