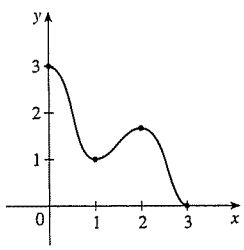
Exercises 4.1

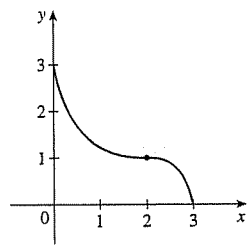
3. Absolute maximum at b, local maxima at b and e, absolute minimum at d, local minima at d and s

5. Absolute maximum $f(4) = 4$; absolute minimum $f(7) = 0$; local maxima $f(4) = 4$ and $f(6) = 3$; local minima $f(2) = 1$ and $f(5) = 2$

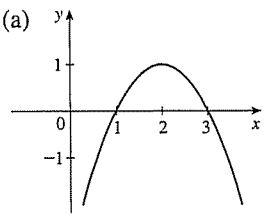
7.



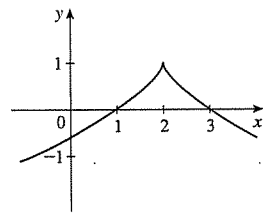
9.



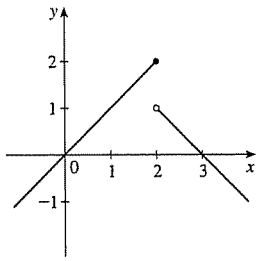
11. (a)



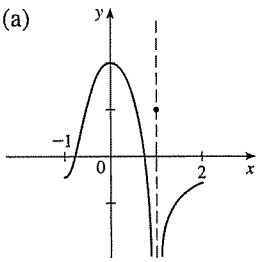
(b)



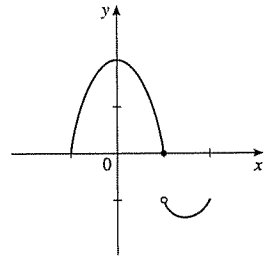
(c)



13. (a)



(b)



15. Absolute maximum $f(1) = 5$ **17.** None

19. Absolute minimum $f(0) = 0$

21. Absolute maximum $f(-3) = 9$; absolute and local minimum $f(0) = 0$

23. None

25. Absolute and local maximum $f(\pi/2) = f(-3\pi/2) = 1$, absolute and local minimum $f(3\pi/2) = f(-\pi/2) = -1$

27. None **29.** No maximum, absolute minimum $f(0) = 0$

31. $-\frac{2}{5}$ **33.** None **35.** $(-1 \pm \sqrt{5})/2$ **37.** ± 1

39. $-\frac{3}{2}$ **41.** $-2, 0$ **43.** $0, \frac{8}{7}, 4$ **45.** $n\pi/4$ (n an integer)

47. $1/e$ **49.** $f(0) = 5, f(2) = -7$

51. $f(1) = 9, f(-2) = 0$ **53.** $f(-3) = 47, f(\pm\sqrt{2}) = -2$

55. $f(2) = 5, f(1) = 3$ **57.** $f(1) = \frac{1}{2}, f(0) = 0$

59. $f(\pi/4) = \sqrt{2}, f(0) = 1$ **61.** $f(1) = 1/e, f(0) = 0$

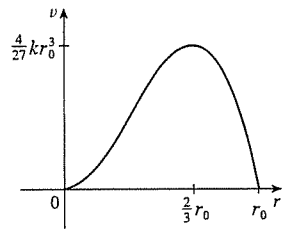
63. $f(1) = 1, f(3) = 3 - 3\ln 3 \approx -0.296$

65. $-1.3, 0.2, 1.1$ **67.** (a) $9.71, -7.71$ (b) $1 \pm 32\sqrt{6}/9$

69. (a) $0.32, 0.00$ (b) $3\sqrt{3}/16, 0$ **71.** 3.9665 °C

73. Cheapest, $t = 10$; most expensive, $t \approx 5.1309$

75. (a) $r = \frac{2}{3}r_0$ (b) $v = \frac{4}{27}kr_0^3$ (c)

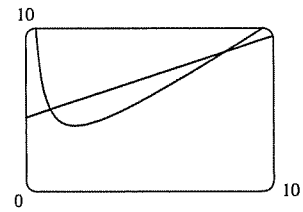


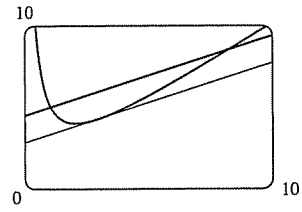
Exercises 4.2 □ page 293

1. 2 **3.** $\pm\frac{1}{4}, \pm\frac{3}{4}$

5. f is not differentiable on $[-1, 1]$ **7.** 0.8, 3.2, 4.4, 6.1

9. (a), (b) (c) $2\sqrt{2}$





11. 0 **13.** $-\frac{1}{2}\ln[(1 - e^{-6})/6]$

15. f is not differentiable at 1 **23.** 16 **25.** No **31.** No

Exercises 4.3 □ page 302

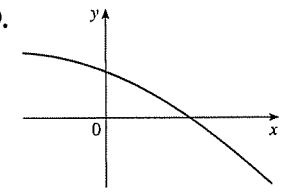
Abbreviations: dec., decreasing; inc., increasing; max., maximum; min., minimum; abs., absolute; loc., local; CD, concave downward; CU, concave upward; IP, inflection point

1. (a) (0, 6), (8, 9) (b) (6, 8) (c) (2, 4), (7, 9)
(d) (0, 2), (4, 7) (e) (2, 3), (4, 4.5), (7, 4)

3. (a) I/D Test (b) Concavity Test
(c) Find points at which the concavity changes.

