CHAPTER 5

SECTION 5.1 *(page 326)*

Prerequisite Review

1. $x^{-1/2}$ **2.** $(2x)^{4/3}$ **3.** $5^{1/2}x^{3/2} + x^{5/2}$
4. $x^{-1/2} + x^{-2/3}$ **5.** $(x + 1)^{5/2}$ **6.** $x^{1/6}$
7. -12 **8.** -10 **9.** 14 **10.** 14

1–7. Answers will vary.

9. $6x + C$

$\frac{d}{dx}[6x + C] = 6$

11. $\frac{5}{3}t^3 + C$ **13.** $-\frac{5}{2x^2} + C$

$\frac{d}{dt}\left[\frac{5}{3}t^3 + C\right] = 5t^2$ $\frac{d}{dx}\left[-\frac{5}{2x^2} + C\right] = 5x^{-3}$

15. $u + C$ **17.** $et + C$

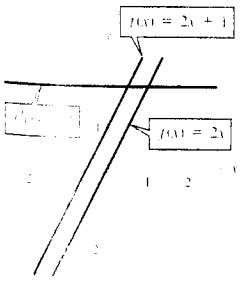
$\frac{d}{du}[u + C] = 1$ $\frac{d}{dt}[et + C] = e$

19. $\frac{2}{5}y^{5/2} + C$

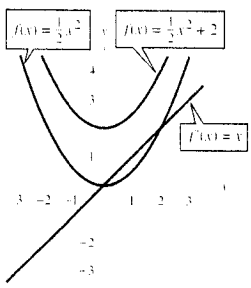
$\frac{d}{dy}\left[\frac{2}{5}y^{5/2} + C\right] = y^{3/2}$

	Rewrite	*Integrate*	*Simplify*
21.	$\int x^{1/3}\,dx$	$\frac{x^{4/3}}{4/3} + C$	$\frac{3}{4}x^{4/3} + C$
23.	$\int x^{-1/2}\,dx$	$\frac{x^{-1/2}}{-1/2} + C$	$-\frac{2}{\sqrt{x}} + C$
25.	$\int (x^2 + 3x)\,dx$	$\frac{x^4}{4} + \frac{3x^2}{2} + C$	$\frac{x^2}{4}(x^2 + 6) + C$
27.	$\frac{1}{2}\int x^{-3}\,dx$	$\frac{1}{2}\left(\frac{x^{-2}}{-2}\right) + C$	$-\frac{1}{4x^2} + C$

29.



31.



33. $\frac{1}{2}x^4 - x^2 + C$ **35.** $\frac{3}{4}x^{4/3} - \frac{3}{4}x^{2/3} + C$

37. $\frac{3}{5}x^{5/3} - x + C$

39. $-\frac{1}{9x^3} + C$ **41.** $2x - \frac{1}{2x^2} + C$

43. $\frac{3}{4}u^4 + \frac{1}{2}u^2 + C$ **45.** $2x^3 - \frac{11}{2}x^2 + 5x + C$

47. $\frac{2}{7}y^{7/2} + C$ **49.** $f(x) = 2x^{3/2} + 3x - 1$

51. $f(x) = 2x^3 - 3x^2$ **53.** $f(x) = -\frac{1}{x^2} + \frac{1}{x} + \frac{1}{2}$

55. $y = -\frac{5}{2}x^2 - 2x + 2$ **57.** $f(x) = 4x^{3/2} - 10x + 10$

59. $f(x) = x^2 + x + 4$ **61.** $f(x) = \frac{9}{4}x^{4/3}$

63. $C = 85x + 5500$ **65.** $C = \frac{1}{10}\sqrt{x} + 4x + 750$

67. $R = 225x - \frac{3}{2}x^2$, $p = 225 - \frac{3}{2}x$

69. $R = 225x + x^2 - \frac{1}{3}x^3$, $p = 225 + x - \frac{1}{3}x^2$

71. $P = -9x^2 + 1650x$ **73.** $P = -12x^2 + 805x + 68$

75. 56.25 feet **77.** $v_0 = 40\sqrt{22} \approx 187.617$ feet/second

79. (a) $C = x^2 - 12x + 125$ (b) \$2025

$\overline{C} = x - 12 + \frac{125}{x}$

(c) \$125 is fixed.

