Capítulo 4

Seção 4.7

1. a) $2x - y - 2 = 0; y = -1; 2ax - y - a^2 - 1 = 0$

b) $5x + y - 5 = 0; x - y + 2 = 0$

c) $8x + 4y + 3 = 0; (6a - 5)x - y - 3a^2 = 0$

2. a) $x + 2y - 1 = 0;\ x = 0; x + 2ay - 2a^3 + a = 0$

b) $x - 5y + 51 = 0;\ x + y - 6 = 0$

c) $x - 2y - 4 = 0;\ x - (5 - 6a)y - 18a^3 + 45a^2 - 26a = 0$

3. $4x + 4y - 5 = 0$ **4.** $6x + y + 3 = 0;\ x - 6y + 56 = 0$

5. a) $16 + 2b + h$ m/s b) 22,1 m/s; 22,01 m/s; 22,001 m/s c) $16 + 2t$ m/s

d) 22 m/s e) 2 m/s^2

6. a) $\frac{-b}{4} + c$ b) $\frac{2b}{t^3}$

7. a) 4 b) 8 c) –1 d) –1 e) 2/15

8. a) $-8x$ b) $4x - 1$ c) $\frac{-1}{(x+2)^2}$ d) $\frac{-4}{(x+3)^2}$ e) $\frac{-1}{(2x-1)\sqrt{2x-1}}$ f) $\frac{1}{3\sqrt[3]{(x+3)^2}}$

9. a) $\frac{(x-1)^2}{-x^2+2x-2}$ b) $-\left(\frac{x-1}{2-x}\right)^2$ c) $\frac{2}{(x-1)^4} - 3$ d) $\frac{-4}{(x-1)^2}$

e) $\frac{4x^3 - 8x^2 + 4x - 1}{(x-1)^2}$ f) $\frac{-1 - 8x(x-1)^2}{(x-1)^2}$ g) $\frac{-4x}{x-1}$

12. a) $(3/4, +\infty)$ b) $(-\infty, 3/4)$

13. $(2, 4)$, $y = 4x - 4$; $(-2, 4)$, $y = -4x - 4$ **14.** 2, $(2, \frac{4}{3})$, $(-2, 4)$

Seção 4.10

1. $f'(3^+) = 2; f'(3^-) = -2$ **2.** $f'(1^+) = 2; f'(1^-) = 1$

3. $f'(-2^+) = 2; f'(-2^-) = -2$ **4.** $f'(-1^+) = 0; f'(-1^-) = 2; f'(1^+) = -2; f'(1^-) = 0$

5. $f'(-2^+) = 0; f'(-2^-) = 4; f'(2^+) = 2; f'(2^-) = 0$

6. b) é contínua c) 2; −2; 2; −2 d) $f'(x) = \begin{cases} 2x, & \text{se } |x| < 1, \\ -2x, & \text{se } |x| > 1, \end{cases} D = \mathbb{R} - \{-1, 1\}$

Seção 4.12

1. $2\pi r$ **2.** $6x + 6$ **3.** $2\,a\,w$

4. $\dfrac{3}{2x^4}$ **5.** $18x^2 + 6x + 12$ **6.** $14x + 27$

7. $-27x^8 + 30x^4 + 4x^3$ **8.** $\dfrac{-20}{(5x-3)^2}$ **9.** $2x$

10. $(s^2 - 1)(3s - 1)(15s^2 + 2) + 3(s^2 - 1)(5s^3 + 2s) + 2s(3s - 1)(5s^3 + 2s)$

11. $7(2a\,x + b)$ **12.** $-24u^2 + 8au + 2a$ **13.** $\dfrac{-14}{(3x-1)^2}$

14. $\dfrac{2}{(t+1)^2}$ **15.** $\dfrac{3t^2 - 6t - 4}{(t-1)^2}$ **16.** $\dfrac{-t^2 + 4t - 2}{t^2 - 4t + 4}$

17. $\dfrac{-x^2 + 8x - 5}{(5 - x^2)^2}$ **18.** $\dfrac{-24}{(2x-2)^2}$ **19.** $\dfrac{6x^3 + 27x^2 + 36 + 12}{(x+2)^2}$

20. $\dfrac{t^2 - 2bt - a^2 + 2ab}{(t-b)^2}$ **21.** $\dfrac{-12}{x^5} - \dfrac{25}{x^6}$ **22.** $2x^3 - \dfrac{12}{x^7}$

24. $A = B = 1/2$ **25.** $4t + 1$ **26.** $11x + 49y + 4 = 0$

27. $x + 64y - 1026 = 0$ **28.** $x - y - 2\sqrt{2} + 2 = 0$; $x - y + 2 + 2\sqrt{2} = 0$

