

Gateway Exam #2 Practice
Differentiation

You should know and be able to use the following differentiation formulas.

1. Constant Rule: $\frac{d}{dx}c = 0$, if c is a constant
2. Constant Multiple Rule: $\frac{d}{dx}(cf(x)) = cf'(x)$, if c is a constant
3. Sum Rule: $\frac{d}{dx}(f(x) + g(x)) = f'(x) + g'(x)$
4. Difference Rule: $\frac{d}{dx}(f(x) - g(x)) = f'(x) - g'(x)$
5. Product Rule: $\frac{d}{dx}(f(x)g(x)) = f(x)g'(x) + g(x)f'(x)$
6. Quotient Rule: $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{g(x)f'(x) - f(x)g'(x)}{(g(x))^2}$
7. Power Rule: $\frac{d}{dx}x^n = nx^{n-1}$, if n is an integer
8. $\frac{d}{dx}\sqrt{x} = \frac{1}{2\sqrt{x}}$
9. $\frac{d}{dx}e^{kx} = ke^{kx}$

Find the derivative of each of the following functions.

1. $f(x) = 7x^{10}$
2. $f(x) = -14x^2 - 14$
3. $f(x) = 7x^4 + 3x^2 - 2$
4. $f(x) = x^3 + x^2 + x + 1$
5. $f(x) = 10x^{-1} - 2$
6. $f(x) = x^3 - x^{-3}$
7. $f(x) = 2x^{-2} + 4x^{-1} - 8$
8. $f(x) = \sqrt{2}x^2 - \sqrt{2}$
9. $f(x) = ex^7 - e^2x^5$

10. $f(x) = x^4 - e^2$
11. $f(x) = 10e^{2x}$
12. $f(x) = x^2 - 4e^{4x}$
13. $f(x) = e^x - e^{-x}$
14. $f(x) = 7e^{10x} - 2e^{-2x}$
15. $f(x) = 2\sqrt{x}$
16. $f(x) = x - \sqrt{x}$
17. $f(x) = 4\sqrt{x} + x^2 + \sqrt{2}$
18. $f(x) = 10x^{10} + 10e^{10x}$
19. $f(x) = -2x^{-4} + e^{3x}$
20. $f(x) = e^{-x} - \sqrt{x}$
21. $f(x) = \sqrt{2x}$
22. $f(x) = \sqrt{4x}$
23. $f(x) = \sqrt{ex}$
24. $f(x) = e^x - x^{-1} + e$
25. $f(x) = (2x^2 - 1)(3x^3 - 3)$
26. $f(x) = (3x^4 - x)^2$
27. $f(x) = x\sqrt{x}$
28. $f(x) = xe^x$
29. $f(x) = xe^{-x}$
30. $f(x) = e^x\sqrt{x}$
31. $f(x) = e^{2x}(x^2 - 1)$
32. $f(x) = e^{3x}(e - 2)$
33. $f(x) = e^{4x}e^{-2x}$
34. $f(x) = x^{10}e^x$

