**83.** $n = 4$: 13.3203          **85.** $n = 4$: 0.7867

     $n = 20$: 13.7167               $n = 20$: 0.7855

**87.** $\pi \ln 4 \approx 4.355$     **89.** $\dfrac{\pi}{2}(e^2 - e^{-2}) \approx 11.394$

**91.** $\dfrac{56\pi}{3}$   **93.** $\dfrac{2\pi}{35}$   **95.** $\dfrac{5\pi}{16}\sqrt{15}$

## SAMPLE POST-GRAD EXAM QUESTIONS
*(page 386)*

**1.** d     **2.** b     **3.** c     **4.** b     **5.** a

**6.** b     **7.** d     **8.** d     **9.** a

# CHAPTER 6

## SECTION 6.1     *(page 394)*

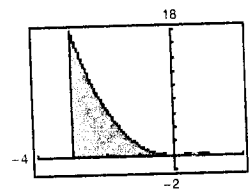### Prerequisite Review

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

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

**6.** $\dfrac{(x^3 - 1)^3}{3} + C$     **7.** $e^{6x} + C$

**8.** $\ln|2x + 1| + C$     **9.** $x(x - 1)(2x - 1)$

**10.** $3x(x + 4)^2(x + 8)$

**11.** $(x + 21)(x + 7)^{-1/2}$     **12.** $x(x + 5)^{-2/3}$

**1.** $\frac{1}{5}(x - 2)^5 + C$     **3.** $-\dfrac{2}{9 - t} + C$

**5.** $\ln|t^2 - t + 2| + C$     **7.** $\frac{2}{3}(1 + x)^{3/2} + C$

**9.** $\ln(3x^2 + x)^2 + C$     **11.** $-\dfrac{1}{10(5x + 1)^2} + C$

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

**17.** $-\frac{1}{3}e^{-3x^2} + C$     **19.** $\frac{1}{2}x^2 + x + \ln|x - 1| + C$

**21.** $\frac{1}{3}(x^2 + 4)^{3/2} + C$     **23.** $\frac{1}{5}e^{5x} + C$

**25.** $-\ln|e^{-x} + 2| + C$     **27.** $\dfrac{-1}{2(x + 1)^2} + \dfrac{1}{3(x + 1)^3} + C$

**29.** $\frac{1}{9}\left(\ln|3x - 1| - \dfrac{1}{3x - 1}\right) + C$

**31.** $2(\sqrt{t} - 1) + 2\ln|\sqrt{t} - 1| + C$

**33.** $4\sqrt{t} + \ln|t| + C$     **35.** $\frac{1}{3}(x - 1)\sqrt{2x + 1} + C$

**37.** $\left\{-\frac{2}{105}(1 - t)^{3/2}[35 - 42(1 - t) + 15(1 - t)^2]\right\} + C =$
     $-\frac{2}{105}(15t^2 + 12t + 8)(1 - t)^{3/2} + C$

**39.** $\frac{26}{3}$     **41.** $\frac{3}{2}(e - 1) \approx 2.577$
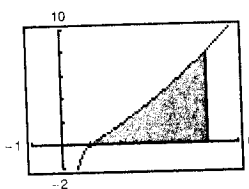
**43.** $\ln 2 - \frac{1}{2} \approx 0.193$     **45.** $\frac{13}{320}$
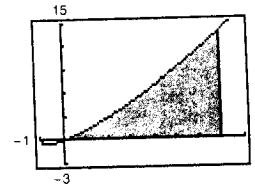
**47.** Area $= \frac{144}{5}$     **49.** Area $= \frac{1696}{105}$
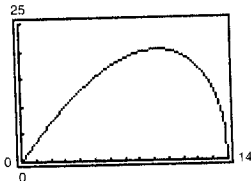


**51.** Area $= \frac{224}{15}$     **53.** Area $= \frac{1209}{28}$



**55.** $\dfrac{16}{15}\sqrt{2}$   **57.** $\dfrac{4}{3}$   **59.** $\dfrac{4\pi}{15} \approx 0.838$   **61.** $\dfrac{1}{2}$

