

# Mastery Exam Retake Review Key

1.  $y = \frac{8x^3-7x}{37x^4-8}$   
 $\frac{dy}{dx} = \frac{(37x^4-8)(8 \cdot 3x^2-7) - (8x^3-7x)(37 \cdot 4x^3)}{(37x^4-8)^2}$

2.  $y = 12\sqrt{5x^3-3}$   
 $\frac{dy}{dx} = 12 \cdot \frac{1}{2} (5x^3-3)^{-\frac{1}{2}} (5 \cdot 3x^2)$

3.  $y = x^9 - 5x^{-7}$   
 $\frac{dy}{dx} = 9x^8 - 5(-7x^{-8})$

4.  $y = 15e^3$   
 $\frac{dy}{dx} = 0$

5.  $9y - 2 = 10x^3 - 5xy$   
 $\frac{dy}{dx} = \frac{30x^2-5y}{9+5x}$   
 $\frac{d}{dx}(9y - 2) = \frac{d}{dx}(10x^3 - 5xy)$   
 $9\frac{dy}{dx} = 10 \cdot 3x^2 - 5\left(1 \cdot y + x\frac{dy}{dx}\right)$   
 $9\frac{dy}{dx} = 30x^2 - 5y - 5x\frac{dy}{dx}$   
 $9\frac{dy}{dx} + 5x\frac{dy}{dx} = 30x^2 - 5y$   
 $\frac{dy}{dx} = \frac{30x^2-5y}{9+5x}$

6.  $y = -\csc(\cot(x))$   
 $\frac{dy}{dx} = \csc(\cot(x)) \cot(\cot(x)) \cdot (-\csc^2(x))$

7.  $y = \cos\left(x^{\frac{2}{7}}\right)$   
 $\frac{dy}{dx} = -\sin\left(x^{\frac{2}{7}}\right) \frac{2}{7}x^{-\frac{5}{7}}$

8.  $y = 10 \ln(3x - 2)$   
 $\frac{dy}{dx} = 10 \cdot \frac{1}{3x-2} \cdot 3$

$$9. \ y = \sin^{-1}(5x - 2)$$

$$\frac{dy}{dx} = \frac{1}{\sqrt{1-(5x-2)^2}} \cdot 5$$


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$$10. \ y = e^{-2x} \left( \frac{5}{x} + 12x^2 \right)$$

$$\frac{dy}{dx} = e^{-2x} \cdot (-2) \left( \frac{5}{x} + 12x^2 \right) + e^{-2x} (5(-x^{-2}) + 12 \cdot 2x)$$


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$$11. \ y = 15.782$$

$$\frac{dy}{dx} = 0$$


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$$12. \ y = \sin(15x^3 - 8x)$$

$$\frac{dy}{dx} = \cos(15x^3 - 8x) (15 \cdot 3x^2 - 8)$$


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$$13. \ y = e^{x^3}$$

$$\frac{dy}{dx} = e^{x^3} \cdot 3x^2$$


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$$14. \ y = \ln(\cos(2x))$$

$$\frac{dy}{dx} = \frac{1}{\cos(2x)} \cdot (-\sin(2x) \cdot 2)$$


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$$15. \ y = x^{\frac{3}{2}} + 3x^{\frac{9}{2}}$$

$$\frac{dy}{dx} = \frac{3}{2}x^{\frac{1}{2}} + 3 \cdot \frac{9}{2}x^{\frac{7}{2}}$$


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$$16. \ y = \csc(\ln(x))$$

$$\frac{dy}{dx} = -\csc(\ln(x)) \cot(\ln(x)) \cdot \frac{1}{x}$$


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$$17. \ y = \csc^{11}(5x - 2)$$

$$\frac{dy}{dx} = 11 \csc^{10}(5x - 2) (-\csc(5x - 2) \cot(5x - 2)) \cdot 5$$


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$$18. \ y = 15 \cot(11x) - \sin(15x)$$

$$\frac{dy}{dx} = 15(-\csc^2(11x)) \cdot 11 - \cos(15x) \cdot 15$$


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19.  $y = 17^{5x^2}$   
 $\frac{dy}{dx} = \underline{17^{5x^2} \ln 17(5 \cdot 2x)}$

20.  $y = 3x\sqrt{9x^3 - 17x + 3}$   
 $\frac{dy}{dx} = \underline{3\sqrt{9x^3 - 17x + 3} + 3x\frac{1}{2}(9x^3 - 17x + 3)^{-1/2}(9 \cdot 3x^2 - 17)}$

