

B

Selected Answers

- 1.1.1. $(2/3)x + (1/3)$
 1.1.2. $y = -2x$
 1.1.3. $(-2/3)x + (1/3)$
 1.1.4. $y = 2x + 2, 2, -1$
 1.1.5. $y = -x + 6, 6, 6$
 1.1.6. $y = x/2 + 1/2, 1/2, -1$
 1.1.7. $y = 3/2$, y -intercept: $3/2$, no x -intercept
 1.1.8. $y = (-2/3)x - 2, -2, -3$
 1.1.9. yes
 1.1.10. $y = 0, y = -2x + 2, y = 2x + 2$
 1.1.11. $y = 75t, 164$ minutes
 1.1.12. $y = (9/5)x + 32, (-40, -40)$
 1.1.13. $y = 0.15x + 10$
 1.1.14. $0.03x + 1.2$
 1.1.15. (a) $y = \begin{cases} 0 & 0 \leq x < 100 \\ (x/10) - 10 & 100 \leq x \leq 1000 \\ x - 910 & 1000 < x \end{cases}$

- 1.1.16. $y = \begin{cases} 0.15x & 0 \leq x \leq 19450 \\ 0.28x - 2528.50 & 19450 < x \leq 47050 \\ 0.33x - 4881 & 47050 < x \leq 97620 \end{cases}$
 1.1.17. (a) $P = -0.0001x + 2$
 (b) $x = -10000P + 20000$
 1.1.18. $(2/25)x - (16/5)$
 1.2.1. (a) $x^2 + y^2 = 9$
 (b) $(x - 5)^2 + (y - 6)^2 = 9$
 (c) $(x + 5)^2 + (y + 6)^2 = 9$
 1.2.2. (a) $\Delta x = 2, \Delta y = 3, m = 3/2$,
 $y = (3/2)x - 3, \sqrt{13}$
 (b) $\Delta x = -1, \Delta y = 3, m = -3$,
 $y = -3x + 2, \sqrt{10}$
 (c) $\Delta x = -2, \Delta y = -2, m = 1$,
 $y = x, \sqrt{8}$
 1.2.6. $(x + 2/7)^2 + (y - 41/7)^2 = 1300/49$
 1.3.1. $\{x \mid x \geq 3/2\}$

289

Appendix B Selected Answers 291

- 3.2.4. $6x^2 + 2x - 8$
 3.2.5. $3x^2 + 6x - 1$
 3.2.6. $9x^2 - x/\sqrt{625 - x^2}$
 3.2.7. $y = 13x/4 + 5$
 3.2.8. $y = 24x - 48 - \pi^3$
 3.2.9. $-49t/5 + 5, -49/5$
 3.2.12. $\sum_{k=1}^n ka_k x^{k-1}$
 3.2.13. $x^3/16 - 3x/4 + 4$
 3.3.1. $3x^2(x^3 - 5x + 10) + x^3(3x^2 - 5)$
 3.3.2. $(x^2 + 5x - 3)(5x^4 - 18x^2 + 6x - 7) + (2x + 5)(x^5 - 6x^3 + 3x^2 - 7x + 1)$
 3.3.3. $\frac{\sqrt{625 - x^2}}{2\sqrt{x}} - \frac{x\sqrt{x}}{\sqrt{625 - x^2}}$
 3.3.4. $\frac{-1}{x^{19}\sqrt{625 - x^2}} - \frac{20\sqrt{625 - x^2}}{x^{21}}$
 3.3.5. $f' = 4(2x - 3), y = 4x - 7$
 3.4.1. $\frac{3x^2}{x^3 - 5x + 10} - \frac{x^3(3x^2 - 5)}{(x^3 - 5x + 10)^2}$
 3.4.2. $\frac{2x + 5}{x^5 - 6x^3 + 3x^2 - 7x + 1} - \frac{x^3(3x^2 - 5)}{(x^5 - 6x^3 + 3x^2 - 7x + 1)^2}$
 3.4.3. $\frac{1}{2\sqrt{x}\sqrt{625 - x^2}} + \frac{x^{3/2}}{(625 - x^2)^{3/2}}$
 3.4.4. $\frac{-1}{x^{19}\sqrt{625 - x^2}} - \frac{20\sqrt{625 - x^2}}{x^{21}}$
 3.4.5. $y = 17x/4 - 41/4$
 3.4.6. $y = 11x/16 - 15/16$
 3.4.8. $y = 19/169 - 5x/338$
 3.4.9. $13/18$
 3.5.1. $4x^3 - 9x^2 + x + 7$
 3.5.2. $3x^2 - 4x + 2/\sqrt{x}$

- 3.5.3. $6(x^2 + 1)^2x$
 3.5.4. $\sqrt{169 - x^2} - x^2/\sqrt{169 - x^2}$
 3.5.5. $(2x - 4)\sqrt{25 - x^2} - (x^2 - 4x + 5)x/\sqrt{25 - x^2}$
 3.5.6. $-x/\sqrt{r^2 - x^2}$
 3.5.7. $2x^3/\sqrt{1 + x^4}$
 3.5.8. $\frac{1}{4\sqrt{x}(5 - \sqrt{x})^{3/2}}$
 3.5.9. $6 + 18x$
 3.5.10. $\frac{2x + 1}{1 - x} + \frac{x^2 + x + 1}{(1 - x)^2}$
 3.5.11. $-1/\sqrt{25 - x^2} - \sqrt{25 - x^2}/x^2$
 3.5.12. $\frac{1}{2} \left(\frac{-169}{x^2} - 1 \right) \sqrt{\frac{169}{x} - x}$
 3.5.13. $\frac{3x^2 - 2x + 1/x^2}{2\sqrt{x^3 - x^2} - (1/x)}$
 3.5.14. $\frac{300x}{(100 - x^2)^{5/2}}$
 3.5.15. $\frac{1 + 3x^2}{3(x + x^3)^{2/3}}$
 3.5.16. $\left(4x(x^2 + 1) + \frac{4x^3 + 4x}{2\sqrt{1 + (x^2 + 1)^2}} \right) / 2\sqrt{(x^2 + 1)^2 + \sqrt{1 + (x^2 + 1)^2}}$
 3.5.17. $5(x + 8)^4$
 3.5.18. $-3(4 - x)^2$
 3.5.19. $6x(x^2 + 5)^2$
 3.5.20. $-12x(6 - 2x^2)^2$
 3.5.21. $24x^2(1 - 4x^3)^{-3}$
 3.5.22. $5 + 5/x^2$
 3.5.23. $-8(4x - 1)(2x^2 - x + 3)^{-3}$
 3.5.24. $1/(x + 1)^2$
 3.5.25. $3(8x - 2)/(4x^2 - 2x + 1)^2$