29. $(2, 2/3); (1, 5/6)$ **30.** $a = 3$; $b = 2$

Seção 4.16

1. a) $9x + y - 6 = 0$; $x + 9y - 6 = 0$

b) $x + (2 + a)^2 y + 4 + a = 0$; $x + (4 - a)^2 y - 8 + a = 0$

c) $x = 0$; $x - \sqrt{3}y + 3 = 0$; $x - \sqrt{a}y + a = 0$

2. $3\sqrt{3}\,x - 3\sqrt{3}\,y - 3\sqrt{3} - 2 = 0$; $3\sqrt{3}\,x - 3\sqrt{3}\,y - 3\sqrt{3} + 2 = 0$

3. a) −16 m b) 3 m/s; 0 m/s; −9 m/s; −24 m/s c) 0 m/s^2; −6 m/s^2; −12 m/s^2; −18 m/s^2

4. $-4{,}9$ m; $-9{,}8$ m e $-19{,}6$ m; $-19{,}6$ m

5. $100\,(3x^2 + 7x - 3)^9(6x + 7)$

6. $\frac{3}{a}(bx^2 + ax)^2(2bx + a)$

7. $(7t^2 + 6t)^6(3t - 1)^3[12\,(7t^2 + 6t) + 7(3t - 1)(14t + 6)]$

8. $\frac{3(7t + 1)^2(-14t^2 - 4t + 21)}{(2t^2 - 3)^4}$

9. $\frac{4(x + 1)}{\sqrt[3]{3x^2 + 6x - 2}}$

10. $\frac{3x - 2}{(3x - 1)\sqrt{3x - 1}}$

11. $\frac{-3}{2(t - 1)^{3/2}(2t + 1)^{1/2}}$

12. $-\frac{1}{3}e^{3-x}$

13. $2^{3x^2+6x}\,6\,(x + 1)\ln 2$

14. $6[(7s^2 + 6s - 1)^2(7s + 3) - e^{-3s}]$

15. $e^{t/2}(1/2t^2 + 9/2t + 5)$

16. $\frac{2}{2x + 4}\log_2 e$

17. $\frac{\log_3 e}{2(s + 1)}$

18. $\frac{-x - 2}{x(x + 1)}$

19. $\frac{3(\ln a)a^{3x} - a^{3x}\,(6x - 6)\ln b}{b^{3x^2-6x}}$

20. $2t(2t + 1)^{t^2-1}\ln(2t + 1) + 2(2t + 1)^{t^2-2}\,(t^2 - 1)$

21. $\frac{b(a + bs)^{\ln(a+bs)}\ln\,(a + bs)}{a + bs}$

22. $\operatorname{sen}\,(\frac{\pi}{2} - u)$

23. $4\cos\theta^2\cos 2\theta - 4\theta\operatorname{sen} 2\theta\operatorname{sen}\theta^2$

24. $3\operatorname{sen}^2(3x^2 + 6x)\cos\,(3x^2 + 6x)(6x + 6)$

25. $6\sec^2(2x + 1) + \frac{1}{2\sqrt{x}}$

26. $\frac{6x\sec^2 x\operatorname{tg} x - 3\sec^2 x}{x^2}$

27. $e^{2x}(2\cos 3x - 3\operatorname{sen} 3x)$

28. $6\theta^2\operatorname{cosec}^2\theta^3 \cdot \operatorname{cotg}\,\theta^3$

29. $\frac{-ab\operatorname{sen} bx}{2\sqrt{\cos bx}}$

30. $2u^2\sec^2 u\,\operatorname{tg} u + 2u\,\operatorname{tg}^2 u$

31. $-a^{\operatorname{cotg}\theta}\ln a\,\operatorname{cosec}^2\theta$

32. $\frac{2\operatorname{arc\,sen} x}{\sqrt{1 - x^2}}$

33. $\frac{-3t}{\sqrt{1 - 9t^2}} + \operatorname{arc\,cos} 3t$

34. -1

35. $\frac{1}{2x\sqrt{x - 1}}$

36. $\frac{-2t^2}{|2t + 3|\sqrt{(2t + 3)^2 - 1}} + 2t\operatorname{arc\,cosec}\,(2t + 3)$

37. $\frac{x\operatorname{cotgh} x - \ln(\operatorname{senh} x)}{x^2}$

38. $\frac{-(t + 1)\operatorname{cosech}^2(t + 1)^2}{\sqrt{\operatorname{cotgh}\,(t + 1)^2}}$

39. $\frac{3}{x^2}\left(\operatorname{cosech}\frac{3x + 1}{x}\right)^3\operatorname{cotgh}\left(\frac{3x + 1}{x}\right)$

