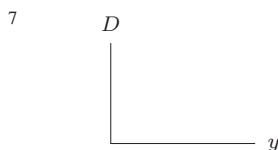
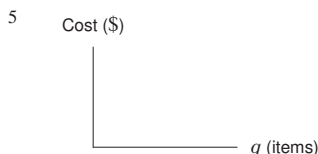


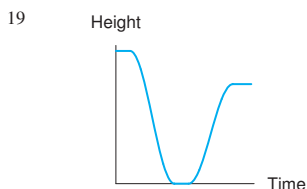
ANSWERS TO ODD NUMBERED PROBLEMS

Section 1.1

- S1 $(2/3)c$
 S3 $6\pi r^2$
 S5 $51/2$
 S7 $3/2$
 S9 $A = (-2, 8)$
 1 (a) 2
 (b) 2
 (c) About 12 hours
 3 $w = f(c)$



- 9 (a) 4
 (b) 3
 (c) 2
 (d) 2 and 4
 11 2.9
 13 0, 4, 8
 15 (a) w
 (b) $(-4, 10)$
 (c) $(6, 1)$
 17 (a) Yes
 (b) No



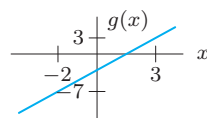
- 21 (a) 100.3 m. own phones in 2000
 (b) 20 m. own phones a years after 1990
 (c) b m. own phones in 2010
 (d) n m. own phones t years after 1990
 23 (a) Most: Hannah; least: Madison
 (b) Most: Madison; least: Alexis
 25 (a) 10.71 gallons
 (b) 0.25 gallons
 (c) 55 mph
 27 (a) $72\pi \text{ ft}^3$
 (b) $45\pi \text{ ft}^3$
 (c) $V(h) = 9\pi h$
 29 (a) 69°F
 (b) July 17 and 20
 (c) Yes

- (d) No
 31 (a) No
 (b) Yes
 (c) In 1981, record was 3 min 47.33 sec
 (d) 1967, record of 3 min 51.1 sec
 33 (a) $x + y$
 (b) $0.15x + 0.18y$
 (c) $(15x + 18y)/(x + y)$
 35 $A(r) = \pi r^2$
 21%
 37 (b) $C = 2 + (0.5)l$

Section 1.2

- S1 -2
 S3 -2
 S5 -1
 S7 $-3x^2 - 4ax - a^2$
 S9 $x + y$
 1 (a) 80/3 CDs per year
 (b) -20 CDs per year
 (c) 0 CDs per year
 3 Decreasing
 5 0.513
 7 0.513
 9 (a) Negative
 (b) Positive
 11 $F(-2) > F(2)$
 13 (a) $A = (10, 30)$
 $B = (30, 40)$
 $C = (50, 90)$
 $D = (60, 40)$
 $E = (90, 40)$

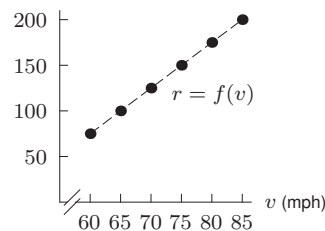
- (b) Point F is on the graph.
 (c) Increasing: 6-21,
 36-51, 66-81
 (d) Decreasing: 22-35,
 52-65, 82-96
 15 (a) 2
 (b) Increasing
 (c) Increasing everywhere



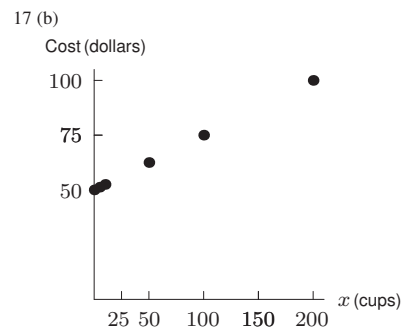
- 17 (a) Town B
 (b) Town A
 19 24.5 degrees/minute
 21 (a) 162 calories
 (b) Swimmer
 (c) Increases
 23 (a) 9
 (b) $\frac{n-k}{m-j}$
 (c) $6x + 3h$
 25 (a) 10, 10, 10, 10, 7, 1
 (b) 30, 30.5, 53.6, 33.9, 15.5, -5
 (c) No; $\Delta G/\Delta t$ not constant
 (d) Recycling and composting program in US