5. (a) Inc. on $(-\infty, 0)$, $(3, \infty)$; dec. on $(0, 3)$
(b) Loc. max. at 0, loc. min. at 3

7. $x = 1, 7$ **9.**



11. (a) Inc. on $(-\infty, -2)$, $(2, \infty)$; dec. on $(-2, 2)$
(b) Loc. max. $f(-2) = 17$; loc. min. $f(2) = -15$
(c) CU on $(0, \infty)$; CD on $(-\infty, 0)$; IP $(0, 1)$

13. (a) Inc. on $(-2, \infty)$; dec. on $(-\infty, -2)$
(b) No loc. max.; loc. min. $f(-2) = -303$ (c) CU on $(-\infty, \infty)$

15. (a) Inc. on $(\pi/3, 5\pi/3)$, $(7\pi/3, 3\pi)$; dec. on $(0, \pi/3)$, $(5\pi/3, 7\pi/3)$
(b) Loc. max. $f(5\pi/3) = 5\pi/3 + \sqrt{3}$; loc. min. $f(\pi/3) = \pi/3 - \sqrt{3}$, $f(7\pi/3) = 7\pi/3 - \sqrt{3}$
(c) CU on $(0, \pi)$, $(2\pi, 3\pi)$; CD on $(\pi, 2\pi)$; IP (π, π), $(2\pi, 2\pi)$

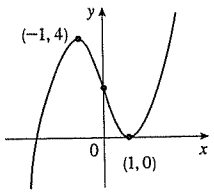
17. (a) Inc. on $(-1, \infty)$; dec. on $(-\infty, -1)$
(b) Loc. min. $f(-1) = -1/e$
(c) CU on $(-2, \infty)$; CD on $(-\infty, -2)$; IP $(-2, -2e^{-2})$

19. (a) Inc. on $(0, e^2)$; dec. on (e^2, ∞)
(b) Loc. max. $f(e^2) = 2/e$
(c) CU on $(e^{8/3}, \infty)$; CD on $(0, e^{8/3})$; IP $\left(e^{8/3}, \frac{8}{3}e^{-4/3}\right)$

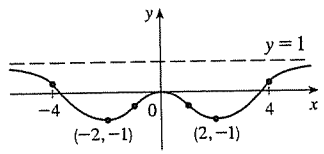
21. Loc. max. $f(-1) = 7$; loc. min. $f(1) = -1$

23. Loc. max. $f(\frac{3}{4}) = \frac{5}{4}$

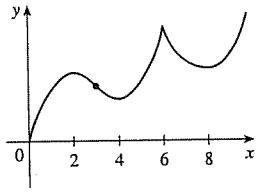
25.



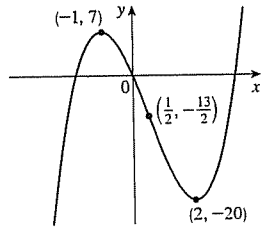
27.



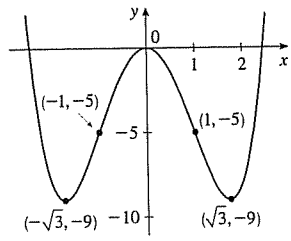
29. (a) Inc. on $(0, 2)$, $(4, 6)$, $(8, \infty)$; dec. on $(2, 4)$, $(6, 8)$
(b) Loc. max. at $x = 2, 6$; loc. min. at $x = 4, 8$
(c) CU on $(3, 6)$, $(6, \infty)$; CD on $(0, 3)$
(d) 3 (e) See graph at right.



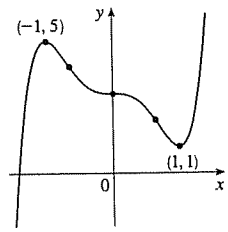
31. (a) Inc. on $(-\infty, -1)$, $(2, \infty)$; dec. on $(-1, 2)$
(b) Loc. max. $f(-1) = 7$; loc. min. $f(2) = -20$
(c) CU on $(\frac{1}{2}, \infty)$; CD on $(-\infty, \frac{1}{2})$; IP $(\frac{1}{2}, -\frac{13}{2})$
(d) See graph at right.



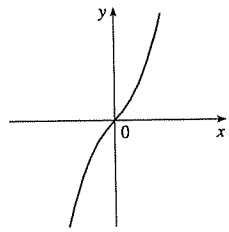
33. (a) Inc. on $(-\sqrt{3}, 0)$, $(\sqrt{3}, \infty)$; dec. on $(-\infty, -\sqrt{3})$, $(0, \sqrt{3})$
(b) Loc. min. $f(\pm\sqrt{3}) = -9$; loc. max. $f(0) = 0$
(c) CD on $(-1, 1)$; CU on $(-\infty, -1)$, $(1, \infty)$; IP $(\pm 1, -5)$
(d) See graph at right.