290 Appendix B Selected Answers

- 1.3.2. $\{x \mid x \neq -1\}$
 1.3.3. $\{x \mid x \neq 1 \text{ and } x \neq -1\}$
 1.3.4. $\{x \mid x < 0\}$
 1.3.5. $\{x \mid x \in \mathbb{R}\}$, i.e., all x
 1.3.6. $\{x \mid x \geq 0\}$
 1.3.7. $\{x \mid h - r \leq x \leq h + r\}$
 1.3.8. $\{x \mid x \geq 1\}$
 1.3.9. $\{x \mid -1/3 < x < 1/3\}$
 1.3.10. $\{x \mid x \geq 0 \text{ and } x \neq 1\}$
 1.3.11. $\{x \mid x \geq 0 \text{ and } x \neq 1\}$
 1.3.12. \mathbb{R}
 1.3.13. $\{x \mid x \geq 3\}, \{x \mid x \geq 0\}$
 1.3.14. $A = x(500 - 2x), \{x \mid 0 \leq x \leq 250\}$
 1.3.15. $V = r(50 - \pi r^2), \{r \mid 0 < r \leq \sqrt{50/\pi}\}$
 1.3.16. $A = 2\pi r^2 + 2000/r, \{r \mid 0 < r < \infty\}$
 2.1.1. $-5, -2.47106145, -2.4067927, -2.400676, -2.4$
 2.1.2. $-4/3, -24/7, 7/24, 3/4$
 2.1.3. $-0.107526881, -0.11074197, -0.1110741, \frac{-1}{3(3 + \Delta x)} \rightarrow \frac{-1}{9}$
 2.1.4. $\frac{3 + 3\Delta x + \Delta x^2}{1 + \Delta x} \rightarrow 3$
 2.1.5. $3.31, 3.003001, 3.0000, 3 + 3\Delta x + \Delta x^2 \rightarrow 3$
 2.1.6. m
 2.2.1. $10, 25/2, 20, 15, 25, 35$
 2.2.2. $5, 4.1, 4.01, 4.001, 4 + \Delta t \rightarrow 4$
 2.2.3. $-10.29, -9.849, -9.8049, -9.8 - 4.9\Delta t \rightarrow -9.8$
 2.3.1. 7
 2.3.2. 5
 2.3.3. 0
 2.3.4. undefined
 2.3.5. $1/6$
 2.3.6. 0
 2.3.7. 3
 2.3.8. 172
 2.3.9. 0
 2.3.10. 2
 2.3.11. does not exist
 2.3.12. $\sqrt{2}$
 2.3.13. $3a^2$
 2.3.14. 512
 2.3.15. -4
 2.3.16. 0
 2.3.18. (a) 8, (b) 6, (c) dne, (d) -2 , (e) -1 , (f) 8, (g) 7, (h) 6, (i) 3, (j) $-3/2$, (k) 6, (l) 2
 2.4.1. $-x/\sqrt{169 - x^2}$
 2.4.2. $-9.8t$
 2.4.3. $2x + 1/x^2$
 2.4.4. $2ax + b$
 2.4.5. $3x^2$
 3.1.1. $100x^{99}$
 3.1.2. $-100x^{-101}$
 3.1.3. $-5x^{-6}$
 3.1.4. $\pi x^{\pi-1}$
 3.1.5. $(3/4)x^{-1/4}$
 3.1.6. $-(9/7)x^{-16/7}$
 3.2.1. $15x^2 + 24x$
 3.2.2. $-20x^4 + 6x + 10/x^3$
 3.2.3. $-30x + 25$