\$1900 is variable.

Examples will vary.

81. (a) $M = 0.212t^3 - 14.24t^2 + 632.7t + 44{,}608$ (in thousands)

(b) 60,700,000; Yes, this seems reasonable.

83. Answers will vary.

SECTION 5.2 *(page 335)*

Prerequisite Review

1. $\frac{1}{5}x^4 + x + C$ **2.** $\frac{3}{5}x^2 + \frac{2}{3}x^{3/2} - 4x + C$
3. $-\frac{1}{x} + C$ **4.** $-\frac{1}{6t^2} + C$
5. $\frac{4}{7}t^{7/2} + \frac{2}{5}t^{5/2} + C$ **6.** $\frac{4}{5}x^{5/2} - \frac{2}{3}x^{3/2} + C$
7. $\frac{5x^3 - 4}{2x} + C$ **8.** $\frac{-6x^2 + 5}{3x^3} + C$
9. $\frac{1}{5}x^5 + \frac{2}{3}x^3 + x + C$
10. $\frac{1}{7}x^7 - \frac{4}{5}x^5 + \frac{1}{2}x^4 + \frac{4}{3}x^3 - 2x^2 + x + C$
11. $-\frac{5(x - 2)^4}{16}$ **12.** $-\frac{1}{12(x - 1)^2}$
13. $9(x^2 + 3)^{2/3}$ **14.** $-\frac{5}{(1 - x^3)^{1/2}}$

	$\int u^n \frac{du}{dx}\,dx$	u	$\frac{du}{dx}$
1.	$\int (5x^2 + 1)^2(10x)\,dx$	$5x^2 + 1$	$10x$
3.	$\int \sqrt{1 - x^2}\,(-2x)\,dx$	$1 - x^2$	$-2x$
5.	$\int \left(4 + \frac{1}{x^2}\right)^5\left(\frac{-2}{x^3}\right)dx$	$4 + \frac{1}{x^2}$	$-\frac{2}{x^3}$
7.	$\int (1 + \sqrt{x})^3\left(\frac{1}{2\sqrt{x}}\right)dx$	$1 + \sqrt{x}$	$\frac{1}{2\sqrt{x}}$

9. $\frac{1}{5}(1 + 2x)^5 + C$ **11.** $\frac{2}{3}(5x^2 - 4)^{3/2} + C$

13. $\frac{1}{5}(x - 1)^5 + C$ **15.** $\frac{1}{16}(x^2 - 1)^8 + C$

17. $-\frac{1}{3(1 + x^3)} + C$ **19.** $-\frac{1}{2(x^2 + 2x - 3)} + C$

21. $\sqrt{x^2 - 4x + 3} + C$ **23.** $-\frac{15}{8}(1 - u^2)^{4/3} + C$

25. $4\sqrt{1 + y^2} + C$ **27.** $-3\sqrt{2t + 3} + C$

29. $-\frac{1}{2}\sqrt{1 - x^4} + C$ **31.** $-\frac{1}{24}\left(1 + \frac{4}{t^2}\right)^3 + C$

33. $\frac{1}{6}(x^3 + 3x)^2 + C$ **35.** $\frac{1}{48}(6x^2 - 1)^4 + C$

37. $-\frac{2}{45}(2 - 3x^3)^{5/2} + C$ **39.** $\sqrt{x^2 + 25} + C$

41. $\frac{2}{3}\sqrt{x^3 + 3x + 4} + C$

43. (a) $\frac{1}{6}(2x - 1)^3 + C_1 = \frac{4}{3}x^3 - 2x^2 + x + C_2$

(b) Answers differ by a constant: $C_2 = C_1 - \frac{1}{6}$

(c) Answers will vary.

