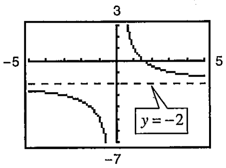
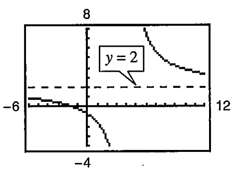
53. 8 **55.** $\frac{2}{3}$ **57.** $-\infty$ **59.** 0 **61.** 6

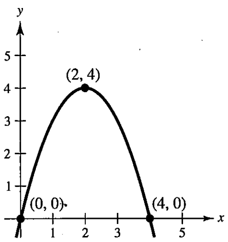
63.



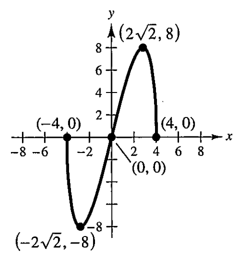
65.



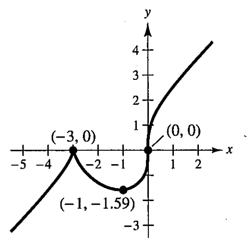
67.



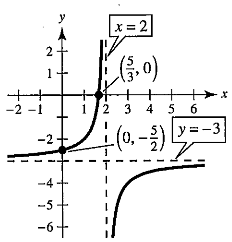
69.



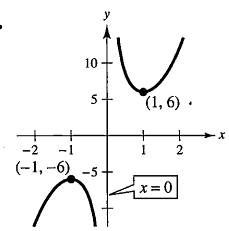
71.



73.



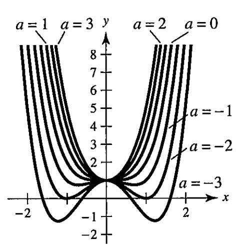
75.



77. $x = 50$ ft and $y = \frac{200}{3}$ ft **79.** (0, 0), (5, 0), (0, 10)
81. 14.05 ft **83.** $32\pi r^3/81$ **85.** $-1.532, -0.347, 1.879$
87. $-2.182, -0.795$ **89.** -0.755
91. $\Delta y = 0.03005$; $dy = 0.03$
93. $dy = (1 - \cos x + x \sin x)\,dx$ **95.** (a) $\pm 8.1\pi\text{ cm}^3$ (b) $\pm 1.8\pi\text{ cm}^2$ (c) About 0.83%; About 0.56%

P.S. Problem Solving *(page 241)*

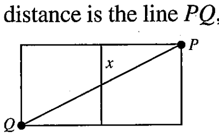
1. Choices of a may vary.



(a) One relative minimum at (0, 1) for $a \geq 0$
(b) One relative maximum at (0, 1) for $a < 0$
(c) Two relative minima for $a < 0$ when $x = \pm\sqrt{-a/2}$
(d) If $a < 0$, then there are three critical points; if $a \geq 0$, then there is only one critical point.

3. All c, where c is a real number **5.** Proof

7. The bug should head towards the midpoint of the opposite side. Without calculus, imagine opening up the cube. The shortest distance is the line PQ, passing through the midpoint as shown.

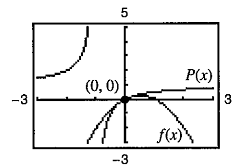


9. $a = 6, b = 1, c = 2$ **11.** Proof

13. Greatest slope: $\left(-\frac{\sqrt{3}}{3}, \frac{3}{4}\right)$; Least slope: $\left(\frac{\sqrt{3}}{3}, \frac{3}{4}\right)$

15. Proof **17.** Proof; Point of inflection: (1, 0)

19. (a) $P(x) = x - x^2$
(b)



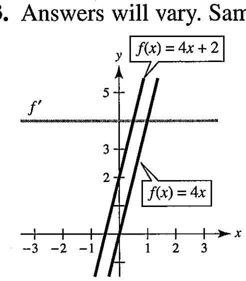
Chapter 4

Section 4.1 *(page 251)*

1. Proof **3.** $y = 3t^3 + C$ **5.** $y = \frac{2}{5}x^{5/2} + C$

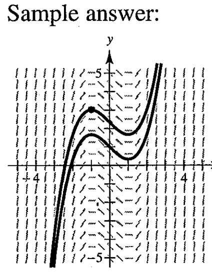
	Original Integral	Rewrite	Integrate	Simplify
7.	$\int \sqrt[3]{x}\,dx$	$\int x^{1/3}\,dx$	$\frac{x^{4/3}}{4/3} + C$	$\frac{3}{4}x^{4/3} + C$
9.	$\int \frac{1}{x\sqrt{x}}\,dx$	$\int x^{-3/2}\,dx$	$\frac{x^{-1/2}}{-1/2} + C$	$-\frac{2}{\sqrt{x}} + C$