21.  $y = \frac{19x^7+10x}{7x^2-1}$   
 $\frac{dy}{dx} = \underline{\frac{(7x^2-1)(19 \cdot 7x^6+10)-(19x^7+10x)(7 \cdot 2x)}{(7x^2-1)^2}}$

22.  $y = -\sqrt[3]{23x^7}$   
 $\frac{dy}{dx} = \underline{-\frac{1}{3}(23x^7)^{-\frac{2}{3}} \cdot 23 \cdot 7x^6}$

23.  $y = -4x^4 + 15x^{-\frac{2}{19}}$   
 $\frac{dy}{dx} = \underline{-4 \cdot 4x^3 + 15\left(-\frac{2}{19}x^{-\frac{21}{19}}\right)}$

24.  $y = 9e^\pi$   
 $\frac{dy}{dx} = \underline{0}$

25.  $y^3 - 5y = x + 2$   
 $\frac{dy}{dx} = \underline{\frac{1}{3y^2-5}}$   
 $\frac{d}{dx}(y^3 - 5y) = \frac{d}{dx}(x + 2)$   
 $3y^2y' - 5y' = 1$   
 $y'(3y^2 - 5) = 1$   
 $y' = \frac{1}{3y^2-5}$

26.  $y = \tan(\cos(x))$   
 $\frac{dy}{dx} = \underline{\sec^2(\cos(x)) \cdot (-\sin(x))}$

27.  $y = 15 \tan(7x - 7)$   
 $\frac{dy}{dx} = \underline{15 \sec^2(7x - 7) \cdot 7}$

$$28. y = -\ln(9x^6 - 13x)$$

$$\frac{dy}{dx} = \underline{-\frac{1}{9x^6-13x} (9 \cdot 6x^5 - 13)}$$

$$29. y = \tan^{-1}(x^7 - 15x^3)$$

$$\frac{dy}{dx} = \underline{\frac{1}{1+(x^7-15x^3)^2} (7x^6 - 15 \cdot 3x^2)}$$

$$30. y = 4e^{x^2}(x^6 - 15x)$$

$$\frac{dy}{dx} = \underline{4e^{x^2} 2x(x^6 - 15x) + 4e^{x^2}(6x^5 - 15)}$$

$$31. y = \frac{e}{19}$$

$$\frac{dy}{dx} = \underline{0}$$

$$32. y = \sec(\ln(2x))$$

$$\frac{dy}{dx} = \underline{\sec(\ln(2x)) \tan(\ln(2x)) \cdot \frac{1}{2x} \cdot 2}$$

$$33. y = 5e^{-x}$$

$$\frac{dy}{dx} = \underline{5e^{-x}(-1)}$$

$$34. y = 3 \ln(x^3)$$

$$\frac{dy}{dx} = \underline{3 \left(\frac{1}{x^3}\right) 3x^2}$$

$$35. y = 6x^{-\frac{1}{4}} + 7x^{-\frac{3}{4}}$$

$$\frac{dy}{dx} = \underline{6 \left(-\frac{1}{4}x^{-\frac{5}{4}}\right) + 7 \left(-\frac{3}{4}x^{-\frac{7}{4}}\right)}$$

$$36. y = \cot(x^6 - 19x)$$

$$\frac{dy}{dx} = \underline{-\csc^2(x^6 - 19x) \cdot (6x^5 - 19)}$$

$$37. y = 7 \cos^3(5x - 2)$$

$$\frac{dy}{dx} = \underline{7 \cdot 3 \cos^2(5x - 2)(-\sin(5x - 2)) \cdot 5}$$

$$38. \ y = -\tan(17x) - \csc^2(x^{-2})$$

$$\frac{dy}{dx} = \underline{-\sec^2(17x) \cdot 17 - 2 \csc(x^{-2}) \cdot (-\csc(x^{-2}) \cot(x^{-2})) \cdot (-2x^{-3})}$$

$$39. \ y = 3^{3x}$$

$$\frac{dy}{dx} = \underline{3^{3x} \ln 3 \cdot 3}$$

$$40. \ y = 19e^{-7x} \left(7x - \frac{3}{13x}\right)$$

$$\frac{dy}{dx} = \underline{19e^{-7x}(-7) \left(7x - \frac{3}{13x}\right) + 19e^{-7x} \left(7 - \frac{3}{13}(-x^{-2})\right)}$$

$$41. \ y = \frac{6x^6 - 13}{15x^4 - 2}$$

$$\frac{dy}{dx} = \underline{\frac{(15x^4 - 2)(6 \cdot 6x^5) - (6x^6 - 13)(15 \cdot 4x^3)}{(15x^4 - 2)^2}}$$