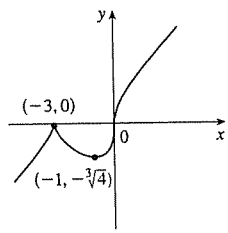
35. (a) Inc. on $(-\infty, -1)$, $(1, \infty)$; dec. on $(-1, 1)$
(b) Loc. max. $h(-1) = 5$; loc. min. $h(1) = 1$
(c) CD on $(-\infty, -1/\sqrt{2})$, $(0, 1/\sqrt{2})$; CU on $(-1/\sqrt{2}, 0)$, $(1/\sqrt{2}, \infty)$; IP $(0, 3)$, $(\pm 1/\sqrt{2}, 3 \mp \frac{7}{8}\sqrt{2})$
(d) See graph at right.



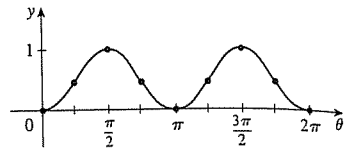
37. (a) Inc. on $(-\infty, \infty)$
(b) None
(c) CD on $(-\infty, 0)$; CU on $(0, \infty)$; IP $(0, 0)$
(d) See graph at right.



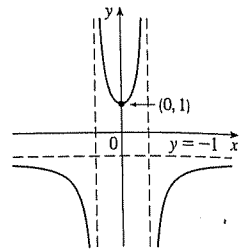
39. (a) Inc. on $(-\infty, -3)$, $(-1, \infty)$; dec. on $(-3, -1)$
(b) Loc. max. $Q(-3) = 0$; loc. min. $Q(-1) = -\sqrt[3]{4}$
(c) CU on $(-\infty, -3)$, $(-3, 0)$; CD on $(0, \infty)$; IP $(0, 0)$
(d) See graph at right.



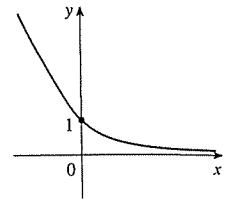
41. (a) Inc. on $(0, \pi/2)$, $(\pi, 3\pi/2)$; dec. on $(\pi/2, \pi)$, $(3\pi/2, 2\pi)$
(b) Loc. max. $f(\pi/2) = f(3\pi/2) = 1$; loc. min. $f(\pi) = 0$
(c) CU on $(0, \pi/4)$, $(3\pi/4, 5\pi/4)$, $(7\pi/4, 2\pi)$; CD on $(\pi/4, 3\pi/4)$, $(5\pi/4, 7\pi/4)$; IP $(\pi/4, \frac{1}{2})$, $(3\pi/4, \frac{1}{2})$, $(5\pi/4, \frac{1}{2})$, $(7\pi/4, \frac{1}{2})$
(d) See graph at right.



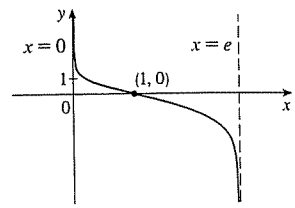
43. (a) VA $x = \pm 1$; HA $y = -1$
(b) Inc. on $(0, 1)$, $(1, \infty)$; dec. on $(-\infty, -1)$, $(-1, 0)$
(c) Loc. min. $f(0) = 1$
(d) CU on $(-1, 1)$; CD on $(-\infty, -1)$, $(1, \infty)$
(e) See graph at right.



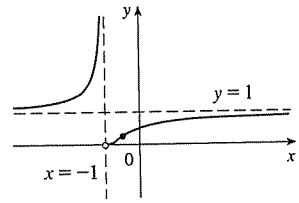
45. (a) HA $y = 0$
(b) Dec. on $(-\infty, \infty)$
(c) None
(d) CU on $(-\infty, \infty)$
(e) See graph at right.



47. (a) VA $x = 0$, $x = e$
(b) Dec. on $(0, e)$
(c) None
(d) CU on $(0, 1)$; CD on $(1, e)$; IP $(1, 0)$
(e) See graph at right.



49. (a) HA $y = 1$, VA $x = -1$
(b) Inc. on $(-\infty, -1)$, $(-1, \infty)$
(c) None
(d) CU on $(-\infty, -1)$, $(-1, -\frac{1}{2})$; CD on $(-\frac{1}{2}, \infty)$; IP $(-\frac{1}{2}, 1/e^2)$
(e) See graph at right.