11. $\frac{1}{2}x^2 + 7x + C$ **13.** $\frac{1}{6}x^6 + x + C$
15. $\frac{2}{5}x^{5/2} + x^2 + x + C$ **17.** $\frac{3}{5}x^{5/3} + C$
19. $-1/(4x^4) + C$ **21.** $\frac{2}{3}x^{3/2} + 12x^{1/2} + C$
23. $x^3 + \frac{1}{2}x^2 - 2x + C$ **25.** $5 \sin x - 4 \cos x + C$
27. $t + \csc t + C$ **29.** $\tan\theta + \cos\theta + C$ **31.** $\tan y + C$
33. Answers will vary. Sample answer:

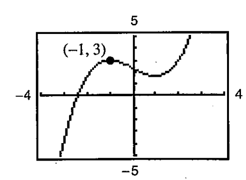


35. $f(x) = 3x^2 + 8$ **37.** $h(t) = 2t^4 + 5t - 11$
39. $f(x) = x^2 + x + 4$ **41.** $f(x) = -4\sqrt{x} + 3x$

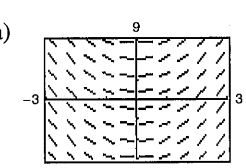
43. (a) Answers will vary. Sample answer:



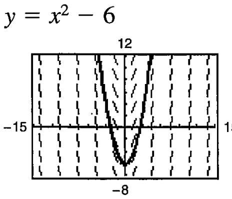
(b) $y = \frac{x^3}{3} - x + \frac{7}{3}$



45. (a)

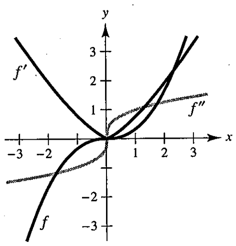


(b) $y = x^2 - 6$
(c)



47. When you evaluate the integral $\int f(x)\,dx$, you are finding a function $F(x)$ that is an antiderivative of $f(x)$. So, there is no difference.

49.



51. (a) $h(t) = \frac{3}{4}t^2 + 5t + 12$ (b) 69 cm **53.** 62.25 ft

55. (a) $t \approx 2.562$ sec (b) $v(t) \approx -65.970$ ft/sec

57. $v_0 \approx 62.3$ m/sec **59.** 320 m; -32 m/sec

61. (a) $v(t) = 3t^2 - 12t + 9$; $a(t) = 6t - 12$
(b) $(0, 1), (3, 5)$ (c) -3

63. $a(t) = -1/(2t^{3/2})$; $x(t) = 2\sqrt{t} + 2$

65. (a) 1.18 m/sec^2 (b) 190 m

67. (a) 300 ft (b) 60 ft/sec $\approx$ 41 mi/h

69. False. f has an infinite number of antiderivatives, each differing by a constant.

71. True **73.** True **75.** $f(x) = \dfrac{x^3}{3} - 4x + \dfrac{16}{3}$

77. Proof

Section 4.2 *(page 263)*

1. 75 **3.** $\dfrac{158}{85}$ **5.** $4c$ **7.** $\displaystyle\sum_{i=1}^{11} \frac{1}{5i}$

9. $\displaystyle\sum_{j=1}^{6}\left[7\left(\frac{j}{6}\right) + 5\right]$ **11.** $\displaystyle\frac{2}{n}\sum_{i=1}^{n}\left[\left(\frac{2i}{n}\right)^3 - \left(\frac{2i}{n}\right)\right]$ **13.** 84

15. 1200 **17.** 2470 **19.** 12,040

21. $(n + 2)/n$
$n = 10$: $S = 1.2$
$n = 100$: $S = 1.02$
$n = 1000$: $S = 1.002$
$n = 10{,}000$: $S = 1.0002$

23. $[2(n + 1)(n - 1)]/n^2$
$n = 10$: $S = 1.98$
$n = 100$: $S = 1.9998$
$n = 1000$: $S = 1.999998$
$n = 10{,}000$: $S = 1.99999998$

25. $13 <$ (Area of region) < 15

27. $55 <$ (Area of region) < 74.5

29. $0.7908 <$ (Area of region) < 1.1835

31. The area of the shaded region falls between 12.5 square units and 16.5 square units.

33. $A \approx S \approx 0.768$
$A \approx s \approx 0.518$

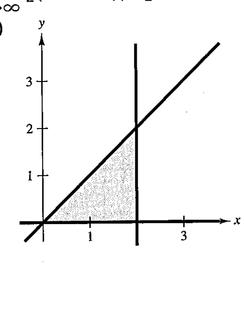
35. $A \approx S \approx 0.746$
$A \approx s \approx 0.646$

37. $\displaystyle\lim_{n\to\infty}\left[\frac{12(n + 1)}{n}\right] = 12$

39. $\displaystyle\lim_{n\to\infty}\frac{1}{6}\left(\frac{2n^3 - 3n^2 + n}{n^3}\right) = \frac{1}{3}$

41. $\displaystyle\lim_{n\to\infty}[(3n + 1)/n] = 3$

43. (a)



