

# A

## 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.  $y = 75t$  ( $t$  in hours); 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.  $\{x \mid x \geq 3/2\}$
- 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.**  $\{x \mid x \geq 1 \text{ or } x < 0\}$   
**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.**  $3x^2$   
**2.4.8.**  $-2/(2x + 1)^{3/2}$   
**2.4.9.**  $5/(t + 2)^2$   
**2.4.10.**  $y = -13x + 17$   
**2.4.11.**  $-8$   
**2.5.6.**  $-0.5$  or  $1.3$  or  $3.2$   
**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.**  $-30x + 25$

- 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.**  $-49t/5 + 5, -49/5$   
**3.2.11.**  $\sum_{k=1}^n ka_k x^{k-1}$   
**3.2.12.**  $x^3/16 - 3x/4 + 4$   
**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.**  $\frac{2x + 5}{x^5 - 6x^3 + 3x^2 - 7x + 1} - \frac{(x^2 + 5x - 3)(5x^4 - 18x^2 + 6x - 7)}{(x^5 - 6x^3 + 3x^2 - 7x + 1)^2}$   
**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.**  $3(8x - 2)/(4x^2 - 2x + 1)^2$   
**3.5.26.**  $-3x^2 + 5x - 1$

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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.  $\frac{\sec \theta \tan \theta}{(1 + \sec \theta)^2} = \frac{\sin \theta}{(\cos \theta + 1)^2}$

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.  $y = \sqrt{3}x/2 + 3/4 - \sqrt{3}\pi/6$