292 Appendix B Selected Answers

- 3.5.26. $-3x^2 + 5x - 1$
 3.5.27. $6x(2x - 4)^3 + 6(3x^2 + 1)(2x - 4)^2$
 3.5.28. $-2/(x - 1)^2$
 3.5.29. $4x/(x^2 + 1)^2$
 3.5.30. $(x^2 - 6x + 7)/(x - 3)^2$
 3.5.31. $-5/(3x - 4)^2$
 3.5.32. $60x^4 + 72x^3 + 18x^2 + 18x - 6$
 3.5.33. $(5 - 4x)/((2x + 1)^2(x - 3)^2)$
 3.5.34. $1/(2(2 + 3x)^2)$
 3.5.35. $56x^6 + 72x^5 + 110x^4 + 100x^3 + 60x^2 + 28x + 6$
 3.5.36. $y = 23x/96 - 29/96$
 3.5.37. $y = 3 - 2x/3$
 3.5.38. $y = 13x/2 - 23/2$
 3.5.39. $y = 2x - 11$
 3.5.40. $y = \frac{20 + 2\sqrt{5}}{5\sqrt{4 + \sqrt{5}}}x + \frac{3\sqrt{5}}{5\sqrt{4 + \sqrt{5}}}$
 4.1.1. $2n\pi - \pi/2$, any integer n
 4.1.2. $n\pi \pm \pi/6$, any integer n
 4.1.3. $(\sqrt{2} + \sqrt{6})/4$
 4.1.4. $-(1 + \sqrt{3})/(1 - \sqrt{3}) = 2 + \sqrt{3}$
 4.1.11. $t = \pi/2$
 4.3.1. 5
 4.3.2. $7/2$
 4.3.3. $3/4$
 4.3.4. 1
 4.3.5. $-\sqrt{2}/2$
 4.3.6. 7
 4.3.7. 2
 4.4.1. $\sin(\sqrt{x})\cos(\sqrt{x})/\sqrt{x}$
 4.4.2. $\frac{\sin x}{2\sqrt{x}} + \sqrt{x}\cos x$
 4.4.3. $-\frac{\cos x}{\sin^2 x}$
 4.4.4. $\frac{(2x + 1)\sin x - (x^2 + x)\cos x}{\sin^2 x}$
 4.4.5. $\frac{-\sin x \cos x}{\sqrt{1 - \sin^2 x}}$
 4.5.1. $\cos^2 x - \sin^2 x$
 4.5.2. $-\sin x \cos(\cos x)$
 4.5.3. $\frac{\tan x + x \sec^2 x}{2\sqrt{x \tan x}}$
 4.5.4. $\frac{\sec^2 x(1 + \sin x) - \tan x \cos x}{(1 + \sin x)^2}$
 4.5.5. $-\csc^2 x$
 4.5.6. $-\csc x \cot x$
 4.5.7. $3x^2 \sin(23x^2) + 46x^4 \cos(23x^2)$
 4.5.8. 0
 4.5.9. $-6 \cos(\cos(6x)) \sin(6x)$
 4.5.10. $\sin \theta / (\cos \theta + 1)^2$
 4.5.11. $5t^4 \cos(6t) - 6t^5 \sin(6t)$
 4.5.12. $3t^2(\sin(3t) + t \cos(3t)) / \cos(2t) + 2t^3 \sin(3t) \sin(2t) / \cos^2(2t)$
 4.5.13. $n\pi/2$, any integer n
 4.5.14. $\pi/2 + n\pi$, any integer n
 4.5.15. $\sqrt{3}x/2 + 3/4 - \sqrt{3}\pi/6$
 4.5.16. $8\sqrt{3}x + 4 - 8\sqrt{3}\pi/3$
 4.5.17. $3\sqrt{3}x/2 - \sqrt{3}\pi/4$
 4.5.18. $\pi/6 + 2n\pi, 5\pi/6 + 2n\pi$, any integer n
 4.7.1. $2 \ln(3)x^{3x^2}$
 4.7.2. $\frac{\cos x - \sin x}{e^x}$
 4.7.3. $2e^{2x}$
 4.7.4. $e^x \cos(e^x)$

- 4.7.5. $\cos(x)e^{\sin x}$
 4.7.6. $x^{\sin x} \left(\cos x \ln x + \frac{\sin x}{x} \right)$
 4.7.7. $3x^2 e^x + x^3 e^x$
 4.7.8. $1 + 2^x \ln(2)$
 4.7.9. $-2x \ln(3)(1/3)^{x^2}$
 4.7.10. $e^{4x}(4x-1)/x^2$
 4.7.11. $(3x^2+3)/(x^3+3x)$
 4.7.12. $-\tan(x)$
 4.7.13. $(1-\ln(x^2))/(x^2\sqrt{\ln(x^2)})$
 4.7.14. $\sec(x)$
 4.7.15. $x^{\sin(x)}(\cos(x)\ln(x) + \sin(x)/x)$
 4.7.20. e
 4.8.1. 0
 4.8.2. ∞
 4.8.3. 1
 4.8.4. 0
 4.8.5. 0
 4.8.6. 1
 4.8.7. $y = 1$ and $y = -1$
 4.9.1. x/y
 4.9.2. $-(2x+y)/(x+2y)$
 4.9.3. $(2xy-3x^2-y^2)/(2xy-3y^2-x^2)$
 4.9.4. $\sin(x)\sin(y)/(\cos(x)\cos(y))$
 4.9.5. $-\sqrt{y}/\sqrt{x}$
 4.9.6. $(y\sec^2(x/y)-y^2)/(x\sec^2(x/y)+y^2)$
 4.9.7. $(y-\cos(x+y))/(\cos(x+y)-x)$
 4.9.8. $-y^2/x^2$
 4.9.9. 1
 4.9.11. $y = 2x \pm 6$
 4.9.12. $y = x/2 \pm 3$
- 4.9.13. $(\sqrt{3}, 2\sqrt{3}), (-\sqrt{3}, -2\sqrt{3}), (2\sqrt{3}, \sqrt{3}), (-2\sqrt{3}, -\sqrt{3})$
 4.9.14. $y = 7x/\sqrt{3} - 8/\sqrt{3}$
 4.9.15. $y = (-y_1^{1/3}x + y_1^{1/3}x_1 + x_1^{1/3}y_1)/x_1^{1/3}$
 4.9.16. $(y-y_1)/(x-x_1) = (2x_1^3 + 2y_1y_1^2 - x_1)/(2y_1^3 + 2y_1x_1^2 + y_1)$
 4.10.3. $-1/(1+x^2)$
 4.10.4. $\frac{2x}{\sqrt{1-x^4}}$
 4.10.5. $\frac{e^x}{1+e^{2x}}$
 4.10.8. $-3x^2 \cos(x^3)/\sqrt{1-\sin^2(x^3)}$
 4.10.10. $-e^x/\sqrt{1-e^{2x}}$
 5.1.1. min at $x = 1/2$
 5.1.2. min at $x = -1$, max at $x = 1$
 5.1.3. max at $x = 2$, min at $x = 4$
 5.1.4. min at $x = \pm 1$, max at $x = 0$.
 5.1.5. min at $x = 1$
 5.1.6. none
 5.1.7. none
 5.1.8. min at $x = 7\pi/12 + k\pi$, max at $x = -\pi/12 + k\pi$, for integer k .
 5.1.9. none
 5.1.10. local max at $x = 5$
 5.1.11. local min at $x = 49$
 5.1.12. local min at $x = 0$
 5.1.15. one
 5.2.1. min at $x = 1/2$
 5.2.2. min at $x = -1$, max at $x = 1$
 5.2.3. max at $x = 2$, min at $x = 4$
 5.2.4. min at $x = \pm 1$, max at $x = 0$.
 5.2.5. min at $x = 1$

