MATH 171 - Derivative Worksheet

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. \( f(x) = (x^3)^{\sqrt{2} - x} \)
12. \( f(x) = 2x - \frac{4}{\sqrt{x}} \)
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. \( f(x) = \frac{6}{(3x^2 - \pi)^2} \)
17. \( f(x) = \frac{(3x^2 - \pi x)^4}{6} \)
18. \( f(x) = \frac{x}{(x^2 + \sqrt{3}x)^5} \)
19. \( f(x) = (xe^x)^x \)
20. \( f(x) = \left[ \arctan(2x) \right]^{10} \)
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. \( f(x) = \frac{\frac{1}{x} + \frac{1}{x^2}}{x - 1} \)
25. \( f(x) = \sqrt{x^2} - \frac{1}{\sqrt{x^3}} \)
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. \( f(x) = \left[ \ln(5x^2 + 9) \right]^3 \)
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. \( f(x) = [(x^2 - 1)^5 - x]^3 \)
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. \( \left( \frac{f}{f + g} \right)'(2) \)
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. \( f'(x) = x^3 \cdot \frac{1}{5}(2-x)^\frac{2}{3}(-1) + (2-x)^\frac{1}{3}(3x^2) \)
12. \( f'(x) = 2 + 2x^{-\frac{3}{2}} \)
13. \( f'(x) = \frac{(x^2 + 7\pi)(4 \cdot 2(3x - 1)(3)) - 4(3x - 1)^2(2x + 7\pi \ln 7)}{(x^2 + 7\pi)^2} \)
14. \( f'(x) = \frac{1}{2}(x^2 + 8)^\frac{1}{3}(2x) \)
15. \( f'(x) = \frac{\left(1 - (\ln x)^2\right)^2(1) - x \cdot \frac{1}{2} \left(1 - (\ln x)^2\right)^{\frac{1}{2}}}{1 - (\ln x)^2} \)
16. \( f'(x) = -24(3x^2 - \pi)^{-5}(6x) \)

17. \( f'(x) = \frac{1}{6} \left[4(3x^2 - \pi x)^3(6x - \pi)\right] \)
18. \( f'(x) = \frac{(x^2 + \sqrt{3}x)^5(1) - x \left[5(x^2 + \sqrt{3}x)^4(2x + \frac{1}{2}(3x^2)\frac{1}{2} \cdot 3)\right]}{(x^2 + \sqrt{3}x)^{10}} \)
19. \( f'(x) = \pi(xe^x)^{(\pi-1)} \left[xe^x + e^x\right] \)
20. \( f'(x) = 10 \left[\arctan(2x)\right]^9 \cdot \frac{1}{1 + (2x)^2} \cdot 2 \)

21. \( f'(x) = \frac{1}{2}(e^{2x} + e^{-\frac{1}{3}} (e^{2x} \cdot 2 + 0) \)
22. \( f'(x) = (x^6 + 1)^5 \left[3(4x + 7)^2(4) + (4x + 7)^3 \left[5(x^6 + 1)^4(6x^5)\right]\right] \)
23. \( f'(x) = 6(7x + \sqrt{x^2 + 3})(7 + \frac{1}{2}(x^2 + 3)^{\frac{1}{2}} \cdot 2x) \)
24. \( f'(x) = \frac{(x - 1)(-x^2 - 2x - 3) - (x^3 - x^2)(1)}{(x - 2)^2} \)
25. \( f'(x) = \frac{2}{3} x^{\frac{1}{3}} + \frac{3}{2} x^{\frac{3}{2}} \)
26. \( f'(x) = \frac{1}{2} \left[\frac{2x + 5}{7x - 9}\right] \cdot \frac{1}{\left((7x - 9)^2\right) ((7x - 9)^{-2})} \)
27. \( f'(x) = \sec^2 x \)
28. \( f'(x) = \left[e^{x^2 + 3}\right] \left((3x^3) + (x^3 + 4) \left[e^{2x}(2x) + (x^2 + 3)e^3\right]\right] \)
29. \( f'(x) = \frac{(x^2 + 2)(10x - 7) - (5x^2 - 7x)(2x)}{(x^2 + 2)^2} \)
30. \( f'(x) = 3 \left[\ln(5x^2 + 9)\right]^2 \cdot \frac{1}{5x^2 + 9} (10x + 0) \)
31. \( f'(x) = \frac{1}{(5x^2 + 9)^3} \cdot \left[3(5x^2 + 9)^2(10x + 0)\right] \)
32. \( f'(x) = -\csc^2(6x) \cdot 6 \)
33. \( f'(x) = \sec^2 x(\sec^2 x) + \tan x \left[2 \cdot \sec x(\sec x \tan x)\right] \)
34. \( f'(x) = \frac{1}{\sqrt{1 - (2x)^2}} \cdot 2x \ln 2 \)
35. \( f'(x) = \left(\sec^2(x)\right)(-\sin x) \)
36. \( f'(x) = 3 \left[(x - 1)^5 - x\right]^2 \left(5x^2 - 1\right) \cdot 2x - 1 \)
37. \( f'(x) = \sec x \left(\cos(3x) \cdot 3\right) + \sin(3x) \left(\sec x \tan x\right) \)
38. \( f'(x) = \frac{x(x + 3)^4(3x - 1)^2(1) - (x - 1)^3 \left[x \cdot 4(x + 3)^3(1) + (x + 3)^4(1)\right]}{x^2(x + 3)^8} \)
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. \( \frac{dy}{dx} = \frac{3(y^2 + 1)^2}{(y^2 + 1) \left(\cos y - 2y \sin y\right)} \)
43. 3
44. 11
45. \(-\frac{1}{25}\)
46. 1
47. -7
48. -\frac{1}{4}