ALL KINDS OF DERIVATIVES

Find $\frac{dy}{dx}$ for each of the following: (Note: Do not simplify)

1. $y = \ln\frac{3}{x} = \ln(3x^{-1})$

$y' = \frac{1}{3x^{-1}}(-3x^{-2})$

2. $y = \sin^3(3x) = (\sin(3x))^3$

$y' = 3\sin^2(3x)\cdot\cos(3x)\cdot 3$

3. $y = \sqrt{2x+5} = (2x+5)^{\frac{1}{2}}$

$y' = \frac{1}{2}(2x+5)^{-\frac{1}{2}}\cdot 2$

4. $y = \frac{2x^5}{3} - \frac{x^4}{7} + \frac{8}{x} + \pi^4$

$y' = \frac{10x^5}{3} - \frac{4x^3}{7} - \frac{8}{x^2}$

5. $y = e^{2x-1}$

$y' = e^{2x-1}\cdot 2$

6. $y = \cos(\sin(2x^3))$

$y' = -\sin(\sin(2x^3))\cdot\cos(2x^3)\cdot 6x^2$

7. $y = \frac{e^{3x}}{5x^2+3}$

$y' = \frac{(5x^2+3)(e^{3x}\cdot 3) - e^{3x}\cdot 10x}{(5x^2+3)^2}$

8. $y = x^{\pi-2}$

$y' = (\pi-2)x^{\pi-3}$

9. $4x^3 - xy = \sin(\frac{\pi}{2})$

$12x^2 - (y + xy') = \cos(\frac{\pi}{2})\cdot 0$

$12x^2 - y - xy' = 0$

$-xy' = y - 12x^2$ $\quad y' = \frac{y-12x^2}{-x}$

10. $x + \cot(y) = 9\pi$

$1 - \csc^2(y)y' = 0$

$y' = \frac{1}{\csc^2 y}$

11. $y = \log_5\left(\frac{2}{e}x\right)$

$y' = \frac{1}{\frac{2}{e}x}\cdot\frac{1}{\ln 5}\cdot\frac{2}{e}$

12. $y = \sqrt[3]{5-x} = (5-x)^{\frac{1}{3}}$

$y' = \frac{1}{3}(5-x)^{-2/3}\cdot(-1)$

13. $y = \csc x - 5x^3\sin x$

$y' = -\csc x\cot x - (5x^3\cos x + 15x^2\sin x)$

14. $y = x^x$

$\ln y = \ln x^x$ $\quad \frac{d}{dx}(\ln y = x\ln x)$ $\quad \frac{1}{y}\cdot y' = 1\cdot\ln x + x\cdot\frac{1}{x}$