Section 1.3

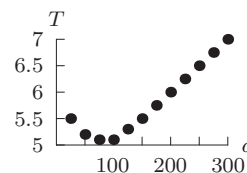
- S1 $f(0) = 5, f(3) = 7$
 S3 5
 S5 $y = 3; x = 3/4$
 S7 $7/2, -2$
 S9 $-ab + a + 3, a - 3$
 1 Not linear
 3 No
 5 Yes
 7 (a) $y = 7 + 2x$
 (b) $y = 8 - 15x$
 9 Vert int: 54.25 thousand; Slope: $-2/7$ thousand/yr
 11 Vert int: $-\$3000$; Slope: $\$0.98/\text{item}$
 13 (a) $r = f(v)$ could be linear
 (b) $\$5$ increase/mph
 (c) r (dollars)



15 $V = 21,500 - 3200t$

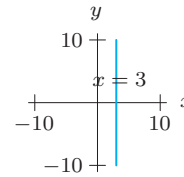
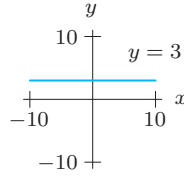


- (c) 0.25
 (d) Start-up cost
 19 $\pi(n) = -10,000 + 127n$
 21 $c = 4000 + 80r$
 23 (a) Radius and circumference
 (c) 2π
 25 (a) No
 (b) Looks linear



- (c) $\Delta T/\Delta d = 0.01^\circ\text{C}/\text{meter}$
 27 (a) $T = \$1900$
 (b) $C = 7$
 (d) Twelve credits
 (e) Fixed costs that do not depend on the number of credits taken
 29 (a) $r = 5/2, s = 16$
 (b) $k = 0.2, j = -3$
 33 No

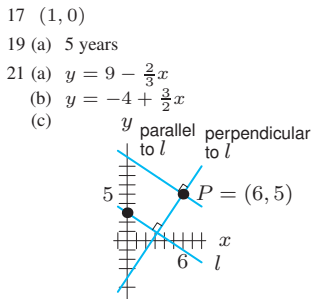
- S7 $x = 3/2, y = 3/2$
 1 (a) (V)
 (b) (VI)
 (c) (I)
 (d) (IV)
 (e) (III)
 (f) (II)
 5 (a)



Section 1.4

- S1 $y = 26$
 S3 $x = 2$
 S5 $y = -17/16$
 S7 $F = (9/5)C + 32$
 S9 $x = (c - ab)/(2a)$
 1 $y = 4/5 - x$
 3 $y = 180 - 10x$
 5 $y = -0.3 + 5x$
 7 $y = -40/3 - 2/3x$
 9 $y = 21 - x$
 11 Yes; $F(P) = 13 + (-1/8)P$
 13 Yes; $C(r) = 0 + 2\pi r$
 15 Yes; $f(x) = n^2 + m^2x$
 17 $y = 8 + 3x$
 19 $y = (11 + 2x)/3$
 21 $y = 0.03 + 0.1x$
 23 $f(x) = 3 - 2x$
 25 $q = 2500 - 2000p$
 27 $y = 459.7 + 1x$
 29 $u = (1/12)n$
 31 $f(x) = -12.5 - 1.5x$
 33 $h(t) = 12,000 + 225t$
 35 (a) \$11,375
 (b) \$125
 (c) \$5
 37 $C(n) = 10,500 + 5n$
 39 (b) $v = 40 - 32t$
 41 (a) $q = 210 - 50p$
 43 $y = -4 + 4x$
 45 $y = \frac{16+5\sqrt{7}}{2+\sqrt{7}} - \frac{3}{2+\sqrt{7}}x$ or
 $y = (1 + 2\sqrt{7}) + (2 - \sqrt{7})x$
 47 (a) $p = 0.1t - 1$, and $t \geq 10$
 (b) 11
 (d) $t = 10p + 10$
 (e) 2 hours 40 minutes
 49 (a) $i(x) = 2.5x$
 (b) $i(0) = 0$
 51 $w(r) = \pi x^2 - s\sqrt{x} + (-3x - 4s)r$;
 $b = \pi x^2 - s\sqrt{x}; m = -3x - 4s$
 53 (a) $r = 0.005H - 0.03$
 (b) $S = 200$