40. $\operatorname{arg\,cosh} x$

41. $\frac{2x^2}{1 - x^4} + \operatorname{arg\,cotgh} x^2$

42. $\frac{2x\operatorname{arg\,cosh} x^2}{\sqrt{x^4 - 1}}$

43. $\frac{10}{3}(2x^5 + 6x^{-3})^4\,(5x^4 - 9x^{-4})$

44. $60(3x^2 + 6x)^9(x + 1) + \frac{2}{x^3}$

45. $(5x - 2)^5(3x - 1)^2(135x - 48)$

46. $8(2x - 5)^3 - \frac{1}{(x + 1)^2} - \frac{1}{2\sqrt{x}}$

47. $-\frac{1}{3}(4t^2 - 5t + 2)^{-4/3}\,(8t - 5)$

48. $-\frac{21}{10}x^2(3x+1)^{-6/5}+7x(3x+1)^{-1/5}+\frac{3}{2}(3x+1)^{-1/2}$

49. $12e^{3x^2+6x+7}(x+1)$

50. $\frac{e^{\sqrt{x}}}{2\sqrt{x}}$

51. $\frac{2^{\ln 2x}\ln 2}{x}$

52. $\frac{-2t^2e^{-t^2}-e^{-t^2}-1}{t^2}$

53. $\sqrt{\frac{e^t+1}{e^t-1}}\cdot\frac{e^t}{(e^t+1)^2}$

54. $\frac{2bx^2-a}{ax}$

55. $\frac{7x}{7x^2-4}$

56. $\frac{2}{1-x^2}$

57. $\left(\frac{a}{b}\right)^{\sqrt{t}}\ln\left(\frac{a}{b}\right)\cdot\frac{1}{2\sqrt{t}}$

58. $(e^{x^2}+4)^{\sqrt{x}}\ln(e^{x^2}+4)\frac{1}{2\sqrt{x}}+2x\sqrt{x}(e^{x^2}+4)^{\sqrt{x}-1}e^{x^2}$

59. $2\cos(2x+4)$

60. $-2\operatorname{sen}(2\theta^2-3\theta+1)(4\theta-3)$

61. $-\operatorname{sen}2\alpha$

62. 0

63. $-16(2s-3)\operatorname{cotg}^3(2s-3)^2\operatorname{cosec}^2(2s-3)^2$

64. $\frac{-2\cos x}{\operatorname{sen}^3 x}$

65. $\frac{\cos(x+1)-\operatorname{sen}(x+1)}{e^x}$

66. $-\operatorname{sen}^3\frac{x}{2}\cos\frac{x}{2}+\cos^3\frac{x}{2}\operatorname{sen}\frac{x}{2}$

67. $-2\operatorname{tg}t$

68. $\frac{3+2\operatorname{sen}2x}{3x-\cos 2x}\log_2 e$

69. $-4\operatorname{sen}2te^{2\cos 2t}$

70. $\frac{-2}{\sqrt{9-4x^2}}$

71. $\frac{1}{(s+1)^2}\left(\frac{s+1}{\sqrt{4-s^2}}-\operatorname{arcsen}\frac{s}{2}\right)$

72. $\frac{2x}{x^4-2x^2+2}$

73. $2\cosh(2x-1)$

74. $2t\operatorname{tgh}(t^2-1)$

75. $16t(4t^2-3)\operatorname{sech}^2(4t^2-3)^2$

76. $\frac{-\operatorname{sech}(\ln x)\operatorname{tgh}(\ln x)}{x}$

77. $\frac{2\operatorname{arg\,senh}x}{\sqrt{x^2+1}}$

78. $\frac{4x}{4-x^4}$

79. $\frac{-(x+1)}{x\sqrt{1-4x^2}}+\operatorname{argsech}2x$

80. a) $f'(x)=\begin{cases}-1, x\le 0\\ -e^{-x}, x>0\end{cases}$ b) $\frac{4}{4x-3}$ c) $f'(x)=\begin{cases}2e^{2x-1}, x>1/2\\ -2e^{1-2x}, x<1/2\end{cases}$

81. -1

82. $\frac{3+2\sqrt{3}}{6}$

83. $1-x$

94. a) $\frac{\pi(2k+1)}{4}, k\in Z$ b) $k\pi, k\in Z$

95. a) duas b) reta tangente 1: $(1, 2), (-1, -2)$ c) $y = 2x$; $y = -2x$

reta tangente 2: $(-1, 2), (1, -2)$

96. (a) $y = 3 + \sqrt{x + 4},\ x \geq -4$ (b) $y = 4x - 20$ (c) $y = \frac{1}{4}x + 5$

Seção 4.21

1. $y^{v} = 0$ **2.** $y''' = 6a$ **3.** $y^{(10)} = 0$

4. $y'' = \dfrac{-3}{(3 - x^2)\sqrt{3 - x^2}}$ **5.** $y^{iv} = \dfrac{24}{(x - 1)^5}$ **6.** $y''' = 8e^{2x+1}$