- 6.1.4. $w = l = 2 \cdot 5^{2/3}$, $h = 5^{2/3}$, $h/w = 1/2$
 6.1.5. $\sqrt[3]{100} \times \sqrt[3]{100} \times 2\sqrt[3]{100}$, $h/s = 2$
 6.1.6. $w = l = 2^{1/3}V^{1/3}$, $h = V^{1/3}/2^{2/3}$, $h/w = 1/2$
 6.1.7. 1250 square feet
 6.1.8. $l^2/8$ square feet
 6.1.9. \$5000
 6.1.10. 100
 6.1.11. r^2
 6.1.12. $h/r = 2$
 6.1.13. $h/r = 2$
 6.1.14. $r = 5$, $h = 40/\pi$, $h/r = 8/\pi$
 6.1.15. $8/\pi$
 6.1.16. $4/27$
 6.1.17. Go direct from A to D .
 6.1.18. (a) 2, (b) $7/2$
 6.1.19. $\frac{\sqrt{3}}{6} \times \frac{\sqrt{3}}{6} + \frac{1}{2} \times \frac{1}{4} - \frac{\sqrt{3}}{12}$
 6.1.20. (a) $a/6$, (b) $(a+b-\sqrt{a^2-ab+b^2})/6$
 6.1.21. 1.5 meters wide by 1.25 meters tall
 6.1.22. If $k \leq 2/\pi$ the ratio is $(2-k\pi)/4$; if $k \geq 2/\pi$, the ratio is zero: the window should be semicircular with no rectangular part.
 6.1.23. a/b
 6.1.24. $w = 2r/\sqrt{3}$, $h = 2\sqrt{2}r/\sqrt{3}$
 6.1.25. $1/\sqrt{3} \approx 58\%$
 6.1.26. $18 \times 18 \times 36$
 6.1.27. $r = 5/(2\pi)^{1/3} \approx 2.7$ cm, $h = 5 \cdot 2^{5/3}/\pi^{1/3} = 4r \approx 10.8$ cm
- 6.1.28. $h = \frac{750}{\pi} \left(\frac{2\pi^2}{750^2} \right)^{1/3}$, $r = \left(\frac{750^2}{2\pi^2} \right)^{1/6}$
 6.1.29. $h/r = \sqrt{2}$
 6.1.30. The ratio of the volume of the sphere to the volume of the cone is $1033/4096 + 33/4096\sqrt{17} \approx 0.2854$, so the cone occupies approximately 28.54% of the sphere.
 6.1.31. P should be at distance $c\sqrt[3]{a}/(\sqrt[3]{a} + \sqrt[3]{b})$ from charge A .
 6.1.32. $1/2$
 6.1.33. \$7000
 6.1.34. There is a critical point when $\sin \theta_1/v_1 = \sin \theta_2/v_2$, and the second derivative is positive, so there is a minimum at the critical point.
 6.2.1. $1/(16\pi)$ cm/s
 6.2.2. $3/(1000\pi)$ meters/second
 6.2.3. $1/4$ m/s
 6.2.4. $-6/25$ m/s
 6.2.5. 80 mi/min
 6.2.6. $3\sqrt{5}$ ft/s
 6.2.7. $20/(3\pi)$ cm/s
 6.2.8. $13/20$ ft/s
 6.2.9. $5\sqrt{10}/2$ m/s
 6.2.10. $75/64$ m/min
 6.2.11. $145\pi/72$ m/s
 6.2.12. $25\pi/144$ m/min
 6.2.13. $\pi\sqrt{2}/36$ ft³/s
 6.2.14. tip: 6 ft/s, length: $5/2$ ft/s
 6.2.15. tip: $20/11$ m/s, length: $9/11$ m/s