$y' = y(\ln x + 1)$

$y' = x^x(\ln x + 1)$

15. $y = 9\tan(\csc(2x^3))$

$y' = 9\sec^2(\csc(2x^3))\cdot(-\csc(2x^3)\cot(2x^3))\cdot 6x^2$

16. $y = \tan^4(2x+3)$

$y' = 4\tan^3(2x+3)\cdot\sec^2(2x+3)\cdot 2$

17. $y = \frac{2x+5}{3x-e^{-x}}$

$y' = \frac{(3x-e^{-x})(2) - (2x+5)(3+e^{-x})}{(3x-e^{-x})^2}$

18. $y = 2x^{1-\pi} + \ln 2x$

$y' = (2-2\pi)x^{-\pi} + \frac{1}{2x}\cdot 2$

19. $x - \cos y = e^2$

$1 + \sin y\cdot y' = 0$

$y' = \frac{-1}{\sin y}$

20. $y = e^{x^2+2x-\pi}$

$y' = e^{x^2+2x-\pi}\cdot(2x+2)$

21. $y = xe^x - x^2e^x$

$y' = x\cdot e^x + e^x - (x^2e^x + 2xe^x)$

22. $y = e^{\cos x} + \sin\pi$

$y' = e^{\cos x}(-\sin x)$

23. $y = \ln\sqrt{5x^2-3}$

$y' = \frac{1}{\sqrt{5x^2-3}}\cdot\frac{1}{2}(5x^2-3)^{-\frac{1}{2}}\cdot 10x$

24. $y = 3^{2x-5} + \pi^e$

$y' = 3^{2x-5}\cdot\ln 3\cdot 2$

25. $y = \cos(\sin(2x-1))$

$y' = -\sin(\sin(2x-1))\cdot\cos(2x-1)\cdot 2$

26. $y = \csc(3-4x)$

$y = -\csc(3-4x)\cot(3-4x)(-4)$

27. $y = 5e^{3x}$

$y' = 5e^{3x} \cdot 3$

28. $y = 6x^{\pi} - \frac{1}{4x}$

$y' = 6\pi x^{\pi-1} + \frac{1}{4} \cdot x^{-2}$

29. $y = x + \sec(y) + e$

$y' = 1 + \sec(y)\tan(y)y'$ $\quad y' = \frac{1}{1-\sec(y)\tan(y)}$

$y' - \sec(y)\tan(y)y' = 1$

30. $y = \frac{4\sin 3x}{5-x}$ $\quad y' = \frac{(5-x)\cdot 4\cos(3x)\cdot 3 + 4\sin 3x}{(5-x)^2}$

31. $y = \ln(6x^2 + 2)$

$y' = \frac{1}{6x^2+2} \cdot 12x$

32. $y = x\cot(5x) + 1$ $\quad y' = x\cdot(-\csc^2(5x)\cdot 5) + \cot(5x)$

33. $y = \tan\sqrt{1+5x}$

$y' = (\sec^2\sqrt{1+5x}) \cdot \frac{1}{2}(1+5x)^{-\frac{1}{2}} \cdot 5$

34. $y = \frac{x^5}{4} + \frac{x^2}{2} + \frac{5}{x} - \pi^4$ $\quad y' = \frac{5}{4}x^4 + x - 5x^{-2}$

35. $y = \sin^6(4x)$

$y' = 6\sin^5(4x) \cdot \cos(4x) \cdot 4$

36. $y = \cos(\sin(7x^4))$

$y' = -\sin(\sin(7x^4)) \cdot \cos(7x^4) \cdot 28x^3$

37. $y = \frac{2x+1}{4+3\cos x}$

$y' = \frac{(4+3\cos x)(2) - (2x+1)(-3\sin x)}{(4+3\cos x)^2}$

38. $y = x^{e+3}$

$y' = (e+3)x^{e+2}$

39. $5x^2 - xy + y^2 = \sin\pi$

$10x - xy' - y + 2yy' = 0$ $\quad y' = \frac{y-10x}{2y-x}$

$y'(2y-x) = y - 10x$

40. $x + \cot(y) = 0$ $\quad y' = \frac{1}{\csc^2(y)}$

$1 - \csc^2(y)y' = 0$

41. $y = \sec\frac{3}{\sqrt{x}}$

$y' = \sec\frac{3}{\sqrt{x}} \cdot \tan\frac{3}{\sqrt{x}} \cdot -\frac{3}{2}x^{-\frac{3}{2}}$