51. (a) Loc. and abs. max. $f(1) = \sqrt{2}$, no min.
(b) $(3 - \sqrt{17})/4$

53. (b) CD on $(-\infty, -2.1)$, $(0.25, 2)$; CU on $(-2.1, 0.25)$, $(1.9, \infty)$; IP at $(-2.1, 380)$, $(0.25, 1.3)$, $(1.9, -92)$

55. CD on $(-\infty, 0.1)$; CU on $(0.1, \infty)$

57. $K(3) - K(2)$; CD **59.** When $t \approx 7.17$

61. $f(x) = \frac{1}{9}(2x^3 + 3x^2 - 12x + 7)$

Exercises 4.4 □ page 311

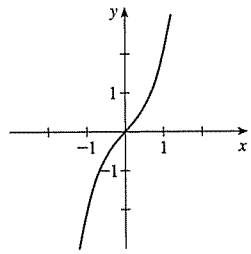
1. (a) Indeterminate (b) 0 (c) 0
(d) ∞, $-\infty$, or does not exist (e) Indeterminate

3. (a) $-\infty$ (b) Indeterminate (c) ∞ **5.** -2 **7.** $\frac{9}{5}$
9. 1 **11.** ∞ **13.** p/q **15.** 0 **17.** $-\infty$ **19.** $\ln \frac{5}{3}$
21. $\frac{1}{2}$ **23.** ∞ **25.** 1 **27.** $\frac{1}{2}$ **29.** 0 **31.** α
33. 1 **35.** $\frac{2}{3}$ **37.** 0 **39.** 0 **41.** 0 **43.** 0
45. 1 **47.** ∞ **49.** 0 **51.** 0 **53.** 0 **55.** 1
57. e^{-2} **59.** e^3 **61.** 1 **63.** $1/e$ **65.** 1
67. 5 **69.** $\frac{1}{4}$ **75.** $\frac{16}{9}a$ **79.** (a) 0

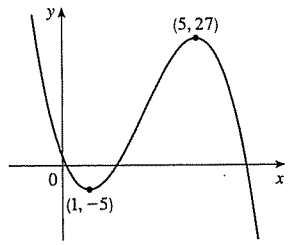
Exercises 4.5 □ page 321

Abbreviations: HA, horizontal asymptote; SA, slant asymptote; VA, vertical asymptote; int., intercept

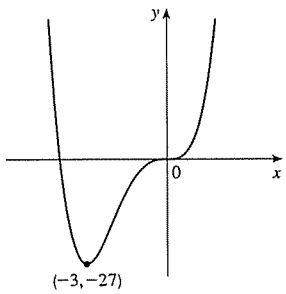
1. A. $\mathbb{R}$ B. y-int. 0; x-int. 0
C. About (0, 0) D. None
E. Inc. on $(-\infty, \infty)$ F. None
G. CU on $(0, \infty)$; CD on $(-\infty, 0)$;
IP (0, 0)
H. See graph at right.



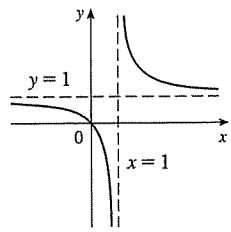
3. A. $\mathbb{R}$
B. y-int. 2; x-int. 2, $(7 \pm 3\sqrt{5})/2$
C. None D. None
E. Inc. on (1, 5);
dec. on $(-\infty, 1)$, $(5, \infty)$
F. Loc. min. $f(1) = -5$;
loc. max. $f(5) = 27$
G. CU on $(-\infty, 3)$; CD on $(3, \infty)$;
IP (3, 11)
H. See graph at right.



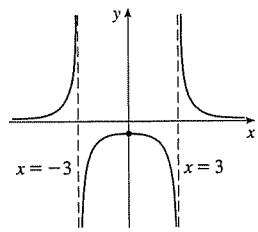
5. A. $\mathbb{R}$ B. y-int. 0; x-int. -4, 0
C. None D. None E. Inc. on $(-3, \infty)$; dec. on $(-\infty, -3)$
F. Loc. min. $f(-3) = -27$
G. CU on $(-\infty, -2)$, $(0, \infty)$; CD on $(-2, 0)$; IP (0, 0), $(-2, -16)$
H.



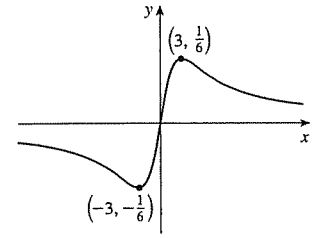
7. A. $\{x \mid x \neq 1\}$ B. y-int. 0; x-int. 0
C. None D. VA $x = 1$, HA $y = 1$
E. Dec. on $(-\infty, 1)$, $(1, \infty)$ F. None
G. CU on $(1, \infty)$; CD on $(-\infty, 1)$
H. See graph at right.



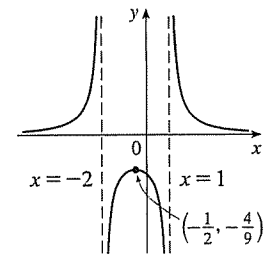
9. A. $\{x \mid x \neq \pm 3\}$ B. y-int. $-\frac{1}{9}$
C. About y-axis
D. VA $x = \pm 3$, HA $y = 0$
E. Inc. on $(-\infty, -3)$, $(-3, 0)$;
dec. on $(0, 3)$, $(3, \infty)$
F. Loc. max. $f(0) = -\frac{1}{9}$
G. CU on $(-\infty, -3)$, $(3, \infty)$;
CD on $(-3, 3)$
H. See graph at right.