**63.** (a) 0.547     (b) 0.586

**65.** (a)



     (b) About 13.97 inches     (c) About 195.56 inches

**67.** 5.885

## SECTION 6.2     *(page 403)*

### Prerequisite Review

**1.** $\dfrac{1}{x + 1}$     **2.** $\dfrac{2x}{x^2 - 1}$     **3.** $3x^2 e^{x^3}$

**4.** $-2xe^{-x^2}$     **5.** $e^x(x^2 + 2x)$     **6.** $e^{-2x}(1 - 2x)$

**7.** $\frac{64}{3}$     **8.** $\frac{4}{3}$     **9.** 36     **10.** 8
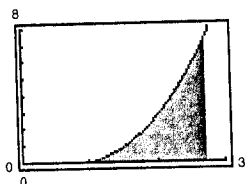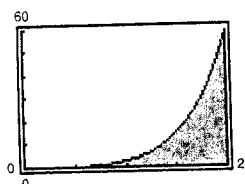
**1.** $\frac{1}{3}xe^{3x} - \frac{1}{9}e^{3x} + C$     **3.** $-x^2 e^{-x} - 2xe^{-x} - 2e^{-x} + C$

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

**9.** $\dfrac{e^{4x}}{16}(4x - 1) + C$     **11.** $\frac{1}{2}e^{x^2} + C$

**13.** $x^2 e^x - 2e^x x + 2e^x + C$

**15.** $\frac{1}{2}t^2 \ln|t + 1| - \frac{1}{2}\ln|t + 1| - \frac{1}{4}(t - 1)^2 + C$

**17.** $-e^{1/t} + C$     **19.** $\dfrac{x^2}{2}(\ln x)^2 - \dfrac{x^2}{2}\ln x + \dfrac{x^2}{4} + C$

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

**25.** $\frac{1}{4}x^4 + \frac{2}{3}x^3 + \frac{1}{2}x^2 + C$    **27.** $\frac{e^{2x}}{4(2x+1)} + C$

**29.** $e - 2 \approx 0.718$    **31.** $\frac{5}{36}e^6 + \frac{1}{36} \approx 56.060$

**33.** $2 \ln 2 - 1 \approx 0.386$

**35.** Area $= 2e^2 + 6$    **37.** Area $= \frac{1}{9}(2e^3 + 1)$



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

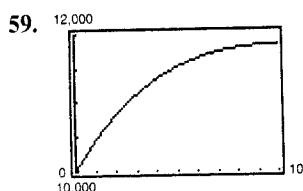**41.** $\frac{2}{75}\sqrt{4 + 5x}(5x - 8) + C$    **43.** Proof