- (b) Yes ($y = 3 + 0x$), No
 7 Perpendicular
 9 Neither
 11 Parallel
 13 $y = 6 - (3/5)x$
 15 Parallel line:
 $y = -4x + 9$
 Perpendicular line:
 $y = 0.25x + 4.75$

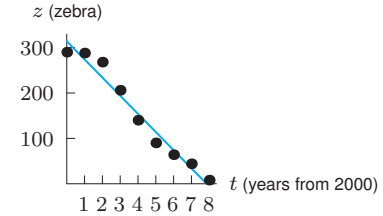


- 23 (a) $P = (a, 0)$
 (b) $A = (0, b), B = (-c, 0)$
 $C = (a + c, b), D = (a, 0)$
 27 $3 < \beta < 6$
 29 (a) $y = -\sqrt{3}x$
 (b) $y = (1/\sqrt{3})x + 4/\sqrt{3}$
 31 $y = x/3 + 2/3$

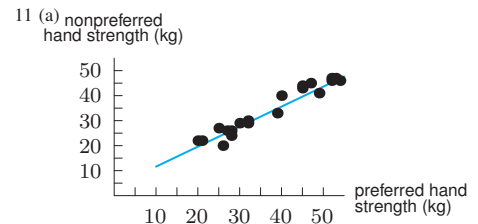
Section 1.6

- 1 $r = 0.93$ is reasonable.
 3 $r = 1$ is not reasonable.
 5 $r = 1$ is not reasonable.
 7 (a) $r = 1$
 (b) $r = 0.7$

- (c) $r = 0$
 (d) $r = -0.98$
 (e) $r = -0.25$
 (f) $r = -0.5$
 9 (a) and (b)



- (c) $z = -40t + 314$
 (e) Strong negative correlation ($r = -0.983$)



- (c) $y = 3.623 + 0.825x$
 (d) ≈ 34
 (e) ≈ 40

Chapter 1 Review

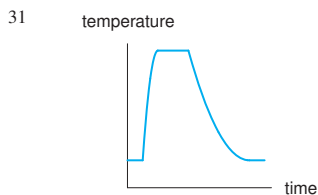
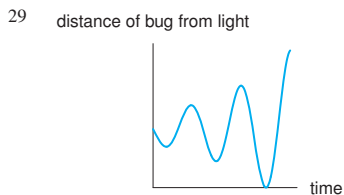
- 1 Neither
 3 Both
 5 Neither
 7 (a)

x	0	1	2	3
$f(x)$	10	5	2	1

- (b) $x = 0$; smallest x -value
 9 (a) #2
 (b) #1, #3
 (c) #3
 11 (a) Owens: 12 yards/sec horse: 20 yards/sec
 (b) 6 seconds
 13 Yes
 15 $f(t) = 2.2 - 1.22t$
 17 (a) (ii)
 (b) (iii)
 (c) (i)
 19 (a) $y = 3 + 4x$
 (b) $y = 5 - 2x$
 21 Neither
 23 Perpendicular
 25 120
 27 500 m

Section 1.5

- S1 $x = -2, y = 5$
 S3 No solution
 S5 $x = 7, y = 4$



33 $T(d) = d/5 + (10 - d)/8$

35 $s = 1440 - w$

37 (a) (i) $1/2$

(ii) $1/2$

(iii) $1/2$

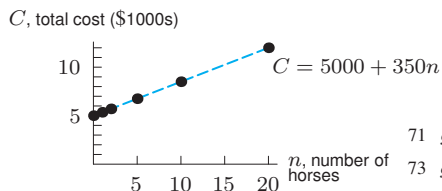
(b) Always $1/2$

39 (a) $0^\circ\text{C}/\text{meter}$

(b) $-0.008^\circ\text{C}/\text{meter}$

(c) $0.009^\circ\text{C}/\text{meter}$.