45. (a) $\frac{(x^2 - 1)^3}{6} + C_1 = \frac{1}{6}x^6 - \frac{1}{2}x^4 + \frac{1}{2}x^2 + C_2$

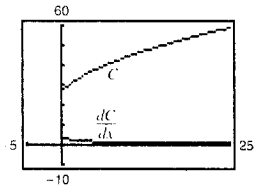
(b) Answers differ by a constant: $C_2 = C_1 - \frac{1}{6}$

(c) Answers will vary.

47. $f(x) = \frac{1}{3}[5 - (1 - x^2)^{3/2}]$

49. (a) $C = 8\sqrt{x + 1} + 18$

(b)



51. $x = \frac{1}{3}(p^2 - 25)^{3/2} + 24$ **53.** $x = \frac{6000}{\sqrt{p^2 - 16}} + 3000$

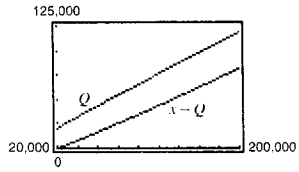
55. (a) $h = \sqrt{17.6t^2 + 1} + 5$ (b) 26 inches

57. (a) $Q = (x - 19{,}999)^{0.95} + 19{,}999$

(b)

x	20,000	50,000	100,000	150,000
Q	20,000	37,916.56	65,491.59	92,151.16
$x - Q$	0	12,083.44	34,508.41	57,848.84

(c)



59. $-\frac{2}{3}x^{3/2} + \frac{2}{3}(x + 1)^{3/2} + C$

SECTION 5.3 *(page 342)*

Prerequisite Review

1. $\left(\frac{5}{2}, \infty\right)$ **2.** $(-\infty, 2) \cup (3, \infty)$

3. $x + 2 - \frac{2}{x + 2}$ **4.** $x - 2 + \frac{1}{x - 4}$

5. $x + 8 + \frac{2x - 4}{x^2 - 4x}$ **6.** $x^2 - x - 4 + \frac{20x + 22}{x^2 + 5}$

7. $\frac{1}{4}x^4 - \frac{1}{x} + C$ **8.** $\frac{1}{2}x^2 + 2x + C$

9. $\frac{1}{2}x^2 - \frac{4}{x} + C$ **10.** $-\frac{1}{x} - \frac{3}{2x^2} + C$

1. $e^{2x} + C$ **3.** $\frac{1}{4}e^{4x} + C$ **5.** $-\frac{9}{2}e^{-x^2} + C$

7. $\frac{5}{3}e^{x^3} + C$ **9.** $\frac{1}{3}e^{x^3 + 3x^2 - 1} + C$ **11.** $-5e^{2 - x} + C$

13. $\ln|x + 1| + C$ **15.** $-\frac{1}{2}\ln|3 - 2x| + C$

17. $\frac{2}{3}\ln|3x + 5| + C$

19. $\ln\sqrt{x^2 + 1} + C$ **21.** $\frac{1}{3}\ln|x^3 + 1| + C$

23. $\frac{1}{2}\ln|x^2 + 6x + 7| + C$ **25.** $\ln|\ln x| + C$

27. $\ln|1 - e^{-x}| + C$ **29.** $-\frac{1}{2}e^{2/x} + C$ **31.** $2e^{x} + C$

33. $\frac{1}{2}e^{2x} - 4e^{x} + 4x + C$ **35.** $-\ln(1 + e^{-x}) + C$

37. $-2\ln|5 - e^{2x}| + C$ **39.** $e^{x} + 2x - e^{-x} + C$

41. $-\frac{2}{3}(1 - e^{x})^{3/2} + C$ **43.** $-\frac{1}{x - 1} + C$

45. $2e^{2x - 1} + C$ **47.** $\frac{1}{4}x^2 - 4\ln|x| + C$

49. $2\ln(e^{x} + 1) + C$ **51.** $\frac{1}{2}x^2 + 3x + 8\ln|x - 1| + C$

53. $\ln|e^{x} + x| + C$

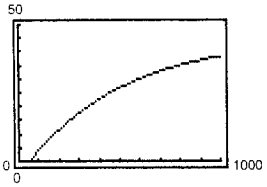
55. $f(x) = \frac{1}{2}x^2 + 5x + 8\ln|x - 1| - 8$

57. (a) $P(t) = 1000[1 + \ln(1 + 0.25t)^{12}]$

(b) $P(3) \approx 7715$ (c) $t \approx 6$ days

59. (a) $p = -50e^{-x/500} + 45.06$

(b)



The price increases as the demand increases.