42. $y = \sqrt{5-3x+2x^2}$

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

43. $y = 2\cos(7x)$

$y' = -2\sin(7x)\cdot 7$

44. $y = \log_3(5-x^3)$

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

45. $y = \frac{3}{x} - x\ln x + 7\sqrt{e}$

$y' = -3x^{-2} - x\cdot\frac{1}{x} - \ln x$

46. $y = 6e^{5x-1}$

$y' = 6e^{5x-1} \cdot 5$

47. $y = \frac{x^2-3}{\cot e^x}$

$y' = \frac{\cot e^x \cdot 2x - (x^2-3)(-\csc^2 e^x)\cdot e^x}{(\cot e^x)^2}$

48. $y = \ln\frac{2}{e^x} = \ln(2e^{-x})$

$y' = \frac{1}{2e^{-x}} \cdot -2e^{-x}$

49. $y - x^2\cos y = \tan\pi$

$y' - 2x\cos y + x^2(+\sin y \cdot y') = 0$

$y' = \frac{2x\cos y}{x^2\sin y + 1}$

50. $y = \pi^{5x} + e^3$

$y = \pi^{5x} \cdot \ln\pi \cdot 5$

51. $y = \log_4(-3x)$

$y' = \frac{1}{-3x} \cdot \frac{1}{\ln 4} \cdot -3$

52. $y = \sqrt[5]{5+3x}$

$y = \frac{1}{5}(5+3x)^{-4/5}(3)$

53. $y = 6x - x^2\sin x$

$y' = 6 - x^2\cos x - 2x\sin x$

54. $y = \frac{3}{x^2} - \frac{x^4}{5} + \ln e$

$y' = -6x^{-3} - \frac{4}{5}x^3$

55. $y = 5x^{3+\pi}$

$y' = 5(3+\pi)x^{2+\pi}$

56. $y = \tan^9(2x)$

$y' = 9\tan^8(2x)\cdot \sec^2(2x)\cdot 2$

57. $y = \dfrac{2x+5}{e^{3x}}$

$y' = \dfrac{e^{3x}\cdot 2 - (2x+5)(3e^{3x})}{e^{6x}}$

58. $y = \ln(2x+1)$

$y' = \frac{1}{2x+1}\cdot 2$

59. $x + 5\sin y = e^2$

$1 + 5\cos y\, y' = 0$

$y' = \frac{-1}{5\cos y}$

60. $y = e^{x^2+2x-\pi}$

$y' = (2x+2)e^{x^2+2x-\pi}$

61. $y = \dfrac{5}{x^2} - \dfrac{x^4}{4} + \ln\pi$

$y' = -10x^{-3} - x^3$

62. $y = x^{2x}$

$\ln y = \ln x^{2x}$

$\ln y = 2x \ln x$

$\frac{1}{y}\cdot y' = 2x\cdot\frac{1}{x} + 2\ln x$

$y' = y(2 + 2\ln x)$

$y' = x^{2x}(2 + 2\ln x)$

63. $y = 5e^x$

$y' = 5e^x$

64. $y = 6e^{2x}$

$y' = 12e^{2x}$

65. $y = 7^{\cos x}$

$y' = 7^{\cos x}\cdot \ln 7\cdot(-\sin x)$

66. $y = 7\sec(3x)$

$y' = 21\sec(3x)\tan(3x)$

67. $y = 5\tan(3x)$

$y' = 5\sec^2(3x)\cdot 3$

68. $y = x^{3x}$

$\ln y = \ln x^{3x}$

$\ln y = 3x\ln x$

$\frac{1}{y}\cdot y' = 3x\cdot\frac{1}{x} + 3\ln x$

$y' = y(3 + 3\ln x)$

$y' = x^{3x}(3 + 3\ln x)$

Find the first derivative

69. $5f(x) - 4g(x)$

$5f'(x) - 4g'(x)$

70. $f(5x)$

$5\cdot f'(5x)$

71. $f(3x)\cdot g(x)$

$f(3x)\cdot g'(x) + 3f'(3x)\cdot g(x)$

72. $\dfrac{f(x) + 5\sin x}{g(x)}$

$\dfrac{g(x)[f'(x) + 5\cos x] - [f(x) + 5\sin x]g'(x)}{g^2(x)}$

73. $f^4(x)\cdot g(5x^2 - 2x)$

$f^4(x)\cdot g'(5x^2-2x)\cdot(10x-2) + 4\cdot f^3(x)\cdot g(5x^2-2x)$

74. $f\left(g(2x)\right)$

$f'(g(2x))\cdot g'(2x)\cdot 2$

75. $g\left(3x - f(x)\right)$

$g'(3x - f(x))\cdot(3 - f'(x))$

76. $f^3\left(g(5-2x)\right)$

$3f^2(g(5-2x))\cdot g'(5-2x)\cdot(-2)$