(b) $\Delta x = (2 - 0)/n = 2/n$

(c) $s(n) = \displaystyle\sum_{i=1}^{n} f(x_{i-1})\,\Delta x = \sum_{i=1}^{n}[(i - 1)(2/n)](2/n)$

(d) $S(n) = \displaystyle\sum_{i=1}^{n} f(x_i)\,\Delta x = \sum_{i=1}^{n}[i(2/n)](2/n)$

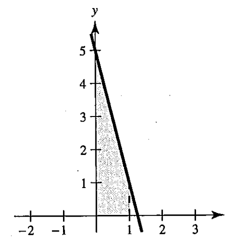
(e)

n	5	10	50	100
$s(n)$	1.6	1.8	1.96	1.98
$S(n)$	2.4	2.2	2.04	2.02

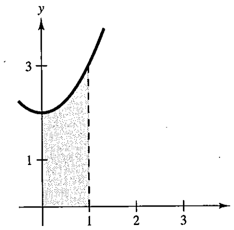
(f) $\displaystyle\lim_{n\to\infty}\sum_{i=1}^{n}[(i - 1)(2/n)](2/n) = 2$;

$\displaystyle\lim_{n\to\infty}\sum_{i=1}^{n}[i(2/n)](2/n) = 2$

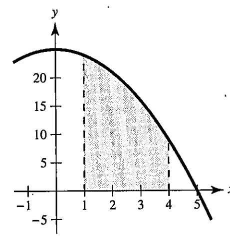
45. $A = 3$



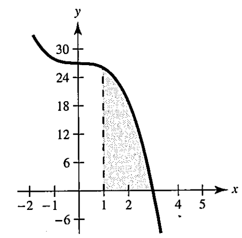
47. $A = \frac{7}{3}$



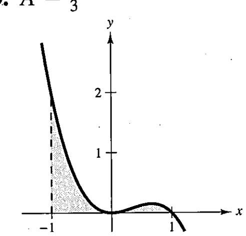
49. $A = 54$



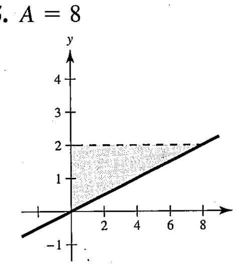
51. $A = 34$



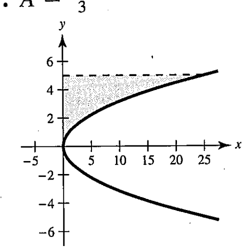
53. $A = \frac{2}{3}$



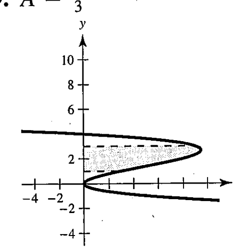
55. $A = 8$



57. $A = \frac{125}{3}$

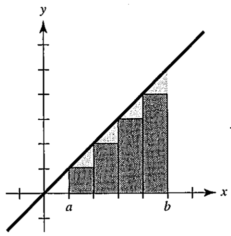


59. $A = \frac{44}{3}$

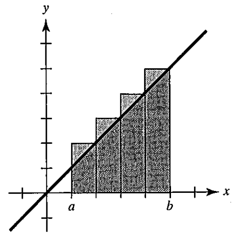


61. $\frac{69}{8}$ **63.** 0.345 **65.** b

67. You can use the line $y = x$ bounded by $x = a$ and $x = b$. The sum of the areas of the inscribed rectangles in the figure below is the lower sum.

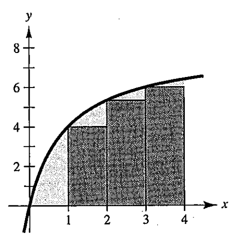


The sum of the areas of the circumscribed rectangles in the figure below is the upper sum.



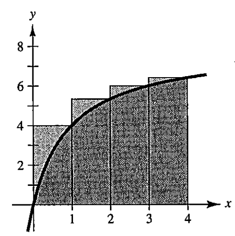
The rectangles in the first graph do not contain all of the area of the region, and the rectangles in the second graph cover more than the area of the region. The exact value of the area lies between these two sums.

69. (a)



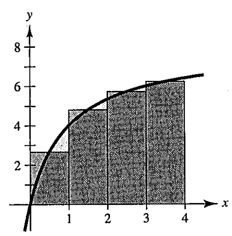
$s(4) = \frac{46}{3}$

(b)



$S(4) = \frac{326}{15}$

(c)



$M(4) = \frac{6112}{315}$

(d) Proof

(e)

n	4	8	20	100	200
$s(n)$	15.333	17.368	18.459	18.995	19.060
$S(n)$	21.733	20.568	19.739	19.251	19.188
$M(n)$	19.403	19.201	19.137	19.125	19.125

(f) Because f is an increasing function, $s(n)$ is always increasing and $S(n)$ is always decreasing.