(c) 387

61. (a) $S = 37{,}452.86e^{0.07t} + 37{,}606.58$ (in dollars)

(b) \$107,928.47

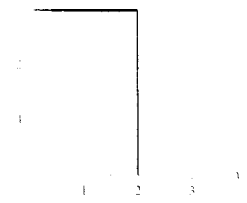
63. False. $\ln x^{1/2} = \frac{1}{2}\ln x$

SECTION 5.4 *(page 353)*

Prerequisite Review

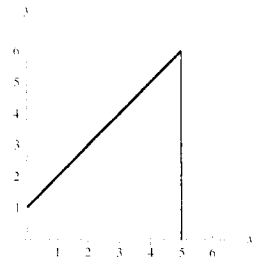
1. $\frac{3}{2}x^2 + 7x + C$ 2. $\frac{2}{5}x^{5/2} + \frac{4}{3}x^{3/2} + C$
3. $\frac{1}{5}\ln|x| + C$ 4. $-\frac{1}{6e^{6x}} + C$ 5. $-\frac{8}{5}$
6. $-\frac{62}{3}$ 7. $C = 0.008x^{5/2} + 29{,}500x + C$
8. $R = x^2 + 9000x + C$
9. $P = 25{,}000x - 0.005x^2 + C$
10. $C = 0.01x^3 + 4600x + C$

1.



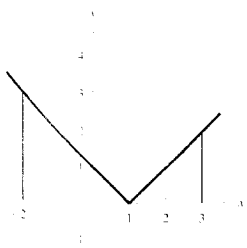
Area = 6

3.



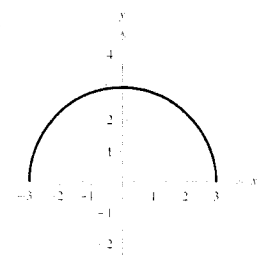
Area = $\frac{35}{2}$

5.



Area = $\frac{13}{2}$

7.



Area = $\frac{9\pi}{2}$

9. (a) 11 (b) 5 (c) -32 (d) -1

11. $\frac{1}{6}$ 13. $\frac{1}{2}$ 15. $6\left(1 - \frac{1}{e^3}\right)$ 17. $8\ln 2 + \frac{15}{2}$

19. 1 21. 0 23. $\frac{14}{3}$ 25. $-\frac{15}{4}$ 27. -4

29. $\frac{22}{3}$ 31. $-\frac{27}{20}$ 33. 2 35. $\frac{1}{2}(1 - e^{-2}) \approx 0.432$

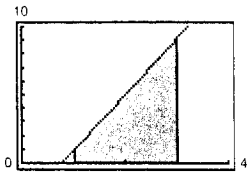
37. $\frac{e^3 - e}{3} \approx 5.789$ 39. $\frac{1}{3}\left[(e^2 + 1)^{3/2} - 2\sqrt{2}\right] \approx 7.157$

41. $\frac{1}{8}\ln 17 \approx 0.354$ 43. 4 45. 4

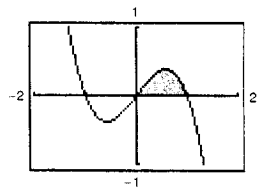
47. $\frac{1}{2}\ln 5 - \frac{1}{2}\ln 8 \approx -0.235$

49. $2\ln(2 + e^3) - 2\ln 3 \approx 3.993$

51. Area = 10



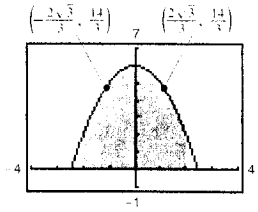
53. Area = $\frac{1}{4}$



55. Area = $\ln 9$

57. 10 59. $4 + 5\ln 5 \approx 12.047$

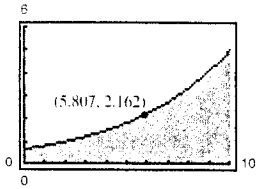
61.