- 5.2.6. none
 5.2.7. none
 5.2.8. min at $x = 7\pi/12 + k\pi$, max at $x = -\pi/12 + k\pi$, for integer k .
 5.2.9. none
 5.2.10. max at $x = 0$, min at $x = \pm 11$
 5.2.11. min at $x = -3/2$, neither at $x = 0$
 5.2.13. min at $n\pi$, max at $\pi/2 + n\pi$
 5.2.14. min at $2n\pi$, max at $(2n+1)\pi$
 5.2.15. min at $\pi/2 + 2n\pi$, max at $3\pi/2 + 2n\pi$
 5.3.1. min at $x = 1/2$
 5.3.2. min at $x = -1$, max at $x = 1$
 5.3.3. max at $x = 2$, min at $x = 4$
 5.3.4. min at $x = \pm 1$, max at $x = 0$.
 5.3.5. min at $x = 1$
 5.3.6. none
 5.3.7. none
 5.3.8. min at $x = 7\pi/12 + n\pi$, max at $x = -\pi/12 + n\pi$, for integer n .
 5.3.9. max at $x = 63/64$
 5.3.10. max at $x = 7$
 5.3.11. max at $-5^{-1/4}$, min at $5^{-1/4}$
 5.3.12. none
 5.3.13. max at -1 , min at 1
 5.3.14. min at $2^{-1/3}$
 5.3.15. none
 5.3.16. min at $n\pi$
 5.3.17. max at $n\pi$, min at $\pi/2 + n\pi$
 5.3.18. max at $\pi/2 + 2n\pi$, min at $3\pi/2 + 2n\pi$
 5.4.1. concave up everywhere
 5.4.2. concave up when $x < 0$, concave down when $x > 0$
- 5.4.3. concave down when $x < 3$, concave up when $x > 3$
 5.4.4. concave up when $x < -1/\sqrt{3}$ or $x > 1/\sqrt{3}$, concave down when $-1/\sqrt{3} < x < 1/\sqrt{3}$
 5.4.5. concave up when $x < 0$ or $x > 2/3$, concave down when $0 < x < 2/3$
 5.4.6. concave up when $x < 0$, concave down when $x > 0$
 5.4.7. concave up when $x < -1$ or $x > 1$, concave down when $-1 < x < 0$ or $0 < x < 1$
 5.4.8. concave down on $((8n-1)\pi/4, (8n+3)\pi/4)$, concave up on $((8n+3)\pi/4, (8n+7)\pi/4)$, for integer n
 5.4.9. concave down everywhere
 5.4.10. concave up on $(-\infty, (21-\sqrt{497})/4)$ and $(21+\sqrt{497})/4, \infty)$
 5.4.11. concave up on $(0, \infty)$
 5.4.12. concave down on $(2n\pi/3, (2n+1)\pi/3)$
 5.4.13. concave up on $(0, \infty)$
 5.4.14. concave up on $(-\infty, -1)$ and $(0, \infty)$
 5.4.15. concave down everywhere
 5.4.16. concave up everywhere
 5.4.17. concave up on $(\pi/4 + n\pi, 3\pi/4 + n\pi)$
 5.4.18. inflection points at $n\pi$, $\pm \arcsin(\sqrt{2/3}) + n\pi$
 5.4.19. up/incr: $(3, \infty)$, up/decr: $(-\infty, 0)$, $(2, 3)$, down/decr: $(0, 2)$
 6.1.1. max at $(2, 5)$, min at $(0, 1)$
 6.1.2. 25×25
 6.1.3. $P/4 \times P/4$

- 6.2.16. $380/\sqrt{3} - 150 \approx 69.4$ mph
 6.2.17. $500/\sqrt{3} - 200 \approx 88.7$ km/hr
 6.2.18. 18 m/s
 6.2.19. $136\sqrt{475}/19 \approx 156$ km/hr
 6.2.20. -50 m/s
 6.2.21. 68 m/s
 6.2.22. $3800/\sqrt{329} \approx 210$ km/hr
 6.2.23. $820/\sqrt{329} + 150\sqrt{57}/\sqrt{47} \approx 210$ km/hr
 6.2.24. $4000/49$ m/s
 6.2.25. (a) $x = a \cos \theta - a \sin \theta \cot(\theta + \beta) = a \sin \beta / \sin(\theta + \beta)$, (c) $\dot{x} \approx 3.79$ cm/s
 6.3.1. $x_3 = 1.475773162$
 6.3.2. 2.15
 6.3.3. 3.36
 6.3.4. 2.19 or 1.26
 6.4.1. $\Delta y = 65/16$, $dy = 2$
 6.4.2. $\Delta y = \sqrt{11/10} - 1$, $dy = 0.05$
 6.4.4. $dV = 32\pi/25$
 6.5.1. $c = 1/2$
 6.5.2. $c = \sqrt{18} - 2$
 6.5.6. $x^3/3 + 47x^2/2 - 5x + k$
 6.5.7. $\arctan x + k$
 6.5.8. $x^4/4 - \ln x + k$
 6.5.9. $-\cos(2x)/2 + k$
 7.1.1. 10
 7.1.2. $35/3$
 7.1.3. x^2
 7.1.4. $2x^2$
 7.1.5. $2x^2 - 8$
 7.1.6. $2b^2 - 2a^2$
- 7.1.7. 4 rectangles: $41/4 = 10.25$, 8 rectangles: $183/16 = 11.4375$
 7.1.8. $23/4$
 7.2.1. $(16/3)x^{3/2} + C$
 7.2.2. $t^3 + t + C$
 7.2.3. $8\sqrt{x} + C$
 7.2.4. $-2/z + C$
 7.2.5. $7 \ln s + C$
 7.2.6. $(5x+1)^3/15 + C$
 7.2.7. $(x-6)^3/3 + C$
 7.2.8. $2x^{5/2}/5 + C$
 7.2.9. $-4/\sqrt{x} + C$
 7.2.10. $4t - t^2 + C$, $t < 2$; $t^2 - 4t + 8 + C$, $t \geq 2$
 7.2.11. $87/2$
 7.2.12. 2
 7.2.13. $\ln(10)$
 7.2.14. $e^3 - 1$
 7.2.15. $3^4/4$
 7.2.16. $2^6/6 - 1/6$
 7.2.17. $x^2 - 3x$
 7.2.18. $2x(x^4 - 3x^2)$
 7.2.19. e^{x^2}
 7.2.20. $2xe^{x^4}$
 7.3.1. It rises until $t = 100/49$, then falls. The position of the object at time t is $s(t) = -4.9t^2 + 20t + k$. The net distance traveled is $-45/2$, that is, it ends up $45/2$ meters below where it started. The total distance traveled is $6205/98$ meters.
 7.3.2. $\int_0^{2\pi} \sin t \, dt = 0$
 7.3.3. net: 2π , total: $2\pi/3 + 4\sqrt{3}$