41 (a) \$5350, \$5700, \$6750, \$8500, \$12,000



(b) $C = 5000 + 350n$

(c) \$350/horse

43 $h(t) = 254 - 248t$

45 (a) 1000, 990.2, 980.4, 970.6, 960.8

(b) v decreasing at constant rate

(c) Slope: $-9.8 \text{ meter}/\text{sec}^2$

v -intercept: 1000meters/sec

t -intercept: 102.04 sec

49 (a) $S = -100 + 100p$

(c) Yes, \$1

(d) \$4

51 $g(x) = -2 - 2x$

53 $y = 2.8 - 0.1x$

55 $d = 60 + 50t$

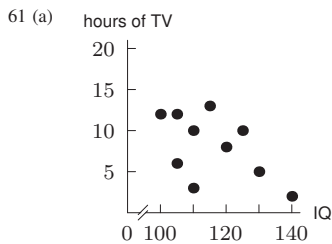
57 $g(x) = 32 - (3/5)x$

59 (a) $Y_A = 0.37x$

$Y_B = 13.95 + 0.22x$

$Y_C = 50$

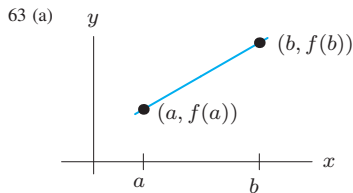
(c) $93 < x \leq 163$



(b) $r \approx -1/2$

(c) $y = 27.5139 - 0.1674x$

$r = -0.5389$



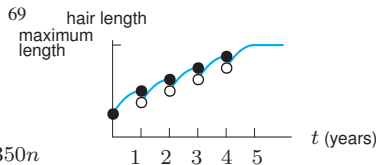
(b) $(f(b) - f(a))/(b - a)$

65 $y = 0.75/(0.75 - 1) - (\sqrt{0.5})^2x; p = 0.75, r = \sqrt{0.5}$

67 (a) y -intercept: c/q

x -intercept: c/p

(b) $-(p/q)$



71 $g(x) = 17/5 + 6/(5\pi) \cdot x$

73 $g(54) = 8^{1/5} = \sqrt[5]{8}$

Ch. 1 Understanding

1 False

3 True

5 True

7 True

9 True

11 True

13 True

15 True

17 False

19 False

21 False

23 True

25 True

27 False

29 True

31 False

33 False

35 True

37 False

39 False

41 True

43 False

45 True

47 True

49 False

51 True

53 True

Ch. 1 Skills: Linear Equations

1 $x = 5$

3 $z = 11/2$

5 $w = -11$

7 $t = 45/13$

9 $t = 10/7$

11 $B = -2$

13 $l = A/w$

15 $a = 2(h - v_0t)/t^2$

17 $v = (3w - 2u - z)/(u + w - z)$

19 $x = -a(b + 1)/(ad - c)$

21 $y' = 4/(y + 2x)$

23 $x = 4, y = 3$

25 $x = -55, y = 39$

27 $x = 1, y = a$

29 $x = 3, y = 6$

31 $A = (-4, 7)$

33 $A = (2, 9), B = (10, 1)$

35 $A = (-7, 8), B = (-3, 4)$

Section 2.1

S1 $5x - 15$

S3 $4m^2 - 38m + 90$

S5 $(3x + 3)/3$

S7 $x = \pm 3$

S9 $(18 \pm \sqrt{285})/3$

1 (a) -4

(b) ± 2

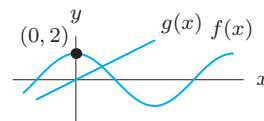
3 (a) $-1/2$

(b) -1

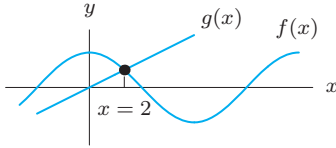
5 $3/2$

7 54

9 $(0, 2)$



11 Intersect at $x = 2$

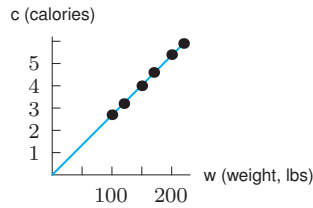