Average = $\frac{14}{3}$

$x = \pm\frac{2\sqrt{3}}{3} \approx \pm 1.155$

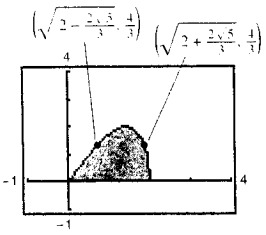
63.



Average = $\frac{5}{2} - \frac{5}{2}e^{-2}$

$x = 5\ln\left(\frac{e^2 - 1}{2}\right) \approx 5.807$

65.

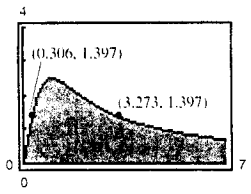


Average $= \frac{4}{3}$

$x = \sqrt{2 + \frac{2\sqrt{5}}{3}} \approx 1.868$

$x = \sqrt{2 - \frac{2\sqrt{5}}{3}} \approx 0.714$

67.



Average $= \frac{5}{14} \ln 50$

$x \approx 0.306$

$x \approx 3.273$

69. Even **71.** Neither odd nor even

73. (a) $\frac{8}{3}$ (b) $\frac{16}{3}$ (c) $-\frac{8}{3}$

Explanations will vary.

75. \$6.75 **77.** \$22.50 **79.** \$3.97 **81.** \$1925.23

83. \$16,605.21 **85.** \$2500 **87.** \$4565.65

89. (a) \$137,000 (b) \$214,720.93 (c) \$338,393.53

91. \$3082.95 **93.** $\frac{2kR^2}{3}$ **95.** $\frac{2}{3}\sqrt{7} - \frac{1}{3}$ **97.** $\frac{39}{200}$

SECTION 5.5 *(page 362)*

Prerequisite Review

1. $-x^2 + 3x + 2$ **2.** $-2x^2 + 4x + 4$

3. $-x^3 + 2x^2 + 4x - 5$ **4.** $x^3 - 6x - 1$

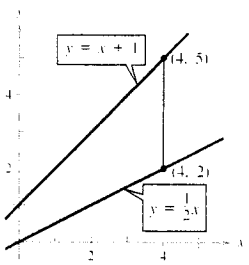
5. $(0, 4), (4, 4)$ **6.** $(1, -3), (2, -12)$

7. $(-3, 9), (2, 4)$ **8.** $(-2, -4), (0, 0), (2, 4)$

9. $(1, -2), (5, 10)$ **10.** $(1, e)$

1. 36 **3.** 9 **5.** $\frac{3}{2}$ **7.** $e - 2$

9.



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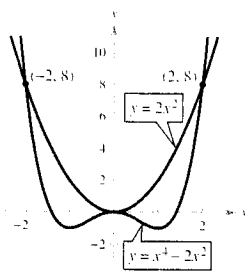

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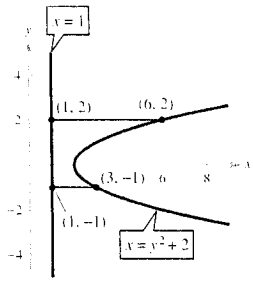

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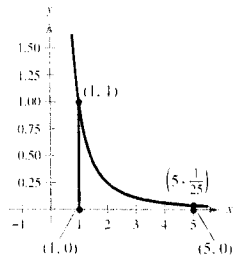
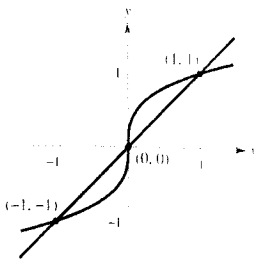


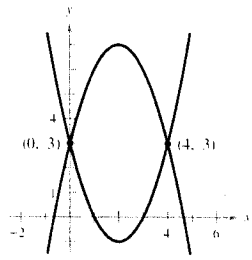
Area $= \frac{4}{5}$

17.