$$42. \ y = -3\sqrt{7x^3 - 5x}$$

$$\frac{dy}{dx} = \underline{(-3) \frac{1}{2} (7x^3 - 5x)^{-\frac{1}{2}} (7 \cdot 3x^2 - 5)}$$

$$43. \ y = 6x^3 + 9x^{-3}$$

$$\frac{dy}{dx} = \underline{6 \cdot 3x^2 + 9(-3x^{-4})}$$

$$44. \ y = e^7$$

$$\frac{dy}{dx} = \underline{0}$$

$$45. \ 5y = 9x + 3xy$$

$$\frac{dy}{dx} = \frac{9+3y}{5-3x}$$

$$\frac{d}{dx}(5y) = \frac{d}{dx}(9x + 3xy)$$

$$5y' = 9 + 3(y + xy')$$

$$5y' = 9 + 3y + 3xy'$$

$$5y' - 3xy' = 9 + 3y$$

$$y'(5 - 3x) = 9 + 3y$$

$$y' = \frac{9+3y}{5-3x}$$

$$46. \ y = 7 \cos(\sin(x))$$

$$\frac{dy}{dx} = \underline{7(-\sin(\sin x))(\cos x)}$$

$$47. \ y = 8 \cot(5\sqrt{2x})$$

$$\frac{dy}{dx} = \underline{8(-\csc^2(5\sqrt{2x}))5 \cdot \frac{1}{2}(2x)^{-\frac{1}{2}} \cdot 2}$$

$$48. \ y = \ln\left(\frac{3x}{x+2}\right)$$

$$\frac{dy}{dx} = \underline{\left(\frac{1}{\frac{3x}{x+2}}\right) \left(\frac{(x+2)(3) - 3x(1)}{(x+2)^2}\right)}$$

$$49. \ y = \cos^{-1}(-6x)$$

$$\frac{dy}{dx} = \underline{-\frac{1}{\sqrt{1-(-6x)^2}}(-6)}$$

$$50. \ y = -7x^3 \sqrt[5]{9x^3 - 2}$$

$$\frac{dy}{dx} = \underline{-7 \cdot 3x^2 \sqrt[5]{9x^3 - 2} + (-7x^3) \frac{1}{5} (9x^3 - 2)^{-\frac{4}{5}} (9 \cdot 3x^2)}$$

$$51. \ y = \ln(\cos(\pi))$$

$$\frac{dy}{dx} = \underline{0}$$

$$52. \ y = \cos(3x + 9)$$

$$\frac{dy}{dx} = \underline{\sin(3x + 9)(3)}$$

$$53. \ y = e^{\sqrt{x}}$$

$$\frac{dy}{dx} = \underline{e^{\sqrt{x}} \left(\frac{1}{2}x^{-\frac{1}{2}}\right)}$$

$$54. \ y = \ln(\sec(5x))$$

$$\frac{dy}{dx} = \underline{\frac{1}{\sec(5x)} \sec(5x) \tan(5x) \cdot 5}$$

$$55. \ y = 17x^{-\frac{4}{5}} + 7x^{\frac{9}{7}}$$

$$\frac{dy}{dx} = \underline{17 \left(-\frac{4}{5}x^{-\frac{9}{5}}\right) + 7 \left(\frac{9}{7}x^{\frac{2}{7}}\right)}$$

$$56. \ y = 17 \csc(x^3 - 1)$$

$$\frac{dy}{dx} = \underline{17(-\csc(x^3 - 1) \cot(x^3 - 1)) \cdot 3x^2}$$

$$57. \ y = \tan^{12}(x^{-2})$$

$$\frac{dy}{dx} = \underline{12 \tan^{11}(x^{-2}) (\sec^2(x^{-2})) (-2x^{-3})}$$

$$58. \ y = \sin^3 x - 7 \cos x$$

$$\frac{dy}{dx} = \underline{3 \sin^2 x (\cos(x)) - 7(-\sin x)}$$

$$59. \ y = 29^{5x}$$

$$\frac{dy}{dx} = \underline{29^{5x} \cdot \ln 29 \cdot 5}$$

$$60. \ y = 5e^{3x^2} (e^{3x} - x^{-3})$$

$$\frac{dy}{dx} = \underline{5e^{3x^2} \cdot 3 \cdot 2x (e^{3x} - x^{-3}) + 5e^{3x^2} (e^{3x} \cdot 3 - (-3x^{-4}))}$$

$$61. \ y = \frac{3x+6}{3x^{15}-9x}$$

$$\frac{dy}{dx} = \underline{\frac{(3x^{15}-9x)(3)-(3x+6)(3 \cdot 15x^{14}-9)}{(3x^{15}-9x)^2}}$$