- 13 100
 15 $f(1/3) = 3.222$; $f(1)/f(3) = 0.238$; Not equal
 17 (a) (i) $1/(1-t)$
 (ii) $-1/t$
 (b) $x = 3/2$
 19 (a) 48 feet for both
 (b) 4 sec, 64 ft
 21 (a) $s(2) = 146$
 (b) Solve $v(t) = 65$
 (c) At 3 hours
 23 (a) \$4261
 (b) $T(x) = 0.8x$
 (c) $L(x) = 0.0548x - 397$
 (d) \$4261
 27 (a) $h(1) = b + c + 1$
 (b) $h(b+1) = 2b^2 + 3b + c + 1$
 29 $a/2$
 31 $a/(a - a^2 + 1)$
 33 (a) (i) 6
 (ii) 5
 (iii) Not defined
 (b) (i) $50 \leq s \leq 75$
 (ii) $76 \leq s \leq 125$
 35 (a) 7000
 (b) 8500; 4 weeks after the beginning of the epidemic
 (c) $w = 1, w = 10$
 (d) $1.5 \leq w \leq 8$

Section 2.2

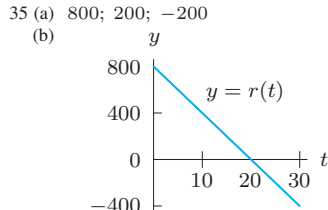
- S1 $x = 3$
 S3 $x < 15$
 S5 $x > 8$
 S7 $n < 0$
 S9 $x > 5$ or $x < -5$.
 1 $f(x) \leq -(1/2)$ or $f(x) \geq (1/2)$
 3 $-4 \leq f(x) \leq 5$
 5 D: all real numbers $\neq -3$
 7 D: all real numbers $\neq -3$
 9 Domain: $x > 4$
 Range: $y > 0$
 11 D: $x \geq 2$ or $x \leq -2$
 13 D: all real numbers
 15 D: all real numbers
 R: all real numbers
 17 $a = 3$
 19 $a = -3$
 21 D: $1 \leq x \leq 7$; R: $2 \leq f(x) \leq 18$
 23 $y = 1/((x+5)\sqrt{-x})$
 25 D: $0 \leq t \leq 12$
 R: $0 \leq f(t) \leq 200$

- 27 Domain: integers $0 \leq n \leq 200$
 Range: $0, 4, 8, \dots, 800$
 29 (a) 162 calories
 (c) (i) Calories = $0.025 \times \text{weight}$



- (ii) (0,0) is the number of calories burned by a weightless runner
 (iii) Domain $0 < w$; range $0 < c$
 (iv) 3.6

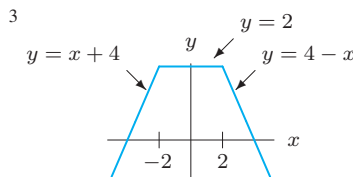
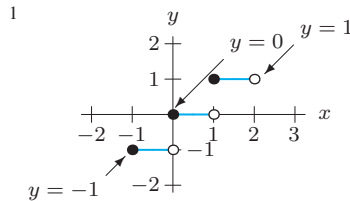
- 31 D: all real numbers;
 R: $h(x) \geq 6$
 33 (a) $p(0) = 50$
 $p(10) \approx 131$
 $p(50) \approx 911$
 (c) $50 \leq p(t) < 1000$



- (c) $t = 20$; $t = 0$
 (d) Domain: $0 \leq t \leq 30$
 Range: $-400 \leq r(t) \leq 800$

Section 2.3

- S1 $x > 0$
 S3 $2 \leq x \leq 3$
 S5 $x \leq -1$ or $x \geq 2$
 S7 Domain: $2 \leq x < 6$
 Range: $3 \leq x < 5$
 S9 Domain: $-2 \leq x \leq 3$
 Range: $-2 \leq x \leq 3$