71. True

73. Suppose there are n rows and $n + 1$ columns. The stars on the left total $1 + 2 + \cdots + n$, as do the stars on the right. There are $n(n + 1)$ stars in total. So, $2[1 + 2 + \cdots + n] = n(n + 1)$ and $1 + 2 + \cdots + n = [n(n + 1)]/2$.

75. For n odd, $\left(\dfrac{n+1}{2}\right)^2$ blocks;

For n even, $\dfrac{n^2 + 2n}{4}$ blocks

77. Putnam Problem B1, 1989

Section 4.3 *(page 273)*

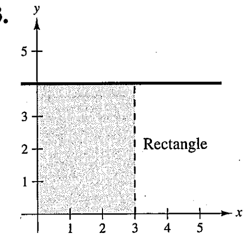
1. $2\sqrt{3} \approx 3.464$ **3.** 32 **5.** 0 **7.** $\frac{10}{3}$

9. $\displaystyle\int_{-1}^{5} (3x + 10)\, dx$ **11.** $\displaystyle\int_{0}^{3} \sqrt{x^2 + 4}\, dx$ **13.** $\displaystyle\int_{0}^{4} 5\, dx$

15. $\displaystyle\int_{-4}^{4} (4 - |x|)\, dx$ **17.** $\displaystyle\int_{-5}^{5} (25 - x^2)\, dx$

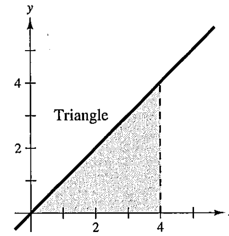
19. $\displaystyle\int_{0}^{\pi/2} \cos x\, dx$ **21.** $\displaystyle\int_{0}^{2} y^3\, dy$

23.



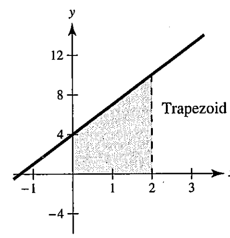
$A = 12$

25.



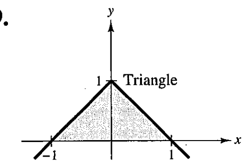
$A = 8$

27.



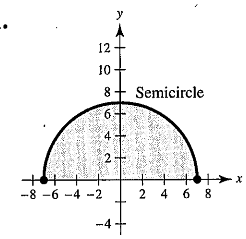
$A = 14$

29.



$A = 1$

31.



$A = 49\pi/2$

33. -6 **35.** 48 **37.** -12

39. 16 **41.** (a) 13 (b) -10 (c) 0 (d) 30

43. (a) 8 (b) -12 (c) -4 (d) 30 **45.** $-48, 88$

47. (a) $-\pi$ (b) 4 (c) $-(1 + 2\pi)$ (d) $3 - 2\pi$ (e) $5 + 2\pi$ (f) $23 - 2\pi$

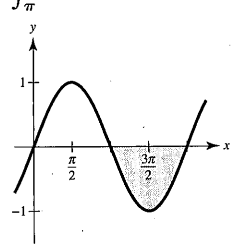
49. (a) 14 (b) 4 (c) 8 (d) 0 **51.** 40 **53.** a **55.** d

57. No. There is a discontinuity at $x = 4$.

59. $a = -2,\ b = 5$

61. Answers will vary. Sample answer: $a = \pi,\ b = 2\pi$

$$\int_{\pi}^{2\pi} \sin x\, dx < 0$$



63. True **65.** True **67.** False. $\displaystyle\int_{0}^{2} (-x)\, dx = -2$

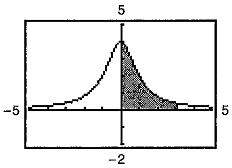
69. 272 **71.** Proof

73. No. No matter how small the subintervals, the number of both rational and irrational numbers within each subinterval is infinite, and $f(c_i) = 0$ or $f(c_i) = 1$.

75. $a = -1$ and $b = 1$ maximize the integral. **77.** $\frac{1}{3}$

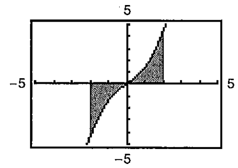
Section 4.4 *(page 288)*

1.



Positive

3.



Zero

5. 12 **7.** -2 **9.** $-\frac{10}{3}$ **11.** $\frac{1}{3}$ **13.** $\frac{1}{2}$ **15.** $\frac{2}{3}$
17. -4 **19.** $-\frac{1}{18}$ **21.** $-\frac{27}{20}$ **23.** $\frac{25}{2}$ **25.** $\frac{64}{3}$
27. $\pi + 2$ **29.** $\pi/4$ **31.** $2\sqrt{3}/3$ **33.** 0 **35.** $\frac{1}{6}$
37. 1 **39.** $\frac{52}{3}$ **41.** 20 **43.** $\frac{32}{3}$
45. $3\sqrt[3]{2}/2 \approx 1.8899$ **47.** $2\sqrt{3} \approx 3.4641$
49. $\pm\arccos\sqrt{\pi}/2 \approx \pm 0.4817$