4.5.16.  $y = 8\sqrt{3}x + 4 - 8\sqrt{3}\pi/3$

4.5.17.  $y = 3\sqrt{3}x/2 - \sqrt{3}\pi/4$

4.5.18.  $\pi/6 + 2n\pi, 5\pi/6 + 2n\pi$ , any integer  $n$

4.6.1.  $x/y$

4.6.2.  $-(2x + y)/(x + 2y)$

4.6.3.  $(2xy - 3x^2 - y^2)/(2xy - 3y^2 - x^2)$

4.6.4.  $\sin(x) \sin(y)/(\cos(x) \cos(y))$

4.6.5.  $-\sqrt{y}/\sqrt{x}$

4.6.6.  $(y \sec^2(x/y) - y^2)/(x \sec^2(x/y) + y^2)$

- 4.6.7.  $(y - \cos(x + y))/(\cos(x + y) - x)$   
 4.6.8.  $-y^2/x^2$   
 4.6.9. 1  
 4.6.12.  $y = 2x \pm 6$   
 4.6.13.  $y = x/2 \pm 3$   
 4.6.14.  $(\sqrt{3}, 2\sqrt{3}), (-\sqrt{3}, -2\sqrt{3}),$   
 $(2\sqrt{3}, \sqrt{3}), (-2\sqrt{3}, -\sqrt{3})$   
 4.6.15.  $y = 7x/\sqrt{3} - 8/\sqrt{3}$   
 4.6.16.  $y = (-y_1^{1/3}x + y_1^{1/3}x_1 + x_1^{1/3}y_1)/x_1^{1/3}$   
 4.6.17.  $(y - y_1) = \frac{(2x_1^3 + 2x_1y_1^2 - x_1)}{(2y_1^3 + 2y_1x_1^2 + y_1)}(x - x_1)$   
 4.7.1. 0  
 4.7.2. 1  
 4.7.3.  $1/6$   
 4.7.4.  $-\infty$   
 4.7.5.  $1/16$   
 4.7.6.  $1/3$   
 4.7.7. 0  
 4.7.8.  $3/2$   
 4.7.9.  $-1/4$   
 4.7.10.  $-3$   
 4.7.11.  $1/2$   
 4.7.12. 0  
 4.7.13.  $-1$   
 4.7.14.  $-1/2$   
 4.7.15. 5  
 4.7.16.  $\infty$   
 4.7.17.  $\infty$   
 4.7.18.  $2/7$   
 4.7.19. 2  
 4.7.20.  $-\infty$   
 4.7.21. 1  
 4.7.22. 0  
 4.7.23.  $\infty$   
 4.7.24.  $1/2$   
 4.7.25. 0  
 4.7.26.  $1/2$   
 4.7.27. 5  
 4.7.28.  $2\sqrt{2}$   
 4.7.29.  $-1/2$   
 4.7.30. 2  
 4.7.31. 0  
 4.7.32.  $\infty$   
 4.7.33. 0  
 4.7.34.  $3/2$   
 4.7.35.  $\infty$   
 4.7.36. 5  
 4.7.37.  $-1/2$   
 4.7.38. does not exist  
 4.7.39.  $\infty$   
 4.7.40.  $y = 1$  and  $y = -1$   
 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  $x = 1$
- 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.  $25 \times 25$
- 6.1.3.  $P/4 \times P/4$
- 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.  $r = 5$  cm,  $h = 40/\pi$  cm,  $h/r = 8/\pi$
- 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.  $80\pi$  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.  $\pi\sqrt{2}/36$  ft<sup>3</sup>/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  
 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.  $\Delta y = \sqrt{11/10} - 1$ ,  $dy = 0.05$   
 6.4.3.  $\Delta y = \sin(\pi/50)$ ,  $dy = \pi/50$   
 6.4.4.  $dV = 8\pi/25$   
 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.  $-\cos(2x)/2 + k$
- 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.  $(5x + 1)^3/15 + C$   
 7.2.6.  $(x - 6)^3/3 + C$   
 7.2.7.  $2x^{5/2}/5 + C$   
 7.2.8.  $-4/\sqrt{x} + C$   
 7.2.9.  $4t - t^2 + C$ ,  $t < 2$ ;  $t^2 - 4t + 8 + C$ ,  
 $t \geq 2$   
 7.2.10.  $87/2$   
 7.2.11. 2  
 7.2.12.  $3^4/4$   
 7.2.13.  $2^6/6 - 1/6$   
 7.2.14.  $x^2 - 3x$   
 7.2.15.  $2x(x^4 - 3x^2)$   
 7.2.16.  $\tan(x^2)$   
 7.2.17.  $2x \tan(x^4)$   
 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:  $2\pi$ , total:  $2\pi/3 + 4\sqrt{3}$   
**7.3.4.** 8  
**7.3.5.**  $17/3$   
**7.3.6.**  $A = 18, B = 44/3, C = 10/3$   
**7.4.1.**  $-(1-t)^{10}/10 + C$   
**7.4.2.**  $x^5/5 + 2x^3/3 + x + C$   
**7.4.3.**  $(x^2 + 1)^{101}/202 + C$   
**7.4.4.**  $-3(1-5t)^{2/3}/10 + C$   
**7.4.5.**  $(\sin^4 x)/4 + C$   
**7.4.6.**  $-(100 - x^2)^{3/2}/3 + C$   
**7.4.7.**  $-2\sqrt{1-x^3}/3 + C$   
**7.4.8.**  $\sin(\sin \pi t)/\pi + C$   
**7.4.9.**  $1/(2 \cos^2 x) = (1/2) \sec^2 x + C$   
**7.4.10.**  $-\ln |\cos x| + C$   
**7.4.11.** 0  
**7.4.12.**  $\tan^2(x)/2 + C$   
**7.4.13.**  $1/4$   
**7.4.14.**  $-\cos(\tan x) + C$   
**7.4.15.**  $1/10$   
**7.4.16.**  $\sqrt{3}/4$   
**7.4.17.**  $(27/8)(x^2 - 7)^{8/9} + C$   
**7.4.18.**  $-(3^7 + 1)/14$   
**7.4.19.** 0  
**7.4.20.**  $f(x)^2/2$   
**8.1.1.**  $8\sqrt{2}/15$   
**8.1.2.**  $1/12$   
**8.1.3.**  $9/2$   
**8.1.4.**  $4/3$   
**8.1.5.**  $2/3 - 2/\pi$   
**8.1.6.**  $3/\pi - 3\sqrt{3}/(2\pi) - 1/8$   
**8.1.7.**  $1/3$   
**8.1.8.**  $10\sqrt{5}/3 - 6$   
**8.1.9.**  $500/3$   
**8.1.10.** 2  
**8.1.11.**  $1/5$   
**8.1.12.**  $1/6$   
**8.2.1.**  $1/\pi, 5/\pi$   
**8.2.2.** 0, 245  
**8.2.3.** 20, 28  
**8.2.4.**  $(3 - \pi)/(2\pi), (18 - 12\sqrt{3} + \pi)/(4\pi)$   
**8.2.5.** 10/49 meters, 20/49 seconds  
**8.2.6.** 45/98 meters, 30/49 seconds  
**8.2.7.** 25000/49 meters, 1000/49 seconds  
**8.2.8.**  $s(t) = \cos t, v(t) = -\sin t$ ,  
 maximum distance is 1,  
 maximum speed is 1  
**8.2.9.**  $s(t) = -\sin(\pi t)/\pi^2 + t/\pi$ ,  
 $v(t) = -\cos(\pi t)/\pi + 1/\pi$ ,  
 maximum speed is  $2/\pi$   
**8.2.10.**  $s(t) = t^2/2 - \sin(\pi t)/\pi^2 + t/\pi$ ,  
 $v(t) = t - \cos(\pi t)/\pi + 1/\pi$   
**8.2.11.**  $s(t) = t^2/2 + \sin(\pi t)/\pi^2 - t/\pi$ ,  
 $v(t) = t + \cos(\pi t)/\pi - 1/\pi$   
**8.3.5.**  $8\pi/3$   
**8.3.6.**  $\pi/30$   
**8.3.7.**  $\pi(\pi/2 - 1)$   
**8.3.8.** (a)  $114\pi/5$  (b)  $74\pi/5$  (c)  $20\pi$   
 (d)  $4\pi$   
**8.3.9.**  $16\pi, 24\pi$   
**8.3.11.**  $\pi h^2(3r - h)/3$   
**8.3.13.**  $2\pi$   
**8.4.1.**  $2/\pi; 2/\pi; 0$