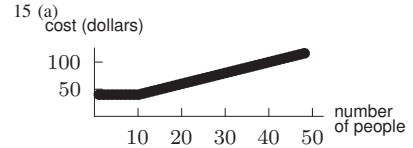


- 5 Domain: all reals;
 Range: $G(x) < 0$ and $G(x) \geq 3$

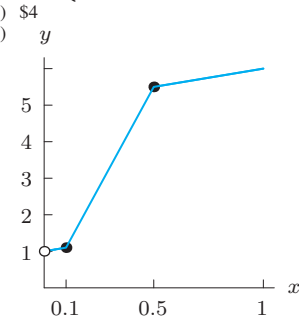
7 $y = \begin{cases} 5 - x & \text{for } x < 3 \\ -1 + (1/2)x & \text{for } x \geq 3 \end{cases}$

9 $y = \begin{cases} 4 - \frac{1}{2}x & \text{for } 1 \leq x \leq 3 \\ -9 + 2x & \text{for } 5 \leq x \leq 8 \end{cases}$

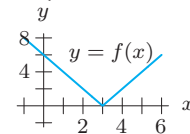
- 11 (a) Yes
 (b) No
 (c) $y = 1, 2, 3, 4$
 13 (c) Domain: all $x, x \neq 0$
 Range: -1 and 1
 (d) False, $u(0)$ is undefined



- (b) Integers from 1 to 50
 Even integers from 40 to 120
 17 (a) \$1.01
 (b) $y = \begin{cases} 1 + x & \text{for } 0 < x < 0.1 \\ 10x + x & \text{for } 0.1 \leq x \leq 0.5 \\ 5 + x & \text{for } x > 0.5 \end{cases}$
 (c) \$4
 (d) y



- 19 (b) 13-69
 21 (a) $f(x) = \begin{cases} 2x - 6 & \text{for } x \geq 3 \\ 6 - 2x & \text{for } x < 3 \end{cases}$
 (b) y



- 23 (a) $f(0) = 0, f(3) = 1$
 (b) Domain: $-1 \leq x \leq 5$;
 Range: $-3 \leq f(x) \leq 3$.

25 $y = \begin{cases} x^2 & \text{for } x < 0 \\ x - 1 & \text{for } x \geq 0 \end{cases}$

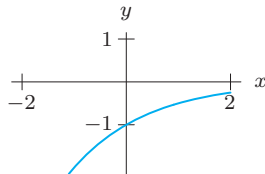
Section 2.4

- S1 $y = (x + 4)/3$
 S3 $y = (2x + 1)/(x - 2)$
 S5 $y = \sqrt[3]{x + 4}$
 S7 x
 S9 $3y^2 - 12y + 5$
 1 Area in sq cm at time t
 3 Price for diameter d
 5 0
 7 -10
 9 $9x - 4$
 11 Year pop is P ; years
 13 Days for N inches snow; days
 15 Diameter in inches of pizza costing c dollars
 17 $f^{-1}(Q) = (Q - 3)^{1/3}$
 19 $g^{-1}(y) = 1/(y - 1)$
 21 (a) b
 (b) a
 (c) a
 (d) b
 23 $n = f(100) = 0.4$ gal
 $A = f^{-1}(100) = 25,000$ ft²
 25 (a) (i) 2
 (ii) 1
 (iii) 1
 (iv) 2
 (b) $f(0) = 2$ means $f^{-1}(2) = 0$
 (c) $f(1) = 0$ means $f^{-1}(0) = 1$
 27 (a) 5000 loaves cost \$653
 (b) 620 loaves \$80
 (c) \$790 for 6300 loaves
 (d) 1200 loaves for \$150
 29 (a) 12, perimeter for $s = 3$
 (b) 5; side for $P = 20$
 (c) $f^{-1}(P) = P/4$
 31 $t = f^{-1}(H) = \frac{9}{8}H + 32 = t$
 33 $20 + (50/9)2^{-n}$;
 $H = f(g(n))$ is temperature in °C at time n
 35 (a) $A = f(r) = \pi r^2$
 (b) $f(0) = 0$
 (c) $f(r + 1) = \pi(r + 1)^2$
 (d) $f(r) + 1 = \pi r^2 + 1$
 (e) Centimeters
 37 $f(t) = 4\pi(50 - 2.5t)^3/3$
 39 $f(t) = \pi(2t - 0.1t^2)^2$
 41 (a) 2 lbs cost \$2.80
 (b) 0.5 lb costs \$0.70
 (c) \$0.35 buys 1/4 lb
 (d) \$7 buys 5 lb
 43 $23/4; -2$
 45 $f^{-1}(y) = (y - 1)^{1/3}$
 47 D: all real numbers
 R: all real numbers
 49 D: all real numbers < 3
 R: all real numbers > 0