7. $y^{iv} = \dfrac{1}{e^x}$ **8.** $y'' = \dfrac{-1}{x^2}$ **9.** $y^{vii} = -a^7 \cos ax$

10. $y^{v} = \dfrac{1}{16} \operatorname{sen} \dfrac{x}{2}$ **11.** $y''' = 2 \sec^4 x + 4 \sec^2 x \cdot \operatorname{tg}^2 x$ **12.** $y'' = \dfrac{-2x}{(1 + x^2)^2}$

13. a) $\operatorname{sen} x$ b) $\cos x$

18. a) $\dfrac{-x^2}{y^2}$ b) $\dfrac{-3x^2 - 2xy}{x^2 + 2y}$

c) $-\sqrt{\dfrac{y}{x}}$ d) $\dfrac{1 - y^3}{3xy^2 + 4y^3 + 1}$

e) -1 f) $\dfrac{y}{\sec^2 y - x}$ g) $\dfrac{1}{e^y - 1}$

19. retas tangentes: $x - \sqrt{3}y + 2 = 0$ e $x + \sqrt{3}y + 2 = 0$

retas normais: $\sqrt{3}x + y - 2\sqrt{3} = 0$ e $\sqrt{3}x - y - 2\sqrt{3} = 0$ **21.** $(1/8; -1/16)$

23. a) $\dfrac{3}{2}t,\ t > 0$ b) $-\operatorname{cotg} 2t, t \in (0, \pi/2)$ c) $-4/3 \operatorname{cotg} t,\ t \in (\pi, 2\pi)$

d) $-\operatorname{tg} t, t \in (-\pi/2, 0)$ e) $\dfrac{3}{2}t^2, t \in \mathbf{R}$ f) $-\operatorname{tg} t, t \in (0, \pi/2) \cup (\pi/2, \pi)$

24. $2y + 3x - 6\sqrt{2} = 0$ **25.** $2\sqrt{3}x - 2y + \sqrt{3} = 0; x + \sqrt{3}y - 1 = 0$

26. a) $3(\Delta x)^2$ b) $\dfrac{2\Delta x}{\sqrt{x + \Delta x} + \sqrt{x}} - \dfrac{\Delta x}{\sqrt{x}}$ c) $\dfrac{-3\,\Delta x}{(2x + 2\Delta x - 1)(2x - 1)} + \dfrac{3\,\Delta x}{(2x - 1)^2}$

27. a) $-0{,}000998;\ -0{,}001$ b) $-0{,}118;\ -0{,}12$ c) $-0{,}078; -0{,}075$

28. a) 7,071 b) 3,9895 c) 1,906

29. a) $\frac{6x - 4}{3x^2 - 4x}dx$ b) $\frac{-x}{e^x}dx$ c) $10x \cos(5x^2 + 6)\,dx$

32. 60.000 cm^3 **33.** 0,0044209 **34.** 11,3097 cm^3

35. $\pm$24.000 m^2 **36.** 2,5%

Capítulo 5

Seção 5.3

1. a) 54 gramas/dia b) 54,5 g c) 24,4 gramas/dia

2. −5,444 ... °C/hora **3.** $-c/100$ $cm^3/kgf/cm^3$

4. a) 6 horas b) 17.500 l/hora c) 10.000 l/hora

5. a) $f(t) = 4.500 + 1.550\,t$ b) 1.550,00/ano

c) 25,6% d) Tenderá para zero.

6. a) 0,8 milhares de pessoas/ano b) 0,068 milhares de pessoas **7.** 1/12

8. 4,875 l/hora **9.** $\frac{1}{\pi}$ m/hora ; 10π horas **10.** $\frac{d^2}{\sqrt{3}}$ m^2; $6\sqrt{3}$ m^3/s .

11. a) $\frac{4\pi r^2}{3}$ b) $1{,}066\pi$ m^3/s

12. a) $15\sqrt{3}$ cm^2/s b) 7,5 cm/s

13. 18 unidades/min **14.** 119,09 km/hora **15.** 1,45 m/s

16. $\sqrt[3]{\frac{2\pi}{3V}}$ **17.** (a) custo fixo

(b) Inicialmente o custo marginal diminui e depois passa a crescer

18. (a) 120 (b) 410 (c) 5,44; 1,2

19. $E = -0{,}087$; um pequeno aumento no preço acarretará uma diminuição muito baixa da demanda.

20. (a) $\frac{y(60 - 0{,}12y)}{15 + 60y - 0{,}06y^2}$ (b) 0,57 ; o aumento de 1% na renda, acarretará um aumento de $\cong 0{,}57\%$ na demanda