- 7.3.4. 8
 7.3.5. $17/3$
 7.3.6. $A = 18, B = 44/3, C = 10/3$
 8.1.1. $-(1-t)^{10}/10 + C$
 8.1.2. $x^5/5 + 2x^3/3 + x + C$
 8.1.3. $(x^2 + 1)^{101}/202 + C$
 8.1.4. $-3(1-5t)^{2/3}/10 + C$
 8.1.5. $(\sin^4 x)/4 + C$
 8.1.6. $-(100 - x^2)^{3/2}/3 + C$
 8.1.7. $-2\sqrt{1-x^3}/3 + C$
 8.1.8. $\sin(\sin \pi t)/\pi + C$
 8.1.9. $1/(2 \cos^2 x) = (1/2) \sec^2 x + C$
 8.1.10. $-\ln |\cos x| + C$
 8.1.11. 0
 8.1.12. $\tan^2(x)/2 + C$
 8.1.13. $1/4$
 8.1.14. $-\cos(\tan x) + C$
 8.1.15. $1/10$
 8.1.16. $\sqrt{3}/4$
 8.1.17. $(27/8)(x^2 - 7)^{8/9}$
 8.1.18. $-(3^7 + 1)/14$
 8.1.19. 0
 8.1.20. $f(x)^2/2$
 8.2.1. $x/2 - \sin(2x)/4 + C$
 8.2.2. $-\cos x + (\cos^3 x)/3 + C$
 8.2.3. $3x/8 - (\sin 2x)/4 + (\sin 4x)/32 + C$
 8.2.4. $(\cos^5 x)/5 - (\cos^3 x)/3 + C$
 8.2.5. $\sin x - (\sin^3 x)/3 + C$
 8.2.6. $x/8 - (\sin 4x)/32 + C$
 8.2.7. $(\sin^3 x)/3 - (\sin^5 x)/5 + C$
 8.2.8. $-2(\cos x)^{5/2}/5 + C$

- 8.2.9. $\tan x - \cot x + C$
 8.2.10. $(\sec^3 x)/3 - \sec x + C$
 8.3.1. $-\ln |\csc x + \cot x| + C$
 8.3.2. $-\csc x \cot x/2 - (1/2) \ln |\csc x + \cot x| + C$
 8.3.3. $x\sqrt{x^2-1}/2 - \ln |x + \sqrt{x^2-1}|/2 + C$
 8.3.4. $x\sqrt{9+4x^2}/2 + (9/4) \ln |2x + \sqrt{9+4x^2}| + C$
 8.3.5. $-(1-x^2)^{3/2}/3 + C$
 8.3.6. $\arcsin(x)/8 - \sin(4 \arcsin x)/32 + C$
 8.3.7. $\ln |x + \sqrt{1+x^2}| + C$
 8.3.8. $(x+1)\sqrt{x^2+2x}/2 - \ln |x+1 + \sqrt{x^2+2x}|/2 + C$
 8.3.9. $-\arctan x - 1/x + C$
 8.3.10. $2 \arcsin(x/2) - x\sqrt{4-x^2}/2 + C$
 8.3.11. $\arcsin(\sqrt{x}) - \sqrt{x}\sqrt{1-x} + C$
 8.3.12. $(2x^2+1)\sqrt{4x^2-1}/24 + C$
 8.4.1. $\cos x + x \sin x + C$
 8.4.2. $x^2 \sin x - 2 \sin x + 2x \cos x + C$
 8.4.3. $(x-1)e^x + C$
 8.4.4. $(1/2)e^{x^2} + C$
 8.4.5. $(x/2) - \sin(2x)/4 + C = (x/2) - (\sin x \cos x)/2 + C$
 8.4.6. $x \ln x - x + C$
 8.4.7. $(x^2 \arctan x + \arctan x - x)/2 + C$
 8.4.8. $-x^2 \cos x + 2x \sin x + 2 \cos x + C$
 8.4.9. $x^2/4 - (\cos^2 x)/4 - (x \sin x \cos x)/2 + C$
 8.4.10. $x/4 - (x \cos^2 x)/2 + (\cos x \sin x)/4 + C$
 8.4.11. $x \arctan(\sqrt{x}) + \arctan(\sqrt{x}) - \sqrt{x} + C$
 8.4.12. $2 \sin(\sqrt{x}) - 2\sqrt{x} \cos(\sqrt{x}) + C$

- 8.4.13. $\sec x \csc x - 2 \cot x + C$
 8.5.1. $-\ln |x-2|/4 + \ln |x+2|/4 + C$
 8.5.2. $-x^3/3 - 4x - 4 \ln |x-2| + 4 \ln |x+2| + C$
 8.5.3. $-1/(x+5) + C$
 8.5.4. $-x - \ln |x-2| + \ln |x+2| + C$
 8.5.5. $-4x + x^3/3 + 8 \arctan(x/2) + C$
 8.5.6. $(1/2) \arctan(x/2 + 5/2) + C$
 8.5.7. $x^2/2 - 2 \ln(4+x^2) + C$
 8.5.8. $(1/4) \ln |x+3| - (1/4) \ln |x+7| + C$
 8.5.9. $(1/5) \ln |2x-3| - (1/5) \ln |1+x| + C$
 8.5.10. $(1/3) \ln |x| - (1/3) \ln |x+3| + C$
 8.6.1. $\frac{(t+4)^4}{4} + C$
 8.6.2. $\frac{(t^2-9)^{5/2}}{5} + C$
 8.6.3. $\frac{(e^t+16)^2}{4} + C$
 8.6.4. $\cos t - \frac{2}{3} \cos^3 t + C$
 8.6.5. $\frac{\tan^2 t}{2} + C$
 8.6.6. $\ln |t^2 + t + 3| + C$
 8.6.7. $\frac{1}{8} \ln |1 - 4/t^2| + C$
 8.6.8. $\frac{1}{25} \tan(\arcsin(t/5)) + C = \frac{t}{25\sqrt{25-t^2}} + C$
 8.6.9. $\frac{2}{3} \sqrt{\sin 3t} + C$
 8.6.10. $t \tan t + \ln |\cos t| + C$
 8.6.11. $2\sqrt{e^t+1} + C$
 8.6.12. $\frac{3t}{8} + \frac{\sin 2t}{4} + \frac{\sin 4t}{32} + C$