- 8.4.2.  $4/3$   
 8.4.3.  $1/A$   
 8.4.4.  $\pi/4$   
 8.4.5.  $-1/3, 1$   
 8.4.6.  $-4\sqrt{1224}$  ft/s;  $-8\sqrt{1224}$  ft/s  
 8.5.1.  $\approx 5,305,028,516$  N-m  
 8.5.2.  $\approx 4,457,854,041$  N-m  
 8.5.3.  $367,500\pi$  N-m  
 8.5.4.  $49000\pi + 196000/3$  N-m  
 8.5.5.  $2450\pi$  N-m  
 8.5.6.  $0.05$  N-m  
 8.5.7.  $6/5$  N-m  
 8.5.8.  $3920$  N-m  
 8.5.9.  $23520$  N-m  
 8.5.10.  $12740$  N-m  
 9.5.3.  $\frac{-1}{1+x^2}$   
 9.5.5.  $\frac{2x}{\sqrt{1-x^4}}$   
 9.5.6.  $\frac{e^x}{1+e^{2x}}$   
 9.5.7.  $-3x^2 \cos(x^3)/\sqrt{1-\sin^2(x^3)}$   
 9.5.8.  $\frac{2}{(\arcsin x)\sqrt{1-x^2}}$   
 9.5.9.  $-e^x/\sqrt{1-e^{2x}}$   
 9.5.10.  $0$   
 9.5.11.  $\frac{(1+\ln x)x^x}{\ln 5(1+x^{2x})\arctan(x^x)}$   
 10.1.1.  $x/2 - \sin(2x)/4 + C$   
 10.1.2.  $-\cos x + (\cos^3 x)/3 + C$   
 10.1.3.  $3x/8 - (\sin 2x)/4 + (\sin 4x)/32 + C$   
 10.1.4.  $(\cos^5 x)/5 - (\cos^3 x)/3 + C$   
 10.1.5.  $\sin x - (\sin^3 x)/3 + C$   
 10.1.6.  $x/8 - (\sin 4x)/32 + C$   
 10.1.7.  $(\sin^3 x)/3 - (\sin^5 x)/5 + C$   
 10.1.8.  $-2(\cos x)^{5/2}/5 + C$   
 10.1.9.  $\tan x - \cot x + C$   
 10.1.10.  $(\sec^3 x)/3 - \sec x + C$   
 10.2.1.  $-\ln|\csc x + \cot x| + C$   
 10.2.2.  $-\csc x \cot x/2 - (1/2)\ln|\csc x + \cot x| + C$   
 10.2.3.  $x\sqrt{x^2-1}/2 - \ln|x+\sqrt{x^2-1}|/2 + C$   
 10.2.4.  $x\sqrt{9+4x^2}/2 + (9/4)\ln|2x+\sqrt{9+4x^2}| + C$   
 10.2.5.  $-(1-x^2)^{3/2}/3 + C$   
 10.2.6.  $\arcsin(x)/8 - \sin(4\arcsin x)/32 + C$   
 10.2.7.  $\ln|x+\sqrt{1+x^2}| + C$   
 10.2.8.  $(x+1)\sqrt{x^2+2x}/2 - \ln|x+1+\sqrt{x^2+2x}|/2 + C$   
 10.2.9.  $-\arctan x - 1/x + C$   
 10.2.10.  $2\arcsin(x/2) - x\sqrt{4-x^2}/2 + C$   
 10.2.11.  $\arcsin(\sqrt{x}) - \sqrt{x}\sqrt{1-x} + C$   
 10.2.12.  $(2x^2+1)\sqrt{4x^2-1}/24 + C$   
 10.3.1.  $\cos x + x \sin x + C$   
 10.3.2.  $x^2 \sin x - 2 \sin x + 2x \cos x + C$   
 10.3.3.  $(x-1)e^x + C$   
 10.3.4.  $(1/2)e^{x^2} + C$   
 10.3.5.  $(x/2) - \sin(2x)/4 + C = (x/2) - (\sin x \cos x)/2 + C$   
 10.3.6.  $x \ln x - x + C$   
 10.3.7.  $(x^2 \arctan x + \arctan x - x)/2 + C$   
 10.3.8.  $-x^3 \cos x + 3x^2 \sin x + 6x \cos x - 6 \sin x + C$   
 10.3.9.  $x^3 \sin x + 3x^2 \cos x - 6x \sin x - 6 \cos x + C$