$$62. \ y = -17\sqrt[4]{15x-3}$$

$$\frac{dy}{dx} = \underline{-17 \cdot \frac{1}{4}(15x-3)^{-\frac{3}{4}} \cdot 15}$$

$$63. \ y = 15x^{\frac{2}{3}} - x^{-\frac{7}{9}}$$

$$\frac{dy}{dx} = \underline{15 \left( \frac{2}{3} x^{-\frac{1}{3}} \right) - \left( \frac{-7}{9} x^{-\frac{16}{9}} \right)}$$

$$64. \ y = \sin(3\pi)$$

$$\frac{dy}{dx} = \underline{0}$$

$$65. \ y - 9 = 5x^2 + xy$$

$$\frac{dy}{dx} = \underline{\frac{10x+y}{1-x}}$$

$$\begin{aligned}\frac{d}{dx}(y - 9) &= \frac{d}{dx}(5x^2 + xy) \\ y' &= 5 \cdot 2x + y + xy' \\ y' - xy' &= 10x + y \\ y'(1 - x) &= 10x + y \\ y' &= \frac{10x + y}{1 - x}\end{aligned}$$

66.  $y = \sec(\sin(x))$   
 $\frac{dy}{dx} = \underline{\sec(\sin x) \tan(\sin x) \cdot \cos x}$

67.  $y = \cot(3x^7 - 4)$   
 $\frac{dy}{dx} = \underline{-\csc^2(3x^7 - 4) (3 \cdot 7x^6)}$

68.  $y = 3 \ln(3x)$   
 $\frac{dy}{dx} = \underline{3 \cdot \frac{1}{3x} \cdot 3}$

69.  $y = \cot^{-1}(\sqrt{2x})$   
 $\frac{dy}{dx} = \underline{-\frac{1}{1+(\sqrt{2x})^2} \cdot \frac{1}{2}(2x)^{-\frac{1}{2}} \cdot 2}$

70.  $y = \left(\cos^3(3x) - \frac{9}{x}\right) (x^3 + 3x^5)$   
 $\frac{dy}{dx} = \underline{\left(3 \cos^2(3x)(-\sin(3x)) \cdot 3 - 9(-x^{-2})\right) (x^3 + 3x^5) + (3x^2 + 3 \cdot 5x^4) \left(\cos^3(3x) - \frac{9}{x}\right)}$

71.  $y = 7e^8$   
 $\frac{dy}{dx} = \underline{0}$

72.  $y = \tan\left(\frac{1}{x}\right)$   
 $\frac{dy}{dx} = \underline{\sec^2\left(\frac{1}{x}\right) (-x^{-2})}$

73.  $y = e^{-5x}$   
 $\frac{dy}{dx} = \underline{e^{-5x}(-5)}$



$$74. \ y = 2 \ln(x^3 - 2x)$$

$$\frac{dy}{dx} = \underline{2 \cdot \frac{1}{x^3 - 2x} (3x^2 - 2)}$$

$$75. \ y = 3x^{-\frac{4}{2}} - x^{\frac{2}{3}}$$

$$\frac{dy}{dx} = \underline{3 \left(-\frac{4}{2}x^{-\frac{6}{2}}\right) - \frac{2}{3}x^{-\frac{5}{3}}}$$

$$76. \ y = \tan\left(\frac{9x}{3x^2}\right)$$

$$\frac{dy}{dx} = \underline{\sec^2\left(\frac{9x}{3x^2}\right) \frac{3x^2(9) - 9x(3 \cdot 2x)}{(3x^2)^2}}$$

$$77. \ y = 6 \sin^7(8x)$$

$$\frac{dy}{dx} = \underline{6 (7 \sin^6(8x)) (\cos(8x))(8)}$$

$$78. \ y = 3 \sin(3x - 7) - \cos(\sqrt{3x})$$

$$\frac{dy}{dx} = \underline{3 \cos(3x - 7)(3) - (-\sin(\sqrt{3x})) \left(\frac{1}{2}(3x)^{-\frac{1}{2}}\right) (3)}$$

$$79. \ y = 8^{19x^3}$$

$$\frac{dy}{dx} = \underline{8^{19x^3} \cdot \ln 8 \cdot 19 (3x^2)}$$

$$80. \ y = e^{7x} \left(9 \cos x + \frac{2x}{x^2+1}\right)$$

$$\frac{dy}{dx} = \underline{e^{7x}(7) \left(9 \cos x + \frac{2x}{x^2+1}\right) + e^{7x} \left(9(-\sin x) + \frac{2(x^2+1) - 2x(2x)}{(x^2+1)^2}\right)}$$