- 8.6.13. $\frac{\ln |t|}{3} - \frac{\ln |t+3|}{3} + C$
 8.6.14. $\frac{-1}{\sin \arctan t} + C = -\sqrt{1+t^2}/t + C$
 8.6.15. $\frac{-1}{2(1+\tan t)^2} + C$
 8.6.16. $\frac{(t^2+1)^{5/2}}{5} - \frac{(t^2+1)^{3/2}}{3} + C$
 8.6.17. $\frac{e^t \sin t - e^t \cos t}{2} + C$
 8.6.18. $\frac{(t^3/2 + 47)^4}{6} + C$
 8.6.19. $\frac{2}{3(2-t^2)^{3/2}} - \frac{1}{(2-t^2)^{1/2}} + C$
 8.6.20. $\frac{\ln |\sin(\arctan(2t/3))|}{9} + C = \frac{(\ln(4t^2) - \ln(9+4t^2))/18 + C}{9}$
 8.6.21. $\frac{(\arctan(2t))^2}{4} + C$
 8.6.22. $\frac{3 \ln |t+3|}{4} + \frac{\ln |t-1|}{4} + C$
 8.6.23. $\frac{\cos^7 t}{7} - \frac{\cos^5 t}{5} + C$
 8.6.24. $\frac{-1}{t-3} + C$
 8.6.25. $\frac{-1}{\ln t} + C$
 8.6.26. $\frac{t^2(\ln t)^2}{2} - \frac{t^2 \ln t}{2} + \frac{t^2}{4} + C$
 8.6.27. $(t^3 - 3t^2 + 6t - 6)e^t + C$
 8.6.28. $\frac{5+\sqrt{5}}{10} \ln(2t+1-\sqrt{5}) + \frac{5-\sqrt{5}}{10} \ln(2t+1+\sqrt{5}) + C$
 9.1.1. $8\sqrt{2}/15$
 9.1.2. $1/12$
 9.1.3. $9/2$
 9.1.4. $4/3$

- 9.1.5. $2/3 - 2/\pi$
 9.1.6. $3/\pi - 3\sqrt{3}/(2\pi) - 1/8$
 9.1.7. $1/3$
 9.1.8. $10\sqrt{5}/3 - 6$
 9.1.9. $500/3$
 9.1.10. 2
 9.1.11. $1/5$
 9.1.12. $1/6$
 9.2.1. $1/\pi, 5/\pi$
 9.2.2. 0, 245
 9.2.3. 20, 28
 9.2.4. $(3-\pi)/(2\pi), (18-12\sqrt{3}+\pi)/(4\pi)$
 9.2.5. 10/49 meters, 20/49 seconds
 9.2.6. 45/98 meters, 30/49 seconds
 9.2.7. 25000/49 meters, 1000/49 seconds
 9.2.8. $s(t) = \cos t, v(t) = -\sin t$, maximum distance is 1, maximum speed is 1
 9.2.9. $s(t) = -\sin(\pi t)/\pi^2 + t/\pi$, $v(t) = -\cos(\pi t)/\pi + 1/\pi$, maximum speed is $2/\pi$
 9.2.10. $s(t) = t^2/2 - \sin(\pi t)/\pi^2 + t/\pi$, $v(t) = t - \cos(\pi t)/\pi + 1/\pi$
 9.2.11. $s(t) = t^2/2 + \sin(\pi t)/\pi^2 - t/\pi$, $v(t) = t + \cos(\pi t)/\pi - 1/\pi$
 9.3.5. $8\pi/3$
 9.3.6. $\pi/30$
 9.3.7. $\pi(\pi/2 - 1)$
 9.3.8. (a) $114\pi/5$ (b) $74\pi/5$ (c) 20π (d) 4π
 9.3.9. $16\pi, 24\pi$
 9.3.11. $\pi h^2(3r-h)/3$

- 9.3.13. 2π
 9.4.1. $2/\pi; 2/\pi; 0$
 9.4.2. $4/3$
 9.4.3. $1/A$
 9.4.4. $\pi/4$
 9.4.5. $-1/3, 1$
 9.4.6. $-4\sqrt{1224}$ ft/s; $-8\sqrt{1224}$ ft/s
 9.5.1. $\approx 5, 305, 028, 517$ N-m
 9.5.2. $\approx 4, 457, 854, 041$ N-m
 9.5.3. 367, 500 N-m
 9.5.4. $49000\pi + 196000/3$
 9.5.5. 2450π N-m
 9.5.6. 0.05 N-m
 9.5.7. $6/5$ N-m
 9.5.8. 3920 N-m
 9.5.9. 23520 N-m
 9.6.1. $15/2$
 9.6.2. 5
 9.6.3. $16/5$
 9.6.5. $\bar{x} = 45/28, \bar{y} = 93/70$
 9.6.6. $\bar{x} = 0, \bar{y} = 4/(3\pi)$
 9.6.7. $\bar{x} = 1/2, \bar{y} = 2/5$
 9.6.8. $\bar{x} = 0, \bar{y} = 8/5$
 9.6.9. $\bar{x} = 4/7, \bar{y} = 2/5$
 9.6.10. $\bar{x} = \bar{y} = 1/5$
 9.6.11. $\bar{x} = 0, \bar{y} = 28/(9\pi)$
 9.6.12. $\bar{x} = \bar{y} = 28/(9\pi)$
 9.7.1. ∞
 9.7.2. $1/2$
 9.7.3. diverges
 9.7.4. diverges

- 9.7.5. 1
 9.7.6. diverges
 9.7.7. 2
 9.7.8. diverges
 9.7.9. $\pi/6$
 9.7.10. diverges, 0
 9.7.11. diverges, 0
 9.7.12. diverges, no CPV
 9.7.13. π
 9.7.14. 80 mph: 90.8 to 95.3 N
 90 mph: 114.9 to 120.6 N
 100.9 mph: 144.5 to 151.6 N
 9.8.13. 4 through 16
 9.9.1. $(22\sqrt{22}-8)/27$
 9.9.2. $\ln(2) + 3/8$
 9.9.3. $a + a^3/3$
 9.9.4. $\ln((\sqrt{2}+1)/\sqrt{3})$
 10.1.1. 1
 10.1.3. 0
 10.1.4. 1
 10.1.5. 1
 10.1.6. 0
 10.2.1. $\lim_{n \rightarrow \infty} n^2/(2n^2+1) = 1/2$
 10.2.2. $\lim_{n \rightarrow \infty} 5/(2^{1/n}+14) = 1/3$
 10.2.3. If $\sum_{n=1}^{\infty} \frac{3}{n}$ converges so does $\frac{1}{3} \sum_{n=1}^{\infty} \frac{3}{n} = \sum_{n=1}^{\infty} \frac{1}{n}$, but the latter in fact diverges.
 10.2.4. $-3/2$
 10.2.5. 11