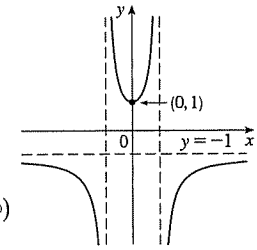
11. A. $\mathbb{R}$ B. y-int. 0; x-int. 0 C. About (0, 0)
D. HA $y = 0$ E. Inc. on $(-3, 3)$; dec. on $(-\infty, -3)$, $(3, \infty)$
F. Loc. min. $f(-3) = -\frac{1}{6}$;
loc. max. $f(3) = \frac{1}{6}$
G. CU on $(-3\sqrt{3}, 0)$, $(3\sqrt{3}, \infty)$;
CD on $(-\infty, -3\sqrt{3})$, $(0, 3\sqrt{3})$;
IP (0, 0), $(\pm 3\sqrt{3}, \pm\sqrt{3}/12)$
H. See graph at right.



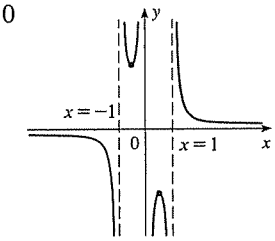
13. A. $\{x \mid x \neq 1, -2\}$
B. y-int. $-\frac{1}{2}$ C. None
D. VA $x = 1$, $x = -2$; HA $y = 0$
E. Inc. on $(-\infty, -2)$, $(-2, -\frac{1}{2})$;
dec. on $(-\frac{1}{2}, 1)$, $(1, \infty)$
F. Loc. max. $f(-\frac{1}{2}) = -\frac{4}{9}$
G. CU on $(-\infty, -2)$, $(1, \infty)$;
CD on $(-2, 1)$ H. See graph at right.



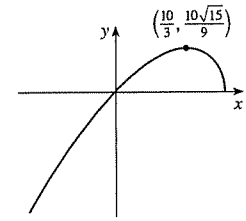
15. A. $\{x \mid x \neq \pm 1\}$ B. y-int. 1
C. About y-axis
D. VA $x = \pm 1$; HA $y = -1$
E. Inc. on (0, 1), $(1, \infty)$;
dec. on $(-\infty, -1)$, $(-1, 0)$
F. Loc. min. $f(0) = 1$
G. CU on $(-1, 1)$; CD on $(-\infty, -1)$, $(1, \infty)$
H. See graph at right.



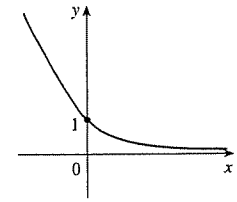
17. A. $\{x \mid x \neq 0, \pm 1\}$ B. None C. About (0, 0)
D. VA $x = -1$, $x = 0$, $x = 1$; HA $y = 0$
E. Inc. on $(-1/\sqrt{3}, 0)$, $(0, 1/\sqrt{3})$;
dec. on $(-\infty, -1)$, $(-1, -1/\sqrt{3})$,
$(1/\sqrt{3}, 1)$, $(1, \infty)$
F. Loc. min. $f(-1/\sqrt{3}) = 3\sqrt{3}/2$;
loc. max. $f(1/\sqrt{3}) = -3\sqrt{3}/2$
G. CU on $(-1, 0)$, $(1, \infty)$;
CD on $(-\infty, -1)$, $(0, 1)$
H. See graph at right.



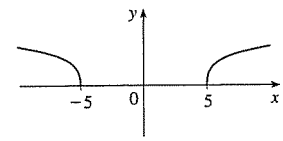
19. A. $(-\infty, 5]$ B. y-int. 0; x-int. 0, 5
C. None D. None
E. Inc. on $(-\infty, \frac{10}{3})$; dec. on $(\frac{10}{3}, 5)$
F. Loc. max. $f(10/3) = 10\sqrt{15}/9$
G. CD on $(-\infty, 5)$
H. See graph at right.



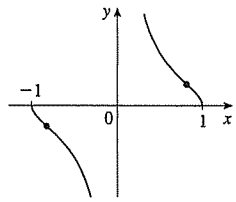
21. A. $\mathbb{R}$ B. y-int. 1
C. None D. HA $y = 0$
E. Dec. on $(-\infty, \infty)$
F. None G. CU on $(-\infty, \infty)$
H. See graph at right.



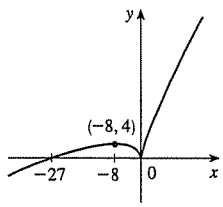
23. A. $\{x \mid |x| \geq 5\} = (-\infty, -5] \cup [5, \infty)$
B. x-int. ± 5 C. About y-axis
D. None
E. Inc. on $(5, \infty)$; dec. on $(-\infty, -5)$
F. None G. CD on $(-\infty, -5)$, $(5, \infty)$
H. See graph at right.



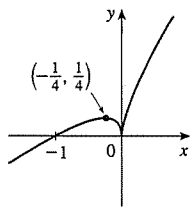
25. A. $\{x \mid |x| \le 1, x \ne 0\} = [-1, 0) \cup (0, 1]$
B. x-int. ± 1 C. About $(0, 0)$
D. VA $x = 0$
E. Dec. on $(-1, 0)$, $(0, 1)$
F. None
G. CU on $(-1, -\sqrt{2/3})$, $(0, \sqrt{2/3})$;
CD on $(-\sqrt{2/3}, 0)$, $(\sqrt{2/3}, 1)$;
IP $(\pm\sqrt{2/3}, \pm 1/\sqrt{2})$
H. See graph at right.