51. Average value $= 6$
$x = \pm\sqrt{3} \approx \pm 1.7321$

53. Average value $= \frac{1}{4}$
$x = \sqrt[3]{2}/2 \approx 0.6300$

55. Average value $= 2/\pi$
$x \approx 0.690, x \approx 2.451$

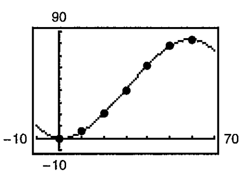
57. About 540 ft

59. (a) 8 (b) $\frac{4}{3}$ (c) $\int_1^7 f(x)\,dx = 20$; Average value $= \frac{10}{3}$

61. (a) $F(x) = 500 \sec^2 x$ (b) $1500\sqrt{3}/\pi \approx 827$ N

63. About 0.5318 L

65. (a) $v = -0.00086t^3 + 0.0782t^2 - 0.208t + 0.10$
(b)



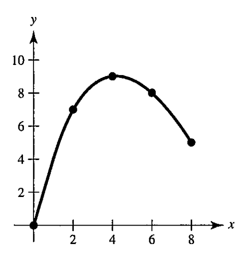
(c) 2475.6 m

67. $F(x) = 2x^2 - 7x$
$F(2) = -6$
$F(5) = 15$
$F(8) = 72$

69. $F(x) = -20/x + 20$
$F(2) = 10$
$F(5) = 16$
$F(8) = \frac{35}{2}$

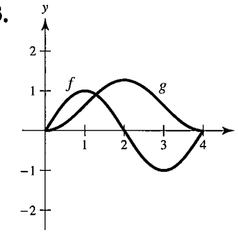
71. $F(x) = \sin x - \sin 1$
$F(2) = \sin 2 - \sin 1 \approx 0.0678$
$F(5) = \sin 5 - \sin 1 \approx -1.8004$
$F(8) = \sin 8 - \sin 1 \approx 0.1479$

73. (a) $g(0) = 0, g(2) \approx 7, g(4) \approx 9, g(6) \approx 8, g(8) \approx 5$
(b) Increasing: $(0, 4)$; Decreasing: $(4, 8)$
(c) A maximum occurs at $x = 4$.
(d)



75. $\frac{1}{2}x^2 + 2x$ **77.** $\frac{3}{4}x^{4/3} - 12$ **79.** $\tan x - 1$
81. $x^2 - 2x$ **83.** $\sqrt{x^4 + 1}$ **85.** $x \cos x$ **87.** 8
89. $\cos x\sqrt{\sin x}$ **91.** $3x^2 \sin x^6$

93.



An extremum of g occurs at $x = 2$.

95. (a) $\frac{3}{2}$ ft to the right
(b) $\frac{113}{10}$ ft

97. (a) 0 ft (b) $\frac{63}{2}$ ft **99.** (a) 2 ft to the right (b) 2 ft
101. 28 units **103.** 8190 L
105. $f(x) = x^{-2}$ has a nonremovable discontinuity at $x = 0$.
107. $f(x) = \sec^2 x$ has a nonremovable discontinuity at $x = \pi/2$.
109. $2/\pi \approx 63.7\%$ **111.** True

113. $f'(x) = \dfrac{1}{(1/x)^2 + 1}\left(-\dfrac{1}{x^2}\right) + \dfrac{1}{x^2 + 1} = 0$
Because $f'(x) = 0$, $f(x)$ is constant.

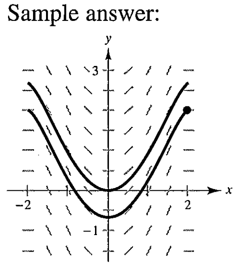
115. (a) 0 (b) 0 (c) $xf(x) + \int_0^x f(t)\,dt$ (d) 0

Section 4.5 *(page 301)*

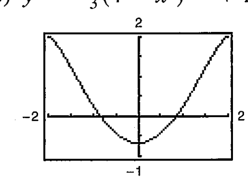
	$\int f(g(x))g'(x)\,dx$	$u = g(x)$	$du = g'(x)\,dx$
1.	$\int (8x^2 + 1)^2(16x)\,dx$	$8x^2 + 1$	$16x\,dx$
3.	$\int \tan^2 x \sec^2 x\,dx$	$\tan x$	$\sec^2 x\,dx$

5. $\frac{1}{5}(1 + 6x)^5 + C$ **7.** $\frac{2}{3}(25 - x^2)^{3/2} + C$
9. $\frac{1}{12}(x^4 + 3)^3 + C$ **11.** $\frac{1}{15}(x^3 - 1)^5 + C$
13. $\frac{1}{3}(t^2 + 2)^{3/2} + C$ **15.** $-\frac{15}{8}(1 - x^2)^{4/3} + C$
17. $1/[4(1 - x^2)^2] + C$ **19.** $-1/[3(1 + x^3)] + C$
21. $-\sqrt{1 - x^2} + C$ **23.** $-\frac{1}{4}(1 + 1/t)^4 + C$
25. $\sqrt{2x} + C$ **27.** $2x^2 - 4\sqrt{16 - x^2} + C$
29. $-1/[2(x^2 + 2x - 3)] + C$