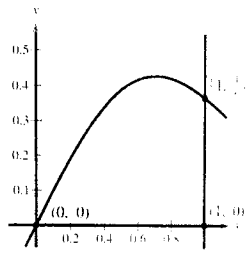
Area $= \frac{1}{2}$

19.



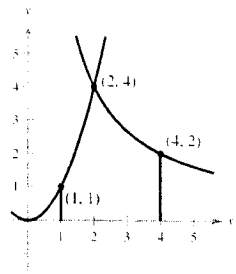
Area $= \frac{64}{3}$

21.



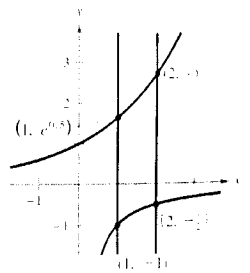
Area $= -\frac{1}{2}e^{-1} + \frac{1}{2}$

23.



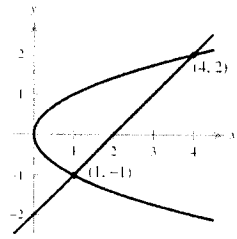
Area $= \frac{7}{3} + 8 \ln 2$

25.



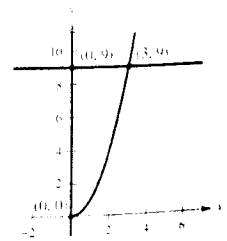
Area $= (2e + \ln 2) - 2e^{\frac{1}{2}}$

27.



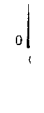
Area $= \frac{9}{2}$

29.



Area $= 18$

31.



A

33.

Area

35.

Area

39. 8

41. Consu

Produc

43. Consu

Produc

45. Consu

Produce

47. A typic

supply f

49. R_1, \$3,1

51. \$287.64

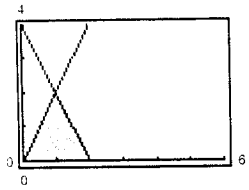
53. (a)

(b) 1412

55. Consume

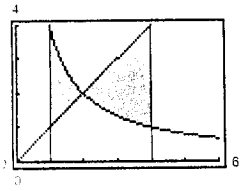
Producer

31.



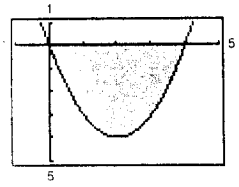
$$\text{Area} = \int_0^1 2x\,dx + \int_1^2 (4 - 2x)\,dx$$

33.



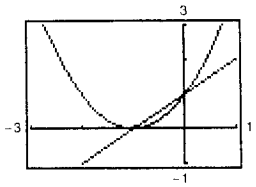
$$\text{Area} = \int_1^2 \left(\frac{4}{x} - x\right) dx + \int_2^4 \left(x - \frac{4}{x}\right) dx$$

35.



Area $= \frac{32}{3}$

37.



Area $= \frac{1}{6}$

39. 8

41. Consumer surplus = 1600

Producer surplus = 400

43. Consumer surplus $\approx$ 1666.67

Producer surplus = 1250

45. Consumer surplus = 50,000

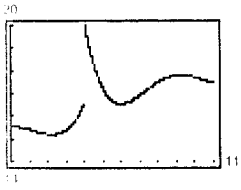
Producer surplus $\approx$ 25,497

47. A typical demand function is decreasing, whereas a typical supply function is increasing.

49. R_3: $3.12 billion

51. $287.64 million; Explanations will vary.

53. (a)



(b) 1412.47 pounds more

55. Consumer surplus = $625,000

Producer surplus = $1,375,000

57. $337.33 million

59.