**45.** $\frac{e^{5x}}{125}(25x^2 - 10x + 2) + C$    **47.** $-\frac{1}{x} - \frac{\ln x}{x} + C$

**49.** $1 - 5e^{-4} \approx 0.908$    **51.** $\frac{1}{4}(e^2 + 1) \approx 2.097$

**53.** (a) 2    (b) $4\pi(e - 2) \approx 9.026$

**55.** $\frac{3}{128} - \frac{379}{128}e^{-8} \approx 0.022$

**57.** $\frac{1,171,875}{256}\pi \approx 14,381.070$

**59.**



(a) Increase

(b) 113,212 units    (c) 11,321 units per year

**61.** (a) $3.2 \ln 2 - 0.2 \approx 2.018$

(b) $12.8 \ln 4 - 7.2 \ln 3 - 1.8 \approx 8.035$

**63.** $18,126.92    **65.** $1,332,474.72    **67.** $4103.07

**69.** (a) $1,200,000    (b) $1,094,142.26

**71.** $45,957.78    **73.** (a) $17,378.62    (b) $3681.26

**75.** 4.254

## SECTION 6.3    *(page 413)*

### Prerequisite Review

**1.** $(x - 4)(x + 4)$    **2.** $(x - 5)(x + 5)$

**3.** $(x - 4)(x + 3)$    **4.** $(x - 2)(x + 3)$

**5.** $x(x - 2)(x + 1)$    **6.** $x(x - 2)^2$

**7.** $(x - 2)(x - 1)^2$    **8.** $(x - 3)(x - 1)^2$

**9.** $\frac{1}{x - 2} + x$    **10.** $-\frac{1}{1 - x} + 2x - 2$

**11.** $-\frac{2}{x - 2} + x^2 - x - 2$

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

**13.** $\frac{6}{x - 1} + x + 4, \quad x \neq -1$

**14.** $\frac{1}{x + 1} + x + 3 \quad x \neq 1$

**1.** $\frac{5}{x - 5} - \frac{3}{x + 5}$    **3.** $\frac{9}{x - 3} - \frac{1}{x}$    **5.** $\frac{1}{x - 5} + \frac{3}{x + 2}$

**7.** $\frac{3}{x} - \frac{5}{x^2}$    **9.** $\frac{1}{3(x - 2)} + \frac{1}{(x - 2)^2}$

**11.** $\frac{8}{x + 1} - \frac{1}{(x + 1)^2} + \frac{2}{(x + 1)^3}$    **13.** $\frac{1}{2}\ln\left|\frac{x - 1}{x + 1}\right| + C$

**15.** $\frac{1}{4}\ln\left|\frac{x + 4}{x - 4}\right| + C$    **17.** $\ln\left|\frac{3x - 1}{x}\right| + C$

**19.** $\ln\left|\frac{x}{2x + 1}\right| + C$    **21.** $\ln\left|\frac{x - 1}{x + 2}\right| + C$

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

**25.** $5\ln|x - 2| - \ln|x + 2| - 3\ln|x| + C$

**27.** $\frac{1}{2}(3\ln|x - 4| - \ln|x|) + C$

**29.** $-3\ln|x - 1| - \frac{1}{x - 1} + C$
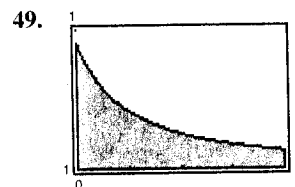
**31.** $\ln|x| + 2\ln|x + 1| + \frac{1}{x + 1} + C$

**33.** $\frac{1}{6}\ln\frac{4}{7} \approx -0.093$    **35.** $-\frac{4}{5} + 2\ln\frac{5}{3} \approx 0.222$

**37.** $\frac{1}{2} - \ln 2 \approx -0.193$    **39.** $4\ln 2 + \frac{1}{2} \approx 3.273$

**41.** $12 - \frac{7}{2}\ln 7 \approx 5.189$    **43.** $5\ln 2 - \ln 5 \approx 1.856$

**45.** $\frac{1}{2a}\left(\frac{1}{a + x} + \frac{1}{a - x}\right)$    **47.** $\frac{1}{a}\left(\frac{1}{x} + \frac{1}{a - x}\right)$

**49.**



$\frac{\pi}{165}\left[136 - 33\ln\frac{11}{3}\right] \approx 1.7731$

**51.**



$\pi\left(\frac{1}{3} \cdot\right.$

**55.** $1.07$

**59.** (a) $1($

## SECTIO

### Prere

**1.** $x^2$ ᆨ

**3.** $x^2 +$

**5.** $\frac{2}{x} -$

**7.** $\frac{3}{2(x - }$

**9.** $2e^{-x}(x$

**1.** $\frac{1}{9}\left(\frac{2}{2 + 3}\right.$

**3.** $\frac{2(3x - 4}{27}$

**7.** $\frac{1}{2}(x^2 - 1$

**11.** $-\frac{1}{3}\ln\left|\frac{3}{}\right.$

**13.** $-\frac{1}{2}\ln\left|\frac{2 -}{}\right.$

**15.** $\frac{1}{4}x^2(-1 +$

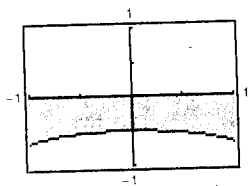**19.** $\frac{1}{4}(x^2\sqrt{x^4 -}$

**21.** $\frac{1}{27}\left[\frac{4}{2 + 3}\right.$

**23.** $\frac{1}{\sqrt{3}}\ln\left|\frac{\sqrt{3}}{\sqrt{3}}\right.$
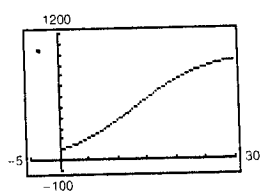
**25.** $\frac{1}{8}\left[\frac{-1}{2(3 + 2}\right.$