$$10.3.10. \quad x^2/4 - (\cos^2 x)/4 - (x \sin x \cos x)/2 + C$$

$$10.3.11. \quad x/4 - (x \cos^2 x)/2 + (\cos x \sin x)/4 + C$$

$$10.3.12. \quad x \arctan(\sqrt{x}) + \arctan(\sqrt{x}) - \sqrt{x} + C$$

$$10.3.13. \quad 2 \sin(\sqrt{x}) - 2\sqrt{x} \cos(\sqrt{x}) + C$$

$$10.3.14. \quad \sec x \csc x - 2 \cot x + C$$

$$10.4.1. \quad -\ln|x-2|/4 + \ln|x+2|/4 + C$$

$$10.4.2. \quad -x^3/3 - 4x - 4 \ln|x-2| + 4 \ln|x+2| + C$$

$$10.4.3. \quad -1/(x+5) + C$$

$$10.4.4. \quad -x - \ln|x-2| + \ln|x+2| + C$$

$$10.4.5. \quad -4x + x^3/3 + 8 \arctan(x/2) + C$$

$$10.4.6. \quad (1/2) \arctan(x/2 + 5/2) + C$$

$$10.4.7. \quad x^2/2 - 2 \ln(4+x^2) + C$$

$$10.4.8. \quad (1/4) \ln|x+3| - (1/4) \ln|x+7| + C$$

$$10.4.9. \quad (1/5) \ln|2x-3| - (1/5) \ln|1+x| + C$$

$$10.4.10. \quad (1/3) \ln|x| - (1/3) \ln|x+3| + C$$

$$10.5.1. \quad \text{T,S: } 4 \pm 0$$

$$10.5.2. \quad \text{T: } 9.28125 \pm 0.281125; \text{ S: } 9 \pm 0$$

$$10.5.3. \quad \text{T: } 60.75 \pm 1; \text{ S: } 60 \pm 0$$

$$10.5.4. \quad \text{T: } 1.1167 \pm 0.0833; \text{ S: } 1.1000 \pm 0.0167$$

$$10.5.5. \quad \text{T: } 0.3235 \pm 0.0026; \text{ S: } 0.3217 \pm 0.000065$$

$$10.5.6. \quad \text{T: } 0.6478 \pm 0.0052; \text{ S: } 0.6438 \pm 0.000033$$

$$10.5.7. \quad \text{T: } 2.8833 \pm 0.0834; \text{ S: } 2.9000 \pm 0.0167$$

$$10.5.8. \quad \text{T: } 1.1170 \pm 0.0077; \text{ S: } 1.1114 \pm 0.0002$$

$$10.5.9. \quad \text{T: } 1.097 \pm 0.0147; \text{ S: } 1.089 \pm 0.0003$$

$$10.5.10. \quad \text{T: } 3.63 \pm 0.087; \text{ S: } 3.62 \pm 0.032$$

$$10.6.1. \quad \frac{(t+4)^4}{4} + C$$

$$10.6.2. \quad \frac{(t^2-9)^{5/2}}{5} + C$$

$$10.6.3. \quad \frac{(e^{t^2}+16)^2}{4} + C$$

$$10.6.4. \quad \cos t - \frac{2}{3} \cos^3 t + C$$

$$10.6.5. \quad \frac{\tan^2 t}{2} + C$$

$$10.6.6. \quad \ln|t^2+t+3| + C$$

$$10.6.7. \quad \frac{1}{8} \ln|1-4/t^2| + C$$

$$10.6.8. \quad \frac{1}{25} \tan(\arcsin(t/5)) + C = \frac{t}{25\sqrt{25-t^2}} + C$$