31. (a) Answers will vary.
Sample answer:



(b) $y = -\frac{1}{3}(4 - x^2)^{3/2} + 2$

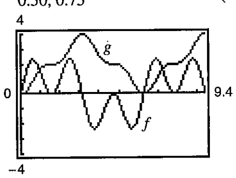


33. $-\cos(\pi x) + C$

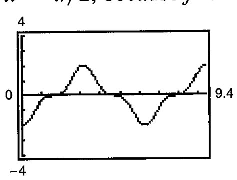
35. $\int \cos 8x\,dx = \dfrac{1}{8}\int (\cos 8x)(8)\,dx = \dfrac{1}{8}\sin 8x + C$

37. $-\sin(1/\theta) + C$
39. $\frac{1}{4}\sin^2 2x + C$ or $-\frac{1}{4}\cos^2 2x + C_1$ or $-\frac{1}{8}\cos 4x + C_2$
41. $\frac{1}{2}\tan^2 x + C$ or $\frac{1}{2}\sec^2 x + C_1$ **43.** $f(x) = 2\cos(x/2) + 4$
45. $f(x) = \frac{1}{12}(4x^2 - 10)^3 - 8$
47. $\frac{2}{5}(x + 6)^{5/2} - 4(x + 6)^{3/2} + C = \frac{2}{5}(x + 6)^{3/2}(x - 4) + C$
49. $-\left[\frac{2}{3}(1 - x)^{3/2} - \frac{4}{5}(1 - x)^{5/2} + \frac{2}{7}(1 - x)^{7/2}\right] + C =$
$-\frac{2}{105}(1 - x)^{3/2}(15x^2 + 12x + 8) + C$

51. $\frac{1}{8}\left[\frac{2}{5}(2x-1)^{5/2}+\frac{4}{3}(2x-1)^{3/2}-6(2x-1)^{1/2}\right]+C = \left(\sqrt{2x-1}/15\right)(3x^2+2x-13)+C$
53. $-x-1-2\sqrt{x+1}+C$ or $-\left(x+2\sqrt{x+1}\right)+C_1$
55. 0 **57.** $12-\frac{8}{9}\sqrt{2}$ **59.** 2 **61.** $\frac{1}{2}$
63. $f(x)=(2x^3+1)^3+3$ **65.** $1209/28$ **67.** $2\left(\sqrt{3}-1\right)$
69. $\frac{272}{15}$ **71.** $\frac{2}{3}$ **73.** (a) $\frac{64}{3}$ (b) $\frac{128}{3}$ (c) $-\frac{64}{3}$ (d) 64
75. $2\int_0^3 (4x^2-6)\,dx = 36$
77. If $u=5-x^2$, then $du=-2x\,dx$ and $\int x(5-x^2)^3\,dx = -\frac{1}{2}\int(5-x^2)^3(-2x)\,dx = -\frac{1}{2}\int u^3\,du.$
79. (a) $\int x^2\sqrt{x^3+1}\,dx$ (b) $\int \tan(3x)\sec^2(3x)\,dx$
81. \$340,000
83. (a) 102.532 thousand units (b) 102.352 thousand units
(c) 74.5 thousand units
85. (a) $P_{0.50,\,0.75}\approx 35.3\%$ (b) $b\approx 58.6\%$
87. (a)



(b) g is nonnegative, because the graph of f is positive at the beginning and generally has more positive sections than negative ones.
(c) The points on g that correspond to the extrema of f are points of inflection of g.
(d) No, some zeros of f, such as $x=\pi/2$, do not correspond to extrema of g. The graph of g continues to increase after $x=\pi/2$, because f remains above the x-axis.
(e)



The graph of h is that of g shifted 2 units downward.

89. (a) and (b) Proofs
91. False. $\int(2x+1)^2\,dx = \frac{1}{6}(2x+1)^3+C$ **93.** True
95. True **97–99.** Proofs **101.** Putnam Problem A1, 1958

Section 4.6 *(page 310)*

	Trapezoidal	Simpson's	Exact
1.	2.7500	2.6667	2.6667
3.	4.2500	4.0000	4.0000
5.	20.2222	20.0000	20.0000
7.	12.6640	12.6667	12.6667
9.	0.3352	0.3334	0.3333

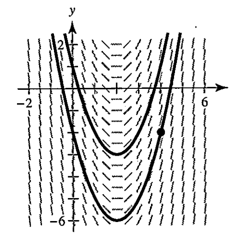
	Trapezoidal	Simpson's	Graphing Utility
11.	3.2833	3.2396	3.2413
13.	0.3415	0.3720	0.3927
15.	0.5495	0.5483	0.5493
17.	−0.0975	−0.0977	−0.0977
19.	0.1940	0.1860	0.1858