Quintile	Lowest	2nd	3rd	4th	Highest
Percent	2.92	7.09	14.58	26.74	44.89

SECTION 5.6 *(page 369)*

Prerequisite Review

1. $\frac{1}{6}$ **2.** $\frac{3}{20}$ **3.** $\frac{7}{40}$ **4.** $\frac{13}{12}$ **5.** $\frac{61}{30}$ **6.** $\frac{53}{18}$

7. $\frac{2}{3}$ **8.** $\frac{4}{7}$ **9.** 0 **10.** 5

1. Midpoint Rule: 2

Exact area: 2

3. Midpoint Rule: 0.6730

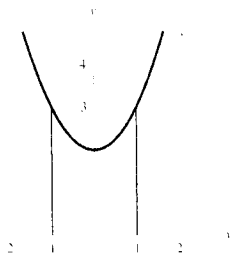
Exact area: $\frac{2}{3} \approx 0.6667$

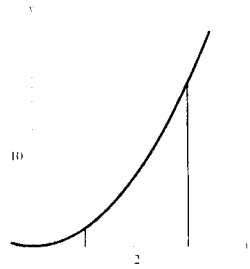
5. Midpoint Rule: 4.6250

Exact area: $\frac{14}{3} = 4.\overline{6}$

7. Midpoint Rule: 17.2500

Exact area: $\frac{52}{3} = 17.\overline{3}$



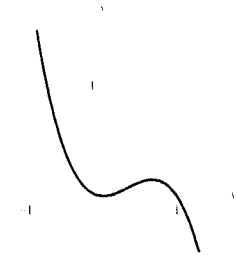


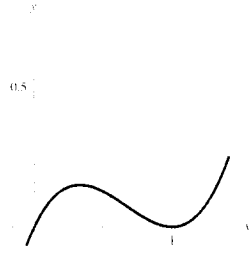
9. Midpoint Rule: 0.0859

Exact area: $\frac{1}{12} = 0.08\overline{3}$

11. Midpoint Rule: 0.0859

Exact area: $\frac{1}{12} = 0.08\overline{3}$





13. Area $\approx$ 54.6667,

$n = 31$

15. Area $\approx$ 4.16,

$n = 5$

17. Midpoint Rule: 1.5

Exact area: 1.5

19. Midpoint Rule: 25

Exact area: $\frac{76}{3} = 25.\overline{3}$

21. Exact: 4

Trapezoidal Rule: 4.0625

Midpoint Rule: 3.9688

Midpoint Rule is better in this example.

23. 1.1167 **25.** 1.55

27.

n	Midpoint Rule	Trapezoidal Rule
4	15.3965	15.6055
8	15.4480	15.5010
12	15.4578	15.4814
16	15.4613	15.4745
20	15.4628	15.4713

29. 4.8103 **31.** 916.25 feet

33. Midpoint Rule: $\pi \approx 3.146801$

Trapezoidal Rule: $\pi \approx 3.131176$

Graphing utility: $\pi \approx 3.141593$

SECTION 5.7 *(page 376)*

Prerequisite Review

1. 0, 2 **2.** 0, 2 **3.** 0, 2, −2 **4.** −1, 2

5. 2, 4 **6.** 1, 5 **7.** $e^4 - 1$ **8.** $\ln 7$

9. $\frac{5\sqrt{5}}{3} - \frac{1}{3}$ **10.** $\frac{(\ln 5)^3}{3}$

1. $\frac{16\pi}{3}$ **3.** $\frac{15\pi}{2}$ **5.** $\frac{512\pi}{15}$ **7.** $\frac{32\pi}{15}$ **9.** $\frac{\pi}{3}$

11. $\frac{171\pi}{2}$ **13.** $\frac{128\pi}{5}$ **15.** $\frac{\pi}{2}(e^2 - 1)$ **17.** 8π

19. $\frac{2\pi}{3}$ **21.** $\frac{\pi}{4}$ **23.** $\frac{256\pi}{15}$ **25.** 18π