$$10.6.9. \quad \frac{2}{3} \sqrt{\sin 3t} + C$$

$$10.6.10. \quad t \tan t + \ln|\cos t| + C$$

$$10.6.11. \quad 2\sqrt{e^t+1} + C$$

$$10.6.12. \quad \frac{3t}{8} + \frac{\sin 2t}{4} + \frac{\sin 4t}{32} + C$$

$$10.6.13. \quad \frac{\ln|t|}{3} - \frac{\ln|t+3|}{3} + C$$

$$10.6.14. \quad \frac{-1}{\sin \arctan t} + C = -\sqrt{1+t^2}/t + C$$

$$10.6.15. \quad \frac{-1}{2(1+\tan t)^2} + C$$

$$10.6.16. \quad \frac{(t^2+1)^{5/2}}{5} - \frac{(t^2+1)^{3/2}}{3} + C$$

$$10.6.17. \quad \frac{e^t \sin t - e^t \cos t}{2} + C$$

$$10.6.18. \quad \frac{(t^{3/2}+47)^4}{6} + C$$

$$10.6.19. \quad \frac{2}{3(2-t^2)^{3/2}} - \frac{1}{(2-t^2)^{1/2}} + C$$

$$10.6.20. \quad \frac{\ln|\sin(\arctan(2t/3))|}{9} + C = \frac{\ln(4t^2) - \ln(9+4t^2)}{18} + C$$

$$10.6.21. \quad \frac{(\arctan(2t))^2}{4} + C$$

$$10.6.22. \frac{3 \ln |t+3|}{4} + \frac{\ln |t-1|}{4} + C$$

$$10.6.23. \frac{\cos^7 t}{7} - \frac{\cos^5 t}{5} + C$$

$$10.6.24. \frac{-1}{t-3} + C$$

$$10.6.25. \frac{-1}{\ln t} + C$$

$$10.6.26. \frac{t^2(\ln t)^2}{2} - \frac{t^2 \ln t}{2} + \frac{t^2}{4} + C$$

$$10.6.27. (t^3 - 3t^2 + 6t - 6)e^t + C$$

$$10.6.28. \frac{5 + \sqrt{5}}{10} \ln(2t + 1 - \sqrt{5}) + \frac{5 - \sqrt{5}}{10} \ln(2t + 1 + \sqrt{5}) + C$$