$$81. \ y = \frac{32x^9+17x}{3x^2-x}$$

$$\frac{dy}{dx} = \underline{\frac{(3x^2-x)(32 \cdot 9x^8+17) - (32x^9+17x)(3 \cdot 2x-1)}{(3x^2-x)^2}}$$

$$82. \ y = -9\sqrt{27x^5 - 3x}$$

$$\frac{dy}{dx} = \underline{-9 \cdot \frac{1}{2} (27x^5 - 3x)^{-\frac{1}{2}} (27 \cdot 5x^4 - 3)}$$

$$83. \ y = 9x^5 - 14x^{-2}$$

$$\frac{dy}{dx} = \underline{9 \cdot 5x^4 - 14 (-2x^{-3})}$$

$$84. y = 9\pi^3$$

$$\frac{dy}{dx} = \underline{0}$$

$$85. y^2 - 1 = 5xy + y$$

$$\frac{dy}{dx} = \frac{5y}{2y-5x-1}$$

$$\frac{d}{dx}(y^2 - 1) = \frac{d}{dx}(5xy + y)$$

$$2yy' = 5(1 \cdot y + xy') + y'$$

$$2yy' = 5y + 5xy' + y'$$

$$2yy' - 5xy' - y' = 5y$$

$$y'(2y - 5x - 1) = 5y$$

$$y' = \frac{5y}{2y-5x-1}$$

$$86. y = \sin(\cos(\sqrt{x}))$$

$$\frac{dy}{dx} = \underline{\cos(\cos(\sqrt{x}))(-\sin(\sqrt{x}))\left(\frac{1}{2}x^{-\frac{1}{2}}\right)}$$

$$87. y = 9 \sec(5x^3 - 17x)$$

$$\frac{dy}{dx} = \underline{9 \sec(5x^3 - 17x) \tan(5x^3 - 17x) (5 \cdot 3x^2 - 17)}$$

$$88. y = \ln(5x^3 + 7x)$$

$$\frac{dy}{dx} = \underline{\frac{1}{5x^3+7x} (5 \cdot 3x^2 + 7)}$$

$$89. y = \cot^{-1}(6x^5 - 2)$$

$$\frac{dy}{dx} = \underline{-\frac{1}{1+(6x^5-2)^2} (6 \cdot 5x^4)}$$

$$90. y = -2x\sqrt{5x^2 - x}$$

$$\frac{dy}{dx} = \underline{-2\sqrt{5x^2 - x} + (-2x) \left(\frac{1}{2}(5x^2 - x)^{-\frac{1}{2}}\right) (5 \cdot 2x - 1)}$$

$$91. y = \pi^2$$

$$\frac{dy}{dx} = \underline{0}$$

$$92. \ y = \csc(5x^3 - 2)$$

$$\frac{dy}{dx} = \underline{-\csc(5x^3 - 2) \cot(5x^3 - 2) (5 \cdot 3x^2)}$$

$$93. \ y = 7e^{2x}$$

$$\frac{dy}{dx} = \underline{7e^{2x}(2)}$$

$$94. \ y = \frac{\ln(x)}{2}$$

$$\frac{dy}{dx} = \underline{\frac{1}{2} \left(\frac{1}{x}\right)}$$

$$95. \ y = 8x^{-\frac{10}{11}} - 12x^{\frac{13}{12}}$$

$$\frac{dy}{dx} = \underline{8 \left(-\frac{10}{11}x^{-\frac{21}{11}}\right) - 12 \left(\frac{13}{12}x^{\frac{1}{12}}\right)}$$

$$96. \ y = 19 \sec(9x^3 + 2)$$

$$\frac{dy}{dx} = \underline{19 \sec(9x^3 + 2) \tan(9x^3 + 2) (9 \cdot 3x^2)}$$

$$97. \ y = 12 \cos^4(13x)$$

$$\frac{dy}{dx} = \underline{12 (4 \cos^3(13x)(-\sin(13x))(13))}$$

$$98. \ y = \csc(7x) - \cos(x - 1)$$

$$\frac{dy}{dx} = \underline{-\csc(7x) \cot(7x)(7) - (-\sin(x - 1)(1))}$$

$$99. \ y = 19^{-5x}$$

$$\frac{dy}{dx} = \underline{19^{-5x} \cdot \ln 19(-5)}$$

$$100. \ y = 5e^x \left(19x^2 - \frac{3}{x^3}\right)$$

$$\frac{dy}{dx} = \underline{5e^x \left(19x^2 - \frac{3}{x^3}\right) + 5e^x (19 \cdot 2x - 3(-3x^{-4}))}$$