**27.** $-\frac{\sqrt{1 - x}}{x}$

**51.**



$$\pi\left(\tfrac{1}{3} + \tfrac{1}{4}\ln 3\right) \approx 1.9100$$

**53.** $y = \dfrac{1000}{1 + 9e^{-0.1656t}}$



**55.** \$1.077 thousand    **57.** \$6188.4 million; \$773.6 million

**59.** (a) 103    (b) 200    **61.** Answers will vary.

## SECTION 6.4    (page 424)

**Prerequisite Review**

**1.** $x^2 + 8x + 16$    **2.** $x^2 - 2x + 1$

**3.** $x^2 + x + \tfrac{1}{4}$    **4.** $x^2 - \tfrac{2}{3}x + \tfrac{1}{9}$

**5.** $\dfrac{2}{x} - \dfrac{2}{x+2}$    **6.** $-\dfrac{3}{4x} + \dfrac{3}{4(x-4)}$

**7.** $\dfrac{3}{2(x-2)} - \dfrac{2}{x^2} - \dfrac{3}{2x}$    **8.** $-\dfrac{3}{x+1} + \dfrac{2}{x-2} + \dfrac{4}{x}$

**9.** $2e^x(x-1) + C$    **10.** $x^3 \ln x - \dfrac{x^3}{3} + C$

**1.** $\dfrac{1}{9}\left(\dfrac{2}{2+3x} + \ln|2+3x|\right) + C$

**3.** $\dfrac{2(3x-4)}{27}\sqrt{2+3x} + C$    **5.** $\ln\left(x^2 + \sqrt{x^4-9}\right) + C$

**7.** $\tfrac{1}{2}(x^2-1)e^{x^2} + C$    **9.** $\ln\left|\dfrac{x}{1+x}\right| + C$

**11.** $-\dfrac{1}{3}\ln\left|\dfrac{3+\sqrt{x^2+9}}{x}\right| + C$

**13.** $-\dfrac{1}{2}\ln\left|\dfrac{2+\sqrt{4-x^2}}{x}\right| + C$

**15.** $\tfrac{1}{2}x^2(-1 + 2\ln x) + C$    **17.** $3x^2 - \ln(1 + e^{3x^2}) + C$

**19.** $\tfrac{1}{4}\left(x^2\sqrt{x^4-4} - 4\ln|x^2 + \sqrt{x^4-4}|\right) + C$

**21.** $\dfrac{1}{27}\left[\dfrac{4}{2+3t} - \dfrac{2}{(2+3t)^2} + \ln|2+3t|\right] + C$

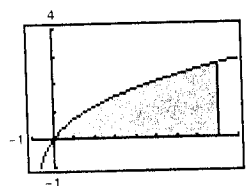**23.** $\dfrac{1}{\sqrt{3}}\ln\left|\dfrac{\sqrt{3+s} - \sqrt{3}}{\sqrt{3+s} + \sqrt{3}}\right| + C$

**25.** $\dfrac{1}{8}\left[\dfrac{-1}{2(3+2x)^2} + \dfrac{2}{(3+2x)^3} - \dfrac{9}{4(3+2x)^4}\right] + C$

**27.** $-\dfrac{\sqrt{1-x^2}}{x} + C$    **29.** $\tfrac{1}{9}x^3(-1 + 3\ln x) + C$

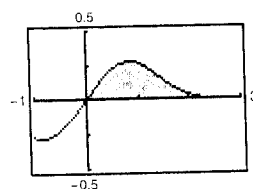**31.** $\dfrac{1}{27}\left(3x - \dfrac{25}{3x-5} + 10\ln|3x-5|\right) + C$