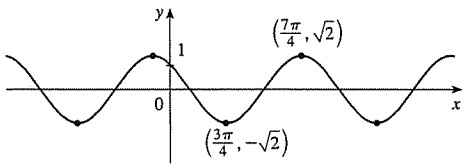
27. A. $\mathbb{R}$ B. y-int. 0; x-int. 0, -27
C. None D. None
E. Inc. on $(-\infty, -8)$, $(0, \infty)$;
dec. on $(-8, 0)$
F. Loc. min. $f(0) = 0$,
loc. max. $f(-8) = 4$
G. CD on $(-\infty, 0)$, $(0, \infty)$
H. See graph at right.



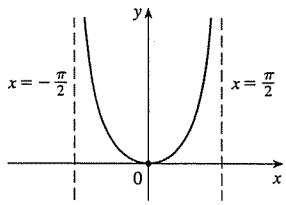
29. A. $\mathbb{R}$ B. y-int. 0; x-int. -1, 0
C. None D. None
E. Inc. on $(-\infty, -\frac{1}{4})$, $(0, \infty)$; dec. on $(-\frac{1}{4}, 0)$
F. Loc. max. $f(-\frac{1}{4}) = \frac{1}{4}$; loc. min. $f(0) = 0$
G. CD on $(-\infty, 0)$, $(0, \infty)$
H. See graph at right.



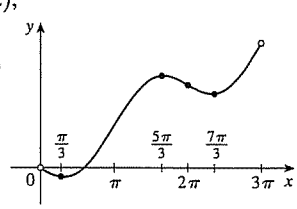
31. A. $\mathbb{R}$ B. y-int. 1; x-int. $n\pi + (\pi/4)$ (n an integer)
C. Period 2π D. None
E. Inc. on $(2n\pi + (3\pi/4), 2n\pi + (7\pi/4))$;
dec. on $(2n\pi - (\pi/4), 2n\pi + (3\pi/4))$
F. Loc. min. $f(2n\pi + (3\pi/4)) = -\sqrt{2}$;
loc. max. $f(2n\pi - (\pi/4)) = \sqrt{2}$
G. CU on $(2n\pi + (\pi/4), 2n\pi + (5\pi/4))$;
CD on $(2n\pi - (3\pi/4), 2n\pi + (\pi/4))$; IP $(n\pi + (\pi/4), 0)$
H.



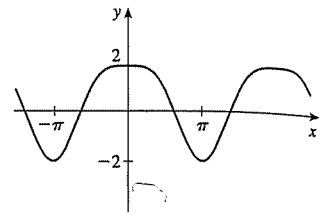
33. A. $(-\pi/2, \pi/2)$ B. y-int. 0; x-int. 0
C. About y-axis D. VA $x = \pm\pi/2$
E. Inc. on $(0, \pi/2)$;
dec. on $(-\pi/2, 0)$
F. Loc. min. $f(0) = 0$
G. CU on $(-\pi/2, \pi/2)$
H. See graph at right.



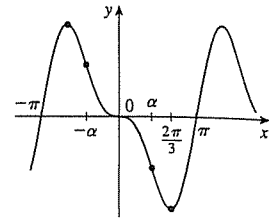
35. A. $(0, 3\pi)$ C. None D. None
E. Inc. on $(\pi/3, 5\pi/3)$, $(7\pi/3, 3\pi)$; dec. on $(0, \pi/3)$, $(5\pi/3, 7\pi/3)$
F. Loc. min. $f(\pi/3) = (\pi/6) - (\sqrt{3}/2)$,
$f(7\pi/3) = (7\pi/6) - (\sqrt{3}/2)$;
loc. max. $f(5\pi/3) = (5\pi/6) + (\sqrt{3}/2)$
G. CU on $(0, \pi)$, $(2\pi, 3\pi)$;
CD on $(\pi, 2\pi)$; IP $(\pi, \pi/2)$, $(2\pi, \pi)$
H. See graph at right.



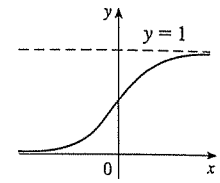
37. A. $\mathbb{R}$ B. y-int. 2
C. About y-axis, period 2π D. None
E. Inc. on $((2n - 1)\pi, 2n\pi)$; dec. on $(2n\pi, (2n + 1)\pi)$
F. Max. $f(2n\pi) = 2$;
min. $f((2n + 1)\pi) = -2$
G. CD on $(2n\pi - (2\pi/3)$,
$2n\pi + (2\pi/3))$;
CU on remaining intervals;
IP $(2n\pi \pm (2\pi/3), -\frac{1}{4})$
H. See graph at right.