$$35. f(x) = \sqrt{x}(x^4 - x^3)$$

$$36. f(x) = x^2 e^x (x^2 - x)$$

$$37. f(x) = x e^{2x} \sqrt{x}$$

$$38. f(x) = 2x e^{4x} \sqrt{x}$$

$$39. f(x) = 10x^2 e^{-x} (\sqrt{x} - 1)$$

$$40. f(x) = \frac{x+1}{x-1}$$

$$41. f(x) = \frac{x^2 - x}{2x + 2}$$

$$42. f(x) = \frac{2x^{10} - 4x}{x^{10} - 1}$$

$$43. f(x) = \frac{7x^6 - 6x + 1}{2x - 4}$$

$$44. f(x) = \frac{8x^4 - 6x^3 + 2}{2}$$

$$45. f(x) = \frac{6x^5 - 3x^3 + 1}{2}$$

$$46. f(x) = \frac{(x-2)(x+1)}{x^2}$$

$$47. f(x) = \frac{x^{10} - 4x^6 + 2}{x^3}$$

$$48. f(x) = \frac{e^x}{x^2}$$

$$49. f(x) = \frac{x^2}{e^x}$$

$$50. f(x) = \frac{x^2}{x^3 - x + 1}$$

$$51. f(x) = \frac{e^{2x} - e^{-2x}}{x}$$

$$52. f(x) = \frac{x^2 - e^{4x}}{x^2 + e}$$

$$53. f(x) = \frac{4x^2 - x + 1}{\sqrt{x}}$$

54. $f(x) = \frac{4x^2 - x + 1}{\sqrt{x} + 1}$
55. $f(x) = \frac{\sqrt{2x} - 1}{x^2 - 1}$
56. $f(x) = \frac{10e^{6x}}{5e^{3x}}$
57. $f(x) = \frac{x^2 e^x}{x^3 - 1}$
58. $f(x) = \frac{x\sqrt{x}}{e^x}$
59. $f(x) = \frac{x(\sqrt{x} + 1)}{e^{2x}}$
60. $f(x) = \frac{\frac{1}{x} - \frac{1}{x^2}}{2x^2 - 2}$
61. $f(x) = \frac{e^{2x}\sqrt{2x}}{x^2 + x^{-2}}$
62. $f(x) = \frac{10x^5 - 6x^2}{x + 1}$
63. $f(x) = e^x \left(\frac{1}{x} - \frac{1}{x^3} \right)$
64. $f(x) = 100x^{100} - 100$
65. $f(x) = (x - 2)(x - 3)(x - 4)$
66. $f(x) = e^x(x - 4)(x - 2)$
67. $f(x) = \frac{1}{\sqrt{x}}(x^2 - x)$
68. $f(x) = 14$
69. $f(x) = e + 2$
70. $f(x) = ex + 2$
71. $f(x) = xe^x + 2$
72. $f(x) = 8x^8 + 6x^6 + 4x^4 + 2x^2$
73. $f(x) = e^x + e^{2x} + e^{4x}$

74. $f(x) = 1200x^0 + x^{1200}$

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

76. $f(x) = e^x(1 + x^{-1})$

77. $f(x) = e^x e^{2x} e^{3x}$

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

79. $f(x) = 2 + e + x + \sqrt{2}$

80. $f(x) = 10(x^4 - 2x^2)$

Answers:

1. $f'(x) = 70x^9$

2. $f'(x) = -28x$

3. $f'(x) = 28x^3 + 6x$

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

5. $f'(x) = -10x^{-2}$

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

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

8. $f'(x) = 2\sqrt{2}x$

9. $f'(x) = 7ex^6 - 5e^2x^4$

10. $f'(x) = 4x^3$

11. $f'(x) = 20e^{2x}$

12. $f'(x) = 2x - 16e^{4x}$

13. $f'(x) = e^x + e^{-x}$

14. $f'(x) = 70e^{10x} + 4e^{-2x}$

15. $f'(x) = \frac{1}{\sqrt{x}}$

16. $f'(x) = 1 - \frac{1}{2\sqrt{x}}$

17. $f'(x) = \frac{2}{\sqrt{x}} + 2x$

18. $f'(x) = 100x^9 + 100e^{10x}$

19. $f'(x) = 8x^{-5}3e^{3x}$

20. $f'(x) = -e^{-x} - \frac{1}{2\sqrt{x}}$

21. $f'(x) = \frac{2}{2\sqrt{x}}$

22. $f'(x) = \frac{1}{\sqrt{x}}$

$$23. f'(x) = \frac{\sqrt{e}}{2\sqrt{x}}$$

$$24. f'(x) = e^x + x^{-2}$$

$$25. f'(x) = (2x^2 - 1)(9x^2) + (3x^3 - 3)(4x)$$

$$26. f'(x) = 2(3x^4 - x)(12x^3 - 1)$$

$$27. f'(x) = \frac{x}{2\sqrt{x}} + \sqrt{x}$$

$$28. f'(x) = xe^x + e^x$$

$$29. f'(x) = -xe^{-x} + e^{-x}$$

$$30. f'(x) = e^x\sqrt{x} + \frac{e^x}{2\sqrt{x}}$$

$$31. f'(x) = e^{2x}(2x) + 2e^{2x}(x^2 - 1)$$

$$32. f'(x) = 3(e - 2)e^{3x}$$

$$33. f'(x) = 2e^{2x}$$

$$34. f'(x) = x^{10}e^x + 10x^9e^x$$

$$35. f'(x) = \sqrt{x}(4x^3 - 3x^2) + \frac{x^4 - x^3}{2\sqrt{x}}$$

$$36. f'(x) = e^x(4x^3 - 3x^2) + e^x(x^4 - x^3)$$

$$37. f'(x) = e^{2x}\sqrt{x} + 2xe^{2x}\sqrt{x} + \frac{xe^{2x}}{2\sqrt{x}}$$

$$38. f'(x) = 2e^{4x}\sqrt{x} + 8xe^{4x}\sqrt{x} + \frac{xe^{4x}}{\sqrt{x}}$$

$$39. f'(x) = 20xe^{-x}(\sqrt{x} - 1) - 10x^2e^{-x}(\sqrt{x} - 1) + \frac{5x^2e^{-x}}{\sqrt{x}}$$