- 10.3.1. diverges
 10.3.2. diverges
 10.3.3. converges
 10.3.4. converges
 10.3.5. converges
 10.3.6. converges
 10.3.7. diverges
 10.3.8. converges
 10.3.9. $N = 5$
 10.3.10. $N = 10$
 10.3.11. $N = 1687$
 10.3.12. any integer greater than e^{200}
 10.4.1. converges
 10.4.2. converges
 10.4.3. diverges
 10.4.4. converges
 10.4.5. 0.90
 10.4.6. 0.95
 10.5.1. converges
 10.5.2. converges
 10.5.3. converges
 10.5.4. diverges
 10.5.5. diverges
 10.5.6. diverges
 10.5.7. converges
 10.5.8. diverges
 10.5.9. converges
 10.5.10. diverges
 10.6.1. converges absolutely
 10.6.2. diverges
 10.6.3. converges conditionally

- 10.6.4. converges absolutely
 10.6.5. converges conditionally
 10.6.6. converges absolutely
 10.6.7. diverges
 10.6.8. converges conditionally
 10.7.5. converges
 10.7.6. converges
 10.7.7. converges
 10.7.8. diverges
 10.8.1. $R = 1, I = (-1, 1)$
 10.8.2. $R = \infty, I = (-\infty, \infty)$
 10.8.3. $R = e, I = (-e, e)$
 10.8.4. $R = e, I = (2 - e, 2 + e)$
 10.8.5. $R = 0$, converges only when $x = 2$
 10.8.6. $R = 1, I = (-6, -4)$
 10.9.1. the alternating harmonic series
 10.9.2. $\sum_{n=0}^{\infty} (n+1)x^n$
 10.9.3. $\sum_{n=0}^{\infty} (n+1)(n+2)x^n$
 10.9.4. $\sum_{n=0}^{\infty} \frac{(n+1)(n+2)}{2} x^n, R = 1$
 10.9.5. $C + \sum_{n=0}^{\infty} \frac{-1}{(n+1)(n+2)} x^{n+2}$
 10.10.1. $\sum_{n=0}^{\infty} (-1)^n x^{2n} / (2n)!, R = \infty$
 10.10.2. $\sum_{n=0}^{\infty} x^n / n!, R = \infty$
 10.10.3. $\sum_{n=0}^{\infty} (-1)^n \frac{(x-5)^n}{5^{n+1}}, R = 5$

- 10.10.4. $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{(x-1)^n}{n}, R = 1$
 10.10.5. $\ln(2) + \sum_{n=1}^{\infty} (-1)^{n-1} \frac{(x-2)^n}{n2^n}, R = 2$
 10.10.6. $\sum_{n=0}^{\infty} (-1)^n (n+1)(x-1)^n, R = 1$
 10.10.7. $1 + \sum_{n=1}^{\infty} \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{n!2^n} x^n =$
 $1 + \sum_{n=1}^{\infty} \frac{(2n-1)!}{2^{2n-1}(n-1)!n!} x^n, R = 1$
 10.10.8. $x + x^3/3$
 10.10.9. $\sum_{n=0}^{\infty} (-1)^n x^{4n+1} / (2n)!$
 10.10.10. $\sum_{n=0}^{\infty} (-1)^n x^{n+1} / n!$
 10.11.1. $1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \cdots + \frac{x^{12}}{12!}$
 10.11.2. 1000; 8
 10.11.3. $x + \frac{x^3}{3} + \frac{2x^5}{15}, \text{ error } \pm 4.26.$
 10.12.1. diverges
 10.12.2. converges
 10.12.3. converges
 10.12.4. diverges
 10.12.5. diverges
 10.12.6. diverges
 10.12.7. converges
 10.12.8. converges
 10.12.9. converges
 10.12.10. converges
 10.12.11. converges
 10.12.12. converges

- 10.12.13. converges
 10.12.14. converges
 10.12.15. converges
 10.12.16. converges
 10.12.17. diverges
 10.12.18. $(-\infty, \infty)$
 10.12.19. $(-3, 3)$
 10.12.20. $(-3, 3)$
 10.12.21. $(-1, 1)$
 10.12.22. radius is 0—it converges only when $x = 0$
 10.12.23. $(-\sqrt{3}, \sqrt{3})$
 10.12.24. $(-\infty, \infty)$
 10.12.25. $\sum_{n=0}^{\infty} \frac{(\ln(2))^n}{n!} x^n$
 10.12.26. $\sum_{n=0}^{\infty} \frac{(-1)^n}{n+1} x^{n+1}$
 10.12.27. $\sum_{n=0}^{\infty} \frac{2}{2n+1} x^{2n+1}$
 10.12.28. $1 + x/2 +$
 $\sum_{n=2}^{\infty} (-1)^{n+1} \frac{1 \cdot 3 \cdot 5 \cdots (2n-3)}{2^n n!} x^n$
 10.12.29. $\sum_{n=0}^{\infty} (-1)^n x^{2n}$
 10.12.30. $\sum_{n=0}^{\infty} \frac{(-1)^n}{2n+1} x^{2n+1}$
 10.12.31. $\pi = \sum_{n=0}^{\infty} (-1)^n \frac{4}{2n+1}$