$$11.1.1. 15/2$$

$$11.1.2. 5$$

$$11.1.3. 16/5$$

$$11.1.5. \bar{x} = 45/28, \bar{y} = 93/70$$

$$11.1.6. \bar{x} = 0, \bar{y} = 4/(3\pi)$$

$$11.1.7. \bar{x} = 1/2, \bar{y} = 2/5$$

$$11.1.8. \bar{x} = 0, \bar{y} = 8/5$$

$$11.1.9. \bar{x} = 4/7, \bar{y} = 2/5$$

$$11.1.10. \bar{x} = \bar{y} = 1/5$$

$$11.1.11. \bar{x} = 0, \bar{y} = 28/(9\pi)$$

$$11.1.12. \bar{x} = \bar{y} = 28/(9\pi)$$

$$11.1.13. \bar{x} = 0, \bar{y} = 244/(27\pi) \approx 2.88$$

$$11.2.1. \infty$$

$$11.2.2. 1/2$$

$$11.2.3. \text{diverges}$$

$$11.2.4. \text{diverges}$$

$$11.2.5. 1$$

$$11.2.6. \text{diverges}$$

$$11.2.7. 2$$

$$11.2.8. \text{diverges}$$

$$11.2.9. \pi/6$$

$$11.2.10. \text{diverges, } 0$$

$$11.2.11. \text{diverges, } 0$$

$$11.2.12. \text{diverges, no CPV}$$

$$11.2.13. \pi$$

$$11.2.14. 80 \text{ mph: } 90.8 \text{ to } 95.3 \text{ N}\cdot\text{m}$$

$$90 \text{ mph: } 114.9 \text{ to } 120.6 \text{ N}\cdot\text{m}$$

$$100.9 \text{ mph: } 144.5 \text{ to } 151.6 \text{ N}\cdot\text{m}$$

$$11.3.2. \mu = 1/c, \sigma = 1/c$$

$$11.3.3. \mu = (a+b)/2, \sigma = \frac{(b-a)}{2\sqrt{3}}$$

$$11.3.4. 7/2$$

$$11.3.5. 21/2$$

$$11.3.9. r = 6$$

$$11.4.1. (22\sqrt{22} - 8)/27$$

$$11.4.2. \ln(2) + 3/8$$

$$11.4.3. a + a^3/3$$

$$11.4.4. \ln((\sqrt{2} + 1)/\sqrt{3})$$

$$11.4.6. 3/4$$

$$11.4.7. \approx 3.82$$

$$11.4.8. \approx 1.01$$

$$11.4.9. \sqrt{1+e^2} - \sqrt{2} + 1 - \ln(\sqrt{1+e^2} + 1) + \ln(\sqrt{2} + 1)$$

$$11.5.1. 8\pi\sqrt{3} - \frac{16\pi\sqrt{2}}{3}$$

$$11.5.3. \frac{730\pi\sqrt{730}}{27} - \frac{10\pi\sqrt{10}}{27}$$

$$11.5.4. \pi + 2\pi e + \frac{1}{4}\pi e^2 - \frac{\pi}{4e^2} - \frac{2\pi}{e}$$

$$11.5.6. 8\pi^2$$

$$11.5.7. 2\pi + \frac{8\pi^2}{3\sqrt{3}}$$

- 11.5.8.**  $a > b$ :  $\frac{2\pi b^2 + 2\pi a^2 b}{\sqrt{a^2 - b^2}} \arcsin(\sqrt{a^2 - b^2}/a)$ ,  
 $a < b$ :  $\frac{2\pi b^2 + 2\pi a^2 b}{\sqrt{b^2 - a^2}} \ln\left(\frac{b}{a} + \frac{\sqrt{b^2 - a^2}}{a}\right)$
- 12.1.2.**  $\theta = \arctan(3)$   
**12.1.3.**  $r = -4 \csc \theta$   
**12.1.4.**  $r^3 \cos \theta \sin^2 \theta = 1$   
**12.1.5.**  $r = \sqrt{5}$   
**12.1.6.**  $r^2 = \sin \theta \sec^3 \theta$   
**12.1.7.**  $r \sin \theta = \sin(r \cos \theta)$   
**12.1.8.**  $r = 2/(\sin \theta - 5 \cos \theta)$   
**12.1.9.**  $r = 2 \sec \theta$   
**12.1.10.**  $0 = r^2 \cos^2 \theta - r \sin \theta + 1$   
**12.1.11.**  $0 = 3r^2 \cos^2 \theta - 2r \cos \theta - r \sin \theta$   
**12.1.12.**  $r = \sin \theta$   
**12.1.21.**  $(x^2 + y^2)^2 = 4x^2 y - (x^2 + y^2)y$   
**12.1.22.**  $(x^2 + y^2)^{3/2} = y^2$   
**12.1.23.**  $x^2 + y^2 = x^2 y^2$   
**12.1.24.**  $x^4 + x^2 y^2 = y^2$
- 12.2.1.**  $(\theta \cos \theta + \sin \theta)/(-\theta \sin \theta + \cos \theta)$ ,  
 $(\theta^2 + 2)/(-\theta \sin \theta + \cos \theta)^3$
- 12.2.2.**  $\frac{\cos \theta + 2 \sin \theta \cos \theta}{\cos^2 \theta - \sin^2 \theta - \sin \theta}$ ,  
 $\frac{3(1 + \sin \theta)}{(\cos^2 \theta - \sin^2 \theta - \sin \theta)^3}$
- 12.2.3.**  $(\sin^2 \theta - \cos^2 \theta)/(2 \sin \theta \cos \theta)$ ,  
 $-1/(4 \sin^3 \theta \cos^3 \theta)$
- 12.2.4.**  $\frac{2 \sin \theta \cos \theta}{\cos^2 \theta - \sin^2 \theta}$ ,  $\frac{2}{(\cos^2 \theta - \sin^2 \theta)^3}$
- 12.2.5.** undefined
- 12.2.6.**  $\frac{2 \sin \theta - 3 \sin^3 \theta}{3 \cos^3 \theta - 2 \cos \theta}$ ,  
 $\frac{3 \cos^4 \theta - 3 \cos^2 \theta + 2}{2 \cos^3 \theta (3 \cos^2 \theta - 2)^3}$
- 12.3.1.** 1  
**12.3.2.**  $9\pi/2$   
**12.3.3.**  $\sqrt{3}/3$   
**12.3.4.**  $\pi/12 + \sqrt{3}/16$   
**12.3.5.**  $\pi a^2$   
**12.3.6.**  $41\pi/2$   
**12.3.7.**  $2 - \pi/2$   
**12.3.8.**  $\pi/12$   
**12.3.9.**  $3\pi/16$   
**12.3.10.**  $\pi/4 - 3\sqrt{3}/8$   
**12.3.11.**  $\pi/2 + 3\sqrt{3}/8$   
**12.3.12.**  $1/2$   
**12.3.13.**  $3/2 - \pi/4$   
**12.3.14.**  $\pi/3 + \sqrt{3}/2$   
**12.3.15.**  $\pi/3 - \sqrt{3}/4$   
**12.3.16.**  $4\pi^3/3$   
**12.3.17.**  $\pi^2$   
**12.3.18.**  $5\pi/24 - \sqrt{3}/4$   
**12.3.19.**  $7\pi/12 - \sqrt{3}$   
**12.3.20.**  $4\pi - \sqrt{15}/2 - 7 \arccos(1/4)$   
**12.3.21.**  $3\pi^3$
- 12.4.6.**  $x = t - \frac{\sin(t)}{2}$ ,  $y = 1 - \frac{\cos(t)}{2}$
- 12.4.7.**  $x = 4 \cos t - \cos(4t)$ ,  
 $y = 4 \sin t - \sin(4t)$
- 12.4.8.**  $x = 2 \cos t + \cos(2t)$ ,  
 $y = 2 \sin t - \sin(2t)$
- 12.4.9.**  $x = \cos t + t \sin t$ ,  
 $y = \sin t - t \cos t$
- 12.5.1.** There is a horizontal tangent at all multiples of  $\pi$ .