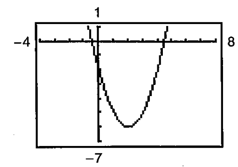
21. Trapezoidal: Linear (1st-degree) polynomials
Simpson's: Quadratic (2nd-degree) polynomials
23. (a) 1.500 (b) 0.000 **25.** (a) $\frac{1}{4}$ (b) $\frac{1}{12}$
27. (a) $n=366$ (b) $n=26$ **29.** (a) $n=77$ (b) $n=8$
31. (a) $n=130$ (b) $n=12$ **33.** (a) $n=643$ (b) $n=48$

35. (a) 24.5 (b) 25.67 **37.** 0.701 **39.** 89,250 m^2
41. 10,233.58 ft-lb **43.** 3.1416 **45.** 2.477 **47.** Proof

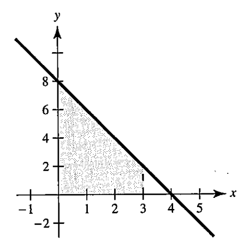
Review Exercises for Chapter 4 *(page 312)*

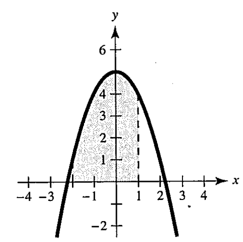
1. $\frac{x^2}{2}-6x+C$ **3.** $\frac{4}{3}x^3+\frac{1}{2}x^2+3x+C$
5. $x^2/2-4/x^2+C$ **7.** $x^2+9\cos x+C$
9. $y=1-3x^2$ **11.** $f(x)=4x^3-5x-3$
13. (a) Answers will vary. (b) $y=x^2-4x-2$
Sample answer:



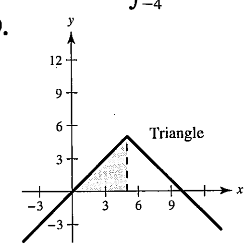


15. (a) 3 sec; 144 ft (b) $\frac{3}{2}$ sec (c) 108 ft
17. 240 ft/sec **19.** 60 **21.** $\sum_{n=1}^{10}\frac{1}{3n}$ **23.** 192
25. 420 **27.** 3310
29. $9.038 <$ (Area of region) < 13.038
31. $A=15$ **33.** $A=12$



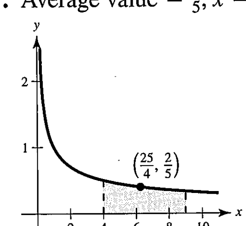


35. $\frac{27}{2}$ **37.** $\int_{-4}^{0}(2x+8)\,dx$
39.



$A=\frac{25}{2}$

41. (a) 17 (b) 7
(c) 9 (d) 84
43. 56 **45.** 0 **47.** $\frac{422}{5}$ **49.** $\left(\sqrt{2}+2\right)/2$
51. $-\cos 2+1\approx 1.416$ **53.** 30 **55.** $\frac{1}{4}$
57. Average value $=\frac{2}{5}$, $x=\frac{25}{4}$

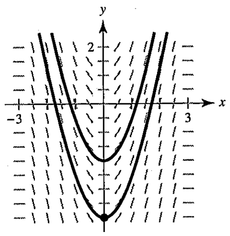


59. $x^2\sqrt{1+x^3}$ **61.** x^2+3x+2 **63.** $\frac{2}{3}\sqrt{x^3+3}+C$
65. $-\frac{1}{30}(1-3x^2)^5+C=\frac{1}{30}(3x^2-1)^5+C$

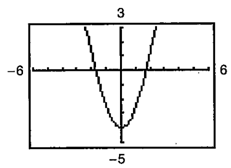
67. $\frac{1}{4}\sin^4 x + C$ **69.** $-2\sqrt{1 - \sin\theta} + C$

71. $\frac{1}{3\pi}(1 + \sec \pi x)^3 + C$

73. (a) Answers will vary. Sample answer:



(b) $y = -\frac{1}{3}(9 - x^2)^{3/2} + 5$



75. $\frac{455}{2}$ **77.** 2 **79.** $28\pi/15$ **81.** 2 **83.** $\frac{468}{7}$

85. (a) $\frac{64}{5}$ (b) $\frac{32}{5}$ (c) $\frac{96}{5}$ (d) -32

87. Trapezoidal Rule: 0.285
Simpson's Rule: 0.284
Graphing Utility: 0.284

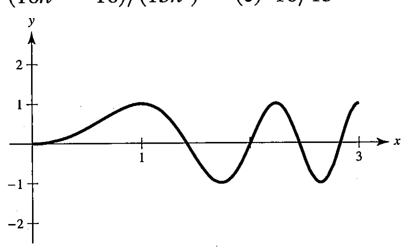
89. Trapezoidal Rule: 0.637
Simpson's Rule: 0.685
Graphing Utility: 0.704