$$40. f'(x) = \frac{(x-1) - (x+1)}{(x-1)^2}$$

$$41. f'(x) = \frac{(2x+2)(2x-1) - 2(x^2-x)}{(2x+2)^2}$$

$$42. f'(x) = \frac{(x^{10}-1)(20x^9-4) - (2x^{10}-4x)(10x^9)}{(x^{10}-1)^2}$$

$$43. f'(x) = \frac{(2x-4)((42x^5-6) - 2(7x^6-6x+1))}{(2x-4)^2}$$

$$44. f'(x) = 16x^3 - 9x^2$$

$$45. f'(x) = \frac{30}{2}x^4 - \frac{9}{2}x^2$$

$$46. f'(x) = x^{-2} + 4x^{-3}$$

$$47. f'(x) = 7x^6 - 12x^2 - 6x^{-4}$$

$$48. f'(x) = \frac{x^2e^x - 2xe^x}{x^4}$$

$$49. f'(x) = \frac{2xe^x - x^2e^x}{e^{2x}}$$

$$50. f'(x) = \frac{(x^3 - x + 1)(2x) - x^2(3x^2 - 1)}{(x^3 - x + 1)^2}$$

$$51. f'(x) = \frac{x(2e^{2x} + 2e^{-2x}) - (e^{2x} - e^{-2x})}{x^2}$$

$$52. f'(x) = \frac{(x^2 + e)(2x - 4e^{4x}) - (x^2 - e^{4x})(2x)}{(x^2 + e)^2}$$

$$53. f'(x) = \frac{\sqrt{x}(8x-1) - (4x^2-x+1)\frac{1}{2\sqrt{x}}}{x}$$

$$54. f'(x) = \frac{(\sqrt{x}+1)(8x-1) - (4x^2-x+1)\frac{1}{2\sqrt{x}}}{(\sqrt{x}+1)^2}$$

$$55. f'(x) = \frac{(x^2-1)\frac{\sqrt{2}}{2\sqrt{x}} - (\sqrt{2x}-1)(2x)}{(x^2-1)^2}$$

$$56. f'(x) = 6e^{3x}$$

$$57. f'(x) = \frac{(x^3-1)(x^2e^x + 2xe^x) - (x^2e^x)(3x^2)}{(x^3-1)^2}$$

$$58. f'(x) = \frac{e^x(\frac{x}{2\sqrt{x}} + \sqrt{x}) - x\sqrt{x}(e^x)}{e^{2x}}$$

$$59. f'(x) = \frac{e^{2x}(\frac{x}{2\sqrt{x}} + \sqrt{x} + 1) - 2x(\sqrt{x} + 1)e^{2x}}{e^{4x}}$$

$$60. f'(x) = \frac{(2x^4 - 2x^2) - (x-1)(8x^3 - 4x)}{(2x^4 - 2x^2)^2}$$

$$61. f'(x) = \frac{(x^2 + x^{-2})\left(\frac{\sqrt{2}e^{2x}}{2\sqrt{x}} + 2e^{2x}\sqrt{2x}\right) - e^{2x}\sqrt{2x}(2x - 2x^{-3})}{(x^2 + x^{-2})^2}$$

$$62. f'(x) = \frac{(x+1)(50x^4 - 12x) - (10x^5 - 6x^2)}{(x+1)^2}$$

$$63. f'(x) = e^x(-x^{-2} + 3x^{-4}) + e^x(x^{-1} - x^{-3})$$

$$64. f'(x) = 10000x^{99}$$

$$65. f'(x) = 3x^2 - 18x + 26$$

$$66. f'(x) = e^x(2x - 6) + e^x(x^2 - 6x + 8)$$

$$67. f'(x) = \frac{\sqrt{x}(2x - 1) - (x^2 - 1)\frac{1}{2\sqrt{x}}}{x}$$

$$68. f'(x) = 0$$

$$69. f'(x) = 0$$

$$70. f'(x) = e$$

$$71. f'(x) = xe^x + e^x$$

$$72. f'(x) = 64x^7 + 36x^5 + 16x^3 + 4x$$

$$73. f'(x) = e^x + 2e^{2x} + 4e^{4x}$$

$$74. f'(x) = 1200x^{1199}$$

$$75. f'(x) = 1 - x^{-2} - 2x^{-3}$$

$$76. f'(x) = -x^{-2}e^x + e^x(1 + x^{-1})$$

$$77. f'(x) = 6e^{6x}$$

$$78. f'(x) = -4x^3 + 3x^2 - 2x$$

$$79. f'(x) = 1$$

$$80. f'(x) = 40x^3 - 40x$$