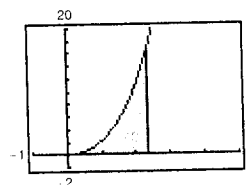**33.** $\tfrac{1}{9}(3\ln x - 4\ln|4 + 3\ln x|) + C$

**35.** Area $= \dfrac{40}{3}$



Area $= 13.\overline{3}$

**37.** Area $= \dfrac{1}{2}\left[4 + \ln\left(\dfrac{2}{1+e^4}\right)\right]$



Area $\approx 0.3375$

**39.** Area $= \tfrac{1}{4}\left[21\sqrt{5} - 8\ln(\sqrt{5} + 3) + 8\ln 2\right]$



Area $\approx 9.8145$

**41.** $\dfrac{5\sqrt{5}}{3}$    **43.** $12\left(2 + \ln\left|\dfrac{2}{1+e^3}\right|\right) \approx 6.7946$

**45.** $(x^2 - 2x + 2)e^x + C$    **47.** $-\left(\dfrac{1}{x} + \ln\left|\dfrac{x}{x+1}\right|\right) + C$

**49.** (a) $(x+3)^2 - 9$    (b) $(x-4)^2 - 7$
(c) $(x^2+1)^2 - 6$    (d) $4 - (x+1)^2$

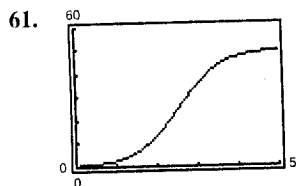**51.** (a) $4\left(x + \tfrac{3}{2}\right)^2 + 6$    (b) $3(x-2)^2 - 21$
(c) $(x-1)^2 - 1$    (d) $25 - (x-4)^2$

**53.** $-\dfrac{1}{2\sqrt{17}}\ln\left|\dfrac{x+3-\sqrt{17}}{x+3+\sqrt{17}}\right| + C$

**55.** $-\ln\left|\dfrac{1 + \sqrt{x^2 - 2x + 2}}{x-1}\right| + C$

**57.** $\dfrac{1}{8}\ln\left|\dfrac{x-3}{x+1}\right| + C$

**59.** $\tfrac{1}{2}\ln|x^2 + 1 + \sqrt{x^4 + 2x^2 + 2}| + C$

**61.**



Average value: 42.58

**63.** $1138.43    **65.** $0.40 billion per year

## SECTION 6.5    *(page 433)*

### Prerequisite Review

**1.** $\frac{2}{x^3}$    **2.** $-\frac{96}{(2x+1)^4}$    **3.** $-\frac{12}{x^4}$    **4.** $6x - 4$

**5.** $16e^{2x}$    **6.** $e^{x^2}(4x^2 + 2)$    **7.** $(3, 18)$

**8.** $(1, 8)$    **9.** $n < -5\sqrt{10}, \; n > 5\sqrt{10}$

**10.** $n < -5, n > 5$

|   | *Exact value* | *Trapezoidal Rule* | *Simpson's Rule* |
|---|---|---|---|
| **1.** | 2.6667 | 2.7500 | 2.6667 |
| **3.** | 8.4000 | 9.0625 | 8.4167 |
| **5.** | 4.0000 | 4.0625 | 4.0000 |
| **7.** | 0.6931 | 0.6941 | 0.6932 |
| **9.** | 5.3333 | 5.2650 | 5.3046 |
| **11.** | 0.6931 | 0.6970 | 0.6933 |