P.S. Problem Solving *(page 315)*

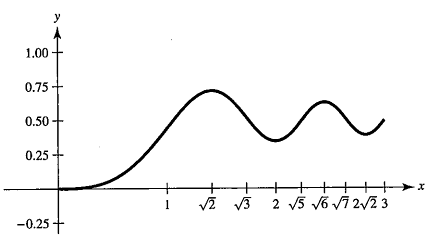
1. (a) $L(1) = 0$ (b) $L'(x) = 1/x$, $L'(1) = 1$
(c) $x \approx 2.718$ (d) Proof

3. (a) $\lim_{n\to\infty}\left[\frac{32}{n^5}\sum_{i=1}^{n} i^4 - \frac{64}{n^4}\sum_{i=1}^{n} i^3 + \frac{32}{n^3}\sum_{i=1}^{n} i^2\right]$
(b) $(16n^4 - 16)/(15n^4)$ (c) $16/15$

5. (a)

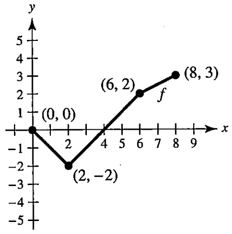


(b)



(c) Relative maxima at $x = \sqrt{2}, \sqrt{6}$
Relative minima at $x = 2, 2\sqrt{2}$
(d) Points of inflection at $x = 1, \sqrt{3}, \sqrt{5}, \sqrt{7}$

7. (a)



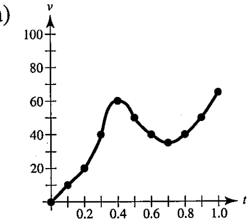
(b)

x	0	1	2	3	4	5	6	7	8
$F(x)$	0	$-\frac{1}{2}$	-2	$-\frac{7}{2}$	-4	$-\frac{7}{2}$	-2	$\frac{1}{4}$	3

(c) $x = 4, 8$ (d) $x = 2$

9. Proof **11.** $\frac{2}{3}$ **13.** $1 \le \int_0^1 \sqrt{1 + x^4}\, dx \le \sqrt{2}$

15. (a)



(b) (0, 0.4) and (0.7, 1.0) (c) 150 mi/h^2
(d) Total distance traveled in miles; 38.5 mi
(e) Sample answer: 100 mi/h^2

17. (a)–(c) Proofs

19. (a) $R(n), I, T(n), L(n)$
(b) $S(4) = \frac{1}{3}[f(0) + 4f(1) + 2f(2) + 4f(3) + f(4)] \approx 5.42$

Chapter 5

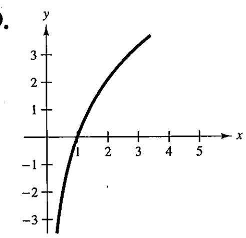
Section 5.1 *(page 325)*

1. (a) 3.8067 (b) $\ln 45 = \int_1^{45} \frac{1}{t}\, dt \approx 3.8067$

3. (a) -0.2231 (b) $\ln 0.8 = \int_1^{0.8} \frac{1}{t}\, dt \approx -0.2231$

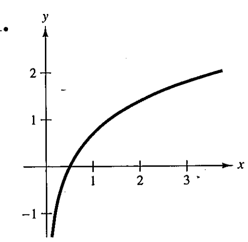
5. b **6.** d **7.** a **8.** c

9.



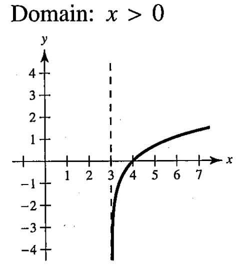
Domain: $x > 0$

11.



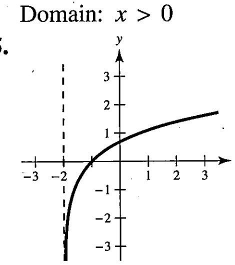
Domain: $x > 0$

13.



Domain: $x > 3$

15.



Domain: $x > -2$

17. (a) 1.7917 (b) -0.4055 (c) 4.3944 (d) 0.5493

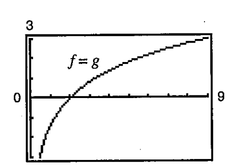
19. $\ln x - \ln 4$ **21.** $\ln x + \ln y - \ln z$

23. $\ln x + \frac{1}{2}\ln(x^2 + 5)$ **25.** $\frac{1}{2}[\ln(x - 1) - \ln x]$

27. $\ln z + 2\ln(z - 1)$ **29.** $\ln\frac{x - 2}{x + 2}$

31. $\ln\sqrt[3]{\frac{x(x + 3)^2}{x^2 - 1}}$ **33.** $\ln\frac{9}{\sqrt{x^2 + 1}}$

35. (a)



(b) $f(x) = \ln\frac{x^2}{4} = \ln x^2 - \ln 4$
$= 2\ln x - \ln 4$
$= g(x)$

37. $-\infty$ **39.** $\ln 4 \approx 1.3863$ **41.** $1/x$ **43.** $2/x$