- 12.5.2.  $9\pi/4$
- 12.5.3.  $\int_0^{2\pi} \frac{1}{2} \sqrt{5 - 4 \cos t} dt$
- 12.5.4. Four points:  

$$\left( \frac{-3 - 3\sqrt{5}}{4}, \pm \sqrt{\frac{5 - \sqrt{5}}{8}} \right),$$

$$\left( \frac{-3 + 3\sqrt{5}}{4}, \pm \sqrt{\frac{5 + \sqrt{5}}{8}} \right)$$
- 12.5.5.  $11\pi/3$
- 12.5.6.  $32/3$
- 12.5.7.  $2\pi$
- 12.5.8.  $16/3$
- 12.5.9.  $(\pi/2, 1)$
- 12.5.10.  $5\pi^3/6$
- 12.5.11.  $2\pi^2$
- 12.5.12.  $(2\pi\sqrt{4\pi^2 + 1} + \ln(2\pi + \sqrt{4\pi^2 + 1}))/2$
- 13.1.1. 1
- 13.1.3. 0
- 13.1.4. 1
- 13.1.5. 1
- 13.1.6. 0
- 13.2.1.  $\lim_{n \rightarrow \infty} n^2/(2n^2 + 1) = 1/2$
- 13.2.2.  $\lim_{n \rightarrow \infty} 5/(2^{1/n} + 14) = 1/3$
- 13.2.3.  $\sum_{n=1}^{\infty} \frac{1}{n}$  diverges, so  $\sum_{n=1}^{\infty} 3\frac{1}{n}$  diverges
- 13.2.4.  $-3/2$
- 13.2.5. 11
- 13.2.6. 20
- 13.2.7.  $3/4$
- 13.2.8.  $3/2$
- 13.2.9.  $3/10$
- 13.3.1. diverges
- 13.3.2. diverges
- 13.3.3. converges
- 13.3.4. converges
- 13.3.5. converges
- 13.3.6. converges
- 13.3.7. diverges
- 13.3.8. converges
- 13.3.9.  $N = 5$
- 13.3.10.  $N = 10$
- 13.3.11.  $N = 1687$
- 13.3.12. any integer greater than  $e^{200}$
- 13.4.1. converges
- 13.4.2. converges
- 13.4.3. diverges
- 13.4.4. converges
- 13.4.5. 0.90
- 13.4.6. 0.95
- 13.5.1. converges
- 13.5.2. converges
- 13.5.3. converges
- 13.5.4. diverges
- 13.5.5. diverges
- 13.5.6. diverges
- 13.5.7. converges
- 13.5.8. diverges
- 13.5.9. converges
- 13.5.10. diverges
- 13.6.1. converges absolutely
- 13.6.2. diverges