27. $V = \pi\int_0^h \left(\frac{r}{h}x\right)^2 dx = \frac{1}{3}\pi r^2 h$ **29.** 100π **31.** $\frac{\pi}{30}$

33. (a) 1,256,637 cubic feet (b) 2513 fish

35. 58.434

REVIEW EXERCISES FOR CHAPTER 5 *(page 382)*

1. $16x + C$ **3.** $\frac{2}{3}x^3 + \frac{5}{2}x^2 + C$ **5.** $x^{2/3} + C$

7. $\frac{3}{7}x^{7/3} + \frac{3}{2}x^2 + C$ **9.** $\frac{4}{9}x^{9/2} - 2\sqrt{x} + C$

11. $f(x) = \frac{3}{2}x^2 + x - 2$ **13.** $f(x) = \frac{1}{6}x^4 - 8x + \frac{33}{2}$

15. (a) 2.5 seconds (b) 100 feet

(c) 1.25 seconds (d) 75 feet

17. $x + 5x^2 + \frac{25}{3}x^3 + C$ or $\frac{1}{15}(1 + 5x)^3 + C_1$

19. $\frac{2}{5}\sqrt{5x - 1} + C$ **21.** $\frac{1}{2}x^2 - x^4 + C$

23. $\frac{1}{4}(x^4 - 2x)^2 + C$

25. (a) 30.5 board-feet (b) 125.2 board-feet

27. $-e^{-3x} + C$ **29.** $\frac{1}{2}e^{x^2-2x} + C$

31. $-\frac{1}{3}\ln|1 - x^3| + C$ **33.** $\frac{2}{3}x^{3/2} + 2x + 2x^{1/2} + C$

35. $A = 4$ **37.** $A = \frac{8}{3}$ **39.** $A = 2\ln 2$

41. 16 **43.** 0 **45.** 2 **47.** $\frac{1}{8}$ **49.** 3.899

51. 0 **53.** Increases \$700.25

55. Average value: $\frac{8}{5}$, $x = \frac{29}{4}$

57. Average value: $\frac{1}{3}(-1 + e^3) \approx 6.362$, $x \approx 3.150$

59. \$520.54; Explanations will vary.

61. (a) $B = -0.0243t^2 + 0.564t - 1.58$

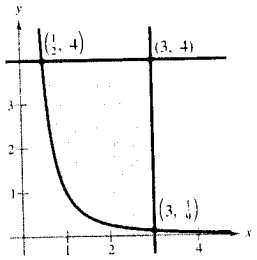
(b) The price of beef per pound does not surpass \$2.00. The highest price is \$1.69 during 2001, and after that the prices are decreasing.

63. \$17,492.94

65. $\int_{-2}^{2} 6x^5\,dx = 0$ (Odd function)

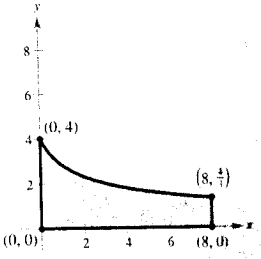
67. $\int_{-2}^{-1} \frac{4}{x^2}\,dx = \int_{1}^{2} \frac{4}{x^2}\,dx = 2$ (Symmetric about y-axis)

69.



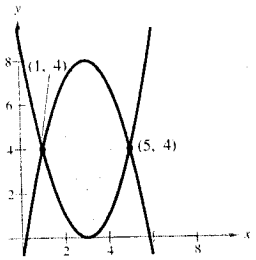
Area $= \frac{25}{3}$

71.



Area = 16

73.



Area $= \frac{64}{3}$

75.

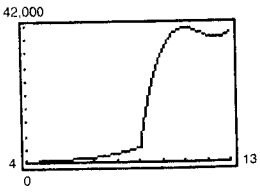
Area $= \frac{9}{2}$

77. Consumer surplus: 11,250

Producer surplus: 14,062.5

79. \$5511 million less

81. (a)



(b) Decreased

(c) \$85,834 million less