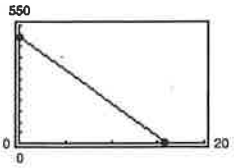
77. True **79–81.** Proofs

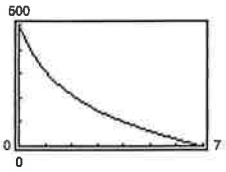
83. (a) $v(t) = -32t + 500$



(b) $s(t) = -16t^2 + 500t$; 3906.25 ft

(c) $v(t) = \sqrt{\frac{32}{k}} \tan\left[\arctan\left(500\sqrt{\frac{k}{32}}\right) - \sqrt{32k}t\right]$

(d)



(e) 1088 ft

(f) When air resistance is taken into account, the maximum height of the object is not as great.

$t_0 = 6.86$ sec

Section 5.9 (page 377)

1. (a) 10.018 (b) -0.964 **3.** (a) $\frac{4}{3}$ (b) $\frac{13}{12}$

5. (a) 1.317 (b) 0.962 **7–11.** Proofs

13. $\cosh x = \sqrt{13}/2$; $\tanh x = 3\sqrt{13}/13$; $\operatorname{csch} x = 2/3$; $\operatorname{sech} x = 2\sqrt{13}/13$; $\coth x = \sqrt{13}/3$

15. $-\operatorname{sech}(x+1)\tanh(x+1)$ **17.** $\coth x$ **19.** $\operatorname{csch} x$

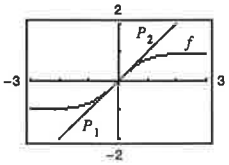
21. $\sinh^2 x$ **23.** $\operatorname{sech} t$ **25.** $y = -2x + 2$ **27.** $y = 1 - 2x$

29. Relative maxima: $(\pm\pi, \cosh \pi)$; Relative minimum: $(0, -1)$

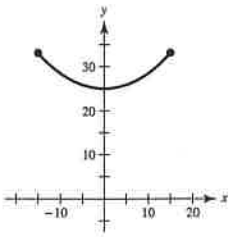
31. Relative maximum: $(1.20, 0.66)$
Relative minimum: $(-1.20, -0.66)$

33. $y = a \sinh x$; $y' = a \cosh x$; $y'' = a \sinh x$; $y''' = a \cosh x$; So, $y''' - y' = 0$.

35. $P_1(x) = x$; $P_2(x) = x$



37. (a)



(b) 33.146 units; 25 units

(c) $m = \sinh(1) \approx 1.175$

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

43. $\ln|\sinh x| + C$ **45.** $-\coth(x^2/2) + C$

47. $\operatorname{csch}(1/x) + C$ **49.** $\frac{1}{2}\arctan x^2 + C$ **51.** $\ln 5 - 2\ln 2$

53. $\frac{1}{5}\ln 3$ **55.** $\pi/4$ **57.** $3/\sqrt{9x^2 - 1}$ **59.** $|\sec x|$

61. $2\sec 2x$ **63.** $2\sinh^{-1}(2x)$ **65.** Answers will vary.

67. ∞ **69.** 0 **71.** 1 **73.** $\ln\left(\sqrt{e^{2x} + 1} - 1\right) - x + C$

75. $2\sinh^{-1}\sqrt{x} + C = 2\ln\left(\sqrt{x} + \sqrt{1 + x}\right) + C$

77. $\frac{1}{4}\ln\left|\frac{x - 4}{x}\right| + C$ **79.** $\frac{1}{2\sqrt{6}}\ln\left|\frac{\sqrt{2}(x + 1) + \sqrt{3}}{\sqrt{2}(x + 1) - \sqrt{3}}\right| + C$

81. $\frac{1}{4}\arcsin\left(\frac{4x - 1}{9}\right) + C$ **83.** $-\frac{x^2}{2} - 4x - \frac{10}{3}\ln\left|\frac{x - 5}{x + 1}\right| + C$

85. $8\arctan(e^2) - 2\pi \approx 5.207$ **87.** $\frac{5}{2}\ln\left(\sqrt{17} + 4\right) \approx 5.237$

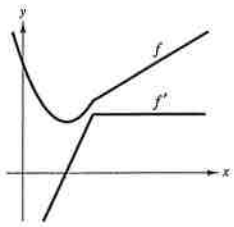
89. (a) $\ln\left(\sqrt{3} + 2\right)$ (b) $\sinh^{-1}\sqrt{3}$

91. $\frac{52}{31}$ kg **93.** $-\sqrt{a^2 - x^2}/x$ **95–101.** Proofs

103. Putnam Problem 8, 1939

Review Exercises for Chapter 5 (page 380)

1.



3. $\frac{2}{3}x^3 + \frac{1}{2}x^2 - x + C$

5. $x^2/2 - 1/x + C$ **7.** $2x^2 + 3\cos x + C$

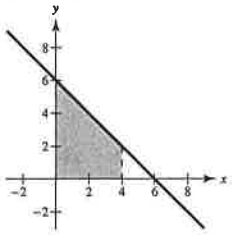
9. $5x - e^x + C$ **11.** $5\ln|x| + C$ **13.** $y = 2 - x^2$

15. 240 ft/sec **17.** (a) 3 sec (b) 144 ft (c) $\frac{3}{2}$ sec (d) 108 ft

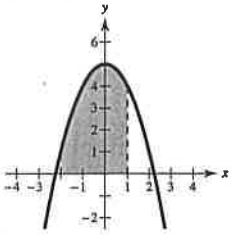
19. (a) $\sum_{i=1}^{10}(2i - 1)$ (b) $\sum_{i=1}^{n} i^3$ (c) $\sum_{i=1}^{10}(4i + 2)$

21. $9.038 <$ (area of region) < 13.038

23. $A = 16$

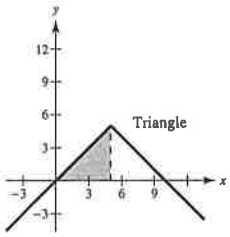


25. $A = 12$



27. $\frac{27}{2}$ **29.** $\int_4^6 (2x - 3)\,dx$

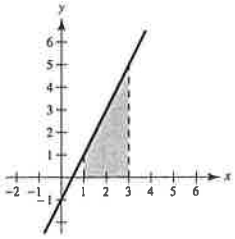
31. $A = \frac{25}{2}$



33. (a) 13 (b) 7 (c) 11 (d) 50 **35.** c **37.** 16 **39.** 0

41. $\frac{422}{5}$ **43.** $\left(\sqrt{2} + 2\right)/2$ **45.** $e^2 + 1$

47. $A = 6$



49. $A = \frac{10}{3}$