- 13.6.3.** converges conditionally  
**13.6.4.** converges absolutely  
**13.6.5.** converges conditionally  
**13.6.6.** converges absolutely  
**13.6.7.** diverges  
**13.6.8.** converges conditionally  
**13.7.5.** converges  
**13.7.6.** converges  
**13.7.7.** converges  
**13.7.8.** diverges  
**13.8.1.**  $R = 1, I = (-1, 1)$   
**13.8.2.**  $R = \infty, I = (-\infty, \infty)$   
**13.8.3.**  $R = e, I = (-e, e)$   
**13.8.4.**  $R = e, I = (2 - e, 2 + e)$   
**13.8.5.**  $R = 0$ , converges only when  $x = 2$   
**13.8.6.**  $R = 1, I = [-6, -4]$   
**13.9.1.** the alternating harmonic series  
**13.9.2.**  $\sum_{n=0}^{\infty} (n+1)x^n$   
**13.9.3.**  $\sum_{n=0}^{\infty} (n+1)(n+2)x^n$   
**13.9.4.**  $\sum_{n=0}^{\infty} \frac{(n+1)(n+2)}{2} x^n, R = 1$   
**13.9.5.**  $C + \sum_{n=0}^{\infty} \frac{-1}{(n+1)(n+2)} x^{n+2}$   
**13.10.1.**  $\sum_{n=0}^{\infty} (-1)^n x^{2n} / (2n)!, R = \infty$   
**13.10.2.**  $\sum_{n=0}^{\infty} x^n / n!, R = \infty$   
**13.10.3.**  $\sum_{n=0}^{\infty} (-1)^n \frac{(x-5)^n}{5^{n+1}}, R = 5$   
**13.10.4.**  $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{(x-1)^n}{n}, R = 1$   
**13.10.5.**  $\ln(2) + \sum_{n=1}^{\infty} (-1)^{n-1} \frac{(x-2)^n}{n2^n}, R = 2$   
**13.10.6.**  $\sum_{n=0}^{\infty} (-1)^n (n+1)(x-1)^n, R = 1$   
**13.10.7.**  $1 + \sum_{n=1}^{\infty} \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{n!2^n} x^n =$   
 $1 + \sum_{n=1}^{\infty} \frac{(2n-1)!}{2^{2n-1}(n-1)!n!} x^n, R = 1$   
**13.10.8.**  $x + x^3/3$   
**13.10.9.**  $\sum_{n=0}^{\infty} (-1)^n x^{4n+1} / (2n)!$   
**13.10.10.**  $\sum_{n=0}^{\infty} (-1)^n x^{n+1} / n!$   
**13.11.1.**  $1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \cdots + \frac{x^{12}}{12!}$   
**13.11.2.** 1000; 8  
**13.11.3.**  $x + \frac{x^3}{3} + \frac{2x^5}{15}$ , error  $\pm 1.27$ .  
**13.12.1.** diverges  
**13.12.2.** converges  
**13.12.3.** converges  
**13.12.4.** diverges  
**13.12.5.** diverges  
**13.12.6.** diverges  
**13.12.7.** converges  
**13.12.8.** converges  
**13.12.9.** converges  
**13.12.10.** converges  
**13.12.11.** converges  
**13.12.12.** converges  
**13.12.13.** converges

13.12.14. converges

13.12.15. converges

13.12.16. converges

13.12.17. diverges

13.12.18.  $(-\infty, \infty)$ 13.12.19.  $(-3, 3)$ 13.12.20.  $(-3, 3)$ 13.12.21.  $(-1, 1)$ 13.12.22. radius is 0—it converges only when  
 $x = 0$ 13.12.23.  $(-\sqrt{3}, \sqrt{3})$ 13.12.24.  $(-\infty, \infty)$ 13.12.25.  $\sum_{n=0}^{\infty} \frac{(\ln(2))^n}{n!} x^n$ 

13.12.26.  $\sum_{n=0}^{\infty} \frac{(-1)^n}{n+1} x^{n+1}$

13.12.27.  $\sum_{n=0}^{\infty} \frac{2}{2n+1} x^{2n+1}$

13.12.28.  $1 + x/2 + \sum_{n=2}^{\infty} (-1)^{n+1} \frac{1 \cdot 3 \cdot 5 \cdots (2n-3)}{2^n n!} x^n$

13.12.29.  $\sum_{n=0}^{\infty} (-1)^n x^{2n}$

13.12.30.  $\sum_{n=0}^{\infty} \frac{(-1)^n}{2n+1} x^{2n+1}$

13.12.31.  $\pi = \sum_{n=0}^{\infty} (-1)^n \frac{4}{2n+1}$