**13.** (a) 0.783    (b) 0.785

**15.** (a) 0.749    (b) 0.771

**17.** (a) 0.877    (b) 0.830

**19.** (a) 1.880    (b) 1.890

**21.** $21,831.20    **23.** $678.36    **25.** $0.3413 = 34.13\%$

**27.** $0.4999 = 49.99\%$    **29.** 89,500 square feet

**31.** (a) 2    (b) $\frac{2^5}{180(4^4)}(24) \approx 0.017$

**33.** (a) $\frac{5e}{64} \approx 0.212$    (b) $\frac{13e}{1024} \approx 0.035$

**35.** (a) $n = 101$    (b) $n = 8$

**37.** (a) $n = 3280$    (b) $n = 60$

**39.** 19.5215    **41.** 3.6558

**43.** Exact value: $\int_0^1 x^3 \, dx = \frac{x^4}{4}\Big]_0^1 = \frac{1}{4}$

Simpson's Rule: $\int_0^1 x^3 \, dx = \frac{1}{6}\left[0^3 + 4\left(\frac{1}{2}\right)^3 + 1^3\right] = \frac{1}{4}$

**45.** 416.1 feet

**47.** 58.876 milligrams (Simpson's Rule with $n = 100$)

**49.** 1876 subscribers (Simpson's Rule with $n = 100$)

## SECTION 6.6    *(page 444)*

### Prerequisite Review

**1.** 9    **2.** 3    **3.** $-\frac{1}{8}$    **4.** Limit does not exist.

**5.** Limit does not exist.    **6.** $-4$

**7.** (a) $\frac{32}{3}b^3 - 16b^2 + 8b - \frac{4}{3}$    (b) $-\frac{4}{3}$

**8.** (a) $\frac{b^2 - b - 11}{(b-2)^2(b-5)}$    (b) $\frac{11}{20}$

**9.** (a) $\ln\left(\frac{5 - 3b^2}{b + 1}\right)$    (b) $\ln 5 \approx 1.609$

**10.** (a) $e^{-3b^2}(e^{6b^2} + 1)$    (b) 2

**1.** 1    **3.** 1    **5.** Diverges    **7.** Diverges

**9.** Diverges    **11.** Diverges    **13.** 0    **15.** 4

**17.** 6    **19.** Diverges    **21.** 6    **23.** Diverges

**25.** 0    **27.** $\ln(4 + \sqrt{7}) - \ln 3 \approx 0.7954$

**29.** (a) 1    (b) $\frac{\pi}{3}$

**31.**

| $x$ | 1 | 10 | 25 | 50 |
|---|---|---|---|---|
| $xe^{-x}$ | 0.3679 | 0.0005 | 0.0000 | 0.0000 |

**33.**

| $x$ | 1 | 10 | 25 | 50 |
|---|---|---|---|---|
| $x^2 e^{-(1/2)x}$ | 0.6065 | 0.6738 | 0.0023 | 0.0000 |

**35.** 2    **37.** $\frac{1}{4}$    **39.** (a) $4,637,228    (b) $5,555,556

**41.** (a) $748,367.34    (b) $808,030.14    (c) $900,000.00

**43.** (a) 0.9687    (b) 0.0724    (c) 0.0009

## REVIEW EXERCISES FOR CHAPTER 6
*(page 450)*

**1.** $t + C$    **3.** $\frac{(x+5)^4}{4} + C$    **5.** $\frac{1}{10}e^{10x} + C$

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

**11.** $2\ln(3 + e^x) + C$    **13.** $\frac{(x-2)^5}{5} + \frac{(x-2)^4}{2} + C$

**15.** $\frac{2}{15}(x+1)^{3/2}(3x - 2) + C$

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

**19.** $-\frac{2}{15}(1 - x)^{3/2}(3x + 7) + C$

**21.** $\frac{26}{15}$    **23.** $\frac{412}{15}$    **25.** (a) 0.696    (b) 0.693

**27.** (a

**29.** 2·

**33.** $x^2$

**37.** $4

**39.** (a,

**41.** $4

**45.** ln|

**47.** $x$ -

**49.** (a)

(b)

(c)

**51.** $\sqrt{x}$

**53.** $\frac{1}{4}$ ln

**57.** $2\sqrt{}$

**59.** $(x$

**61.** $\frac{1}{10}$

**63.** $\frac{1}{2}[($

**65.** 0.7

**73.** 9.0

**81.** 2

**87.** (a)

**SAMI**
*(page 4*

**1.** a

**6.** d