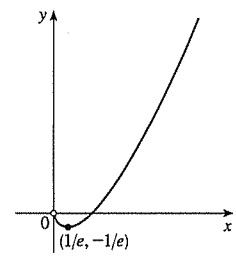
39. A. $\mathbb{R}$ B. y-int. 0; x-int. $n\pi$
C. About $(0, 0)$, period 2π D. None
E. Inc. on $(-\pi, -2\pi/3)$, $(2\pi/3, \pi)$; dec. on $(-2\pi/3, 2\pi/3)$
F. Loc. max. $f(-2\pi/3) = 3\sqrt{3}/2$;
loc. min. $f(2\pi/3) = -3\sqrt{3}/2$
G. CU on $(-\alpha, 0)$, (α, π)
where $\cos\alpha = \frac{1}{4}$;
CD on $(-\pi, -\alpha)$, $(0, \alpha)$;
IP when $x = 0, \pm\alpha, \pm\pi$
H. See graph at right.



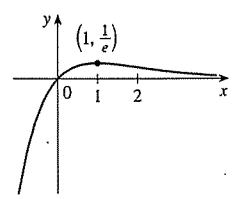
41. A. $\mathbb{R}$ B. y-int. $\frac{1}{2}$ C. None
D. HA $y = 0, y = 1$
E. Inc. on $\mathbb{R}$ F. None
G. CU on $(-\infty, 0)$; CD on $(0, \infty)$;
IP $(0, \frac{1}{2})$ H. See graph at right.



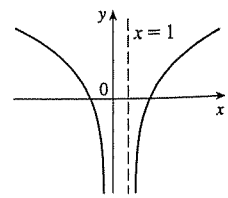
43. A. $(0, \infty)$ B. x-int. 1
C. None D. None
E. Inc. on $(1/e, \infty)$; dec. on $(0, 1/e)$
F. Loc. min. $f(1/e) = -1/e$
G. CU on $(0, \infty)$
H. See graph at right.



45. A. $\mathbb{R}$ B. y-int. 0; x-int. 0
C. None D. HA $y = 0$
E. Inc. on $(-\infty, 1)$; dec. on $(1, \infty)$
F. Loc. max. $f(1) = 1/e$
G. CU on $(2, \infty)$; CD on $(-\infty, 2)$;
IP $(2, 2/e^2)$
H. See graph at right.

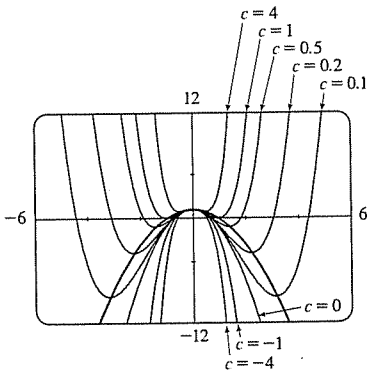


47. A. $(-\infty, 0) \cup (1, \infty)$
B. x-int. $(1 \pm \sqrt{5})/2$
C. None D. VA $x = 0$, $x = 1$
E. Inc. on $(1, \infty)$; Dec. on $(-\infty, 0)$
F. None
G. CD on $(-\infty, 0)$, $(1, \infty)$
H. See graph at right.



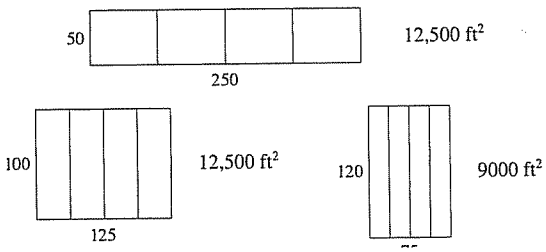
49. A. $\mathbb{R}$ B. y-int. 0; x-int. 0 C. About $(0, 0)$ D. HA $y = 0$
E. Inc. on $(-1/\sqrt{2}, 1/\sqrt{2})$; dec. on $(-\infty, -1/\sqrt{2})$, $(1/\sqrt{2}, \infty)$
F. Loc. min. $f(-1/\sqrt{2}) = -1/\sqrt{2e}$; loc. max. $f(1/\sqrt{2}) = 1/\sqrt{2e}$
G. CU on $(-\sqrt{3/2}, 0)$, $(\sqrt{3/2}, \infty)$; CD on $(-\infty, -\sqrt{3/2})$, $(0, \sqrt{3/2})$;
IP $(\pm\sqrt{3/2}, \pm\sqrt{3/2}e^{-3/2})$, $(0, 0)$

37. (a) Positive (b)

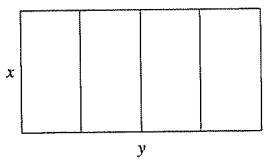


Exercises 4.7 □ page 334

1. (a) 11, 12 (b) 11.5, 11.5 **3.** 10, 10
5. 25 m by 25 m
7. (a)



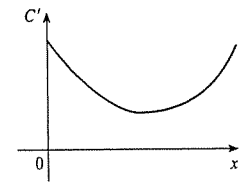
(b)



(c) $A = xy$ (d) $5x + 2y = 750$ (e) $A = 375x - \frac{5}{2}x^2$
(f) 14,062.5 ft²
9. 1000 ft by 1500 ft **11.** 4000 cm³ **13.** \$191.28
15. $\left(-\frac{28}{17}, \frac{7}{17}\right)$ **17.** $(1, \pm\sqrt{5})$ **19.** Square, side $\sqrt{2}\,r$
21. $L/2$, $\sqrt{3}\,L/4$ **23.** Base $\sqrt{3}\,r$, height $3r/2$
25. $4\pi r^3/(3\sqrt{3})$ **27.** $\pi r^2(1 + \sqrt{5})$ **29.** 24 cm, 36 cm
31. (a) Use all of the wire for the square
(b) $40\sqrt{3}/(9 + 4\sqrt{3})$ m for the square
33. Height = radius = $\sqrt[3]{V/\pi}$ cm **35.** $V = 2\pi R^3/(9\sqrt{3})$
37. (a) $\frac{3}{2}s^2 \csc\theta(\csc\theta - \sqrt{3}\cot\theta)$ (b) $\cos^{-1}(1/\sqrt{3}) \approx 55°$
(c) $6s[h + s/(2\sqrt{2})]$ **39.** Row directly to B
41. $10\sqrt[3]{3}/(1 + \sqrt[3]{3})$ ft from the stronger source
45. 9.35 m **49.** $x = 6$ in. **51.** $\pi/6$
53. At a distance $5 - 2\sqrt{5}$ from A **55.** $(L + W)^2/2$
57. (a) About 5.1 km from B
(b) C is close to B; C is close to D;
$W/L = \sqrt{25 + x^2}/x$, where $x = |BC|$
(c) ≈1.07; no such value (d) $\sqrt{41}/4 \approx 1.60$

Exercises 4.8 □ page 344

1. (a) $C(0)$ represents fixed costs, which are incurred even when nothing is produced.
(b) The marginal cost is a minimum there.
(c)



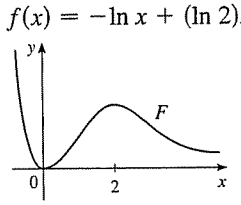
3. \$17.40/unit; the cost of producing the 1001st unit is about \$17.40
5. (a) \$1,340,000; \$1340; \$2300/unit (b) 200 (c) \$700
7. (a) \$2330.71, \$2.33, \$4.07/unit (b) 159 (c) \$1.07
9. (a) \$188.25, \$0.19, \$0.28/unit (b) 400 (c) \$0.15
11. (a) $c(x) = 3700/x + 5 - 0.04x + 0.0003x^2$,
$C'(x) = 5 - 0.08x + 0.0009x^2$
(b) Between 208 and 209 units (c) $c(209) \approx$ \$27.45/unit
(d) \$3.22/unit
13. 400 **15.** 672 **17.** 100
19. (a) About 200 yd (b) 192 yd
21. (a) $p(x) = 19 - (x/3000)$ (b) \$9.50
23. (a) $p(x) = 550 - (x/10)$ (b) \$175 (c) \$100

Exercises 4.9 □ page 349

1. $x_2 \approx 2.3$, $x_3 \approx 3$ **3.** $\frac{4}{5}$ **5.** −0.6860 **7.** 2.1148
9. 3.10723251 **11.** 2.224745 **13.** 1.895494
15. −2.114908, 0.254102, 1.860806 **17.** 0.520269
19. 0, 1.109144, 3.698154
21. −1.39194691, 1.07739428, 2.71987822
23. 0.15438500, 0.84561500 **25.** −0.51031156, 1.19843871
27. (b) 31.622777
33. (a) −0.455, 6.810, 0.645 (b) $f(6.810) \approx -1949.07$
35. (0.904557, 1.855277) **37.** 11.28 ft **39.** 0.76286%

Exercises 4.10 □ page 356

1. $2x^3 - 4x^2 + 3x + C$ **3.** $x - \frac{1}{4}x^4 + \frac{5}{6}x^6 - \frac{3}{8}x^8 + C$
5. $4x^{5/4} - 4x^{7/4} + C$ **7.** $(2x^{3/2}/3) + (3x^{4/3}/4) + C$
9. $-5/(4x^8) + C$ **11.** $(2t^{7/2}/7) + (4t^{5/2}/5) + C$
13. $3\sin t + 4\cos t + C$ **15.** $x^2 + 5\sin^{-1}x + C$
17. $x^5 - (x^6/3) + 4$ **19.** $x^3 + x^4 + Cx + D$
21. $\frac{1}{2}x^2 + \frac{25}{126}x^{14/5} + Cx + D$ **23.** $e^t + \frac{1}{2}Ct^2 + Dt + E$
25. $8 + x - 3x^2$ **27.** $2x^{3/2} - 2\sqrt{x} + 2$
29. $3\sin x - 5\cos x + 9$ **31.** $2\ln(-x) + 7$
33. $(x^3/6) + 2x - 3$ **35.** $(x^4/12) - 3\cos x + 3x + 5$
37. $x^3 + 3x^2 - 5x + 4$ **39.** $f(x) = 1/(2x) + (x/4) - (3/4)$
41. $f(x) = -\ln x + (\ln 2)x - \ln 2$ **43.** 10 **45.** b
47.



49.