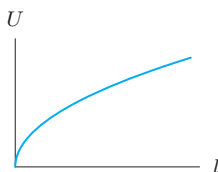
Section 2.5

- 1 Concave down
 3 Concave up

- 5 Concave up
 7 Concave up
 9 Rates of change: 2.889, 1.417, 1.167; Concave down
 11 Possible graph:



- 13 Increasing; concave up
 15 Increasing; concave up then down
 17 Increasing; concave up then down
 19 (a) E, III
 (b) G, I
 (c) F, II
 21 No
 23 (a) Larger swims twice as fast
 (b) Increasing, concave down

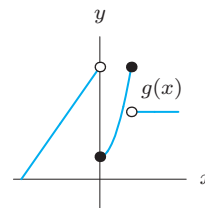


- (c) \sqrt{l} increasing
 (d) \sqrt{l} concave down; greater

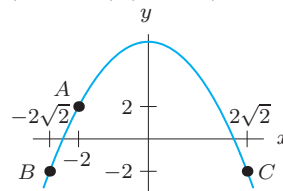
Chapter 2 Review

- 1 $f(-7) = -9/2$
 3 $-3/31; 1$
 5 $32; \sqrt[3]{9/4}$
 7 (a) 1
 (b) $-1/2$
 9 -8
 11 (a) 2, 0, -2
 (b) $x = -1$
 13 Domain: $x \geq 3$ or $x \leq -3$
 Range: $q(x) \geq 0$
 15 Domain: all real numbers
 Range: all real numbers
 17 D: all real numbers
 R: all real numbers
 21 (a) $2(1 - x)$
 (b) $2 - x$
 (c) x
 (d) $(1 - x)^2$
 (e) 0

- (f) $\sqrt{1 - x}$
 23 $(3x - 7)^3 + 1$
 25 Period in sec at time t
 27 26
 29 7
 31 $2x^2 + 5$
 33 $4x + 9$
 35 Interest rate for \$I interest; %/year
 37 D: all real numbers $\geq b$;
 R: all real numbers ≥ 6
 39 $f^{-1}(P) = (P + 2)/14$.
 41 Time, yrs, at which pop is P mil
 43 Rates of change: 4.35, 4.10, 3.80; Concave down
 45 8; 81



- 47
 49 (a) -22
 (b) $3 - a^2$
 (c) $-a^2 + 10a - 22$
 (d) $-a^2 - 2$
 (e) $-a^2 + 25$
 51 (a) $t = 6$
 (b) $t = 1, t = 2$
 53 (a) -1
 (b) $x = \pm 3$
 (c) 0
 (d) -1
 (e) 3, -3
 55 $g^{-1}(7) = 1, g^{-1}(12) = 2, g^{-1}(13) = 3,$
 $g^{-1}(19) = 4, g^{-1}(22) = 5$
 57 (a) $s = f(A) = +\sqrt{\frac{A}{6}}$
 (b) $V = g(f(A)) = \left(\sqrt{\frac{A}{6}}\right)^3$
 59 (a) $C(3.5) = \$6.25$
 (b) $C^{-1}(\$3.5) \approx 1.67$
 61 (a) $d/\sqrt{2}$
 (b) s^2
 (c) $d^2/2$
 (d) $h(d) = g(f(d))$
 63 (a) $(-2, 2)$
 (b) $(-2\sqrt{2}, -2), (2\sqrt{2}, -2)$
 (c)



- (d) -3

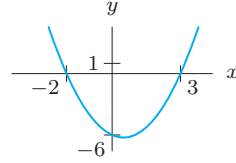
- 65 (a) $t(400) = 272$
 (d) $t(2x) = t(x)/2$
 69 $y = \sqrt{x-4} + 1/(x-8)$
 71 (a) Increasing until year 60, then decreasing
 (c) Appears concave up
 (d) Greatest between 40 and 60; smallest between 60 and 70
 (f) 1840; potato famine

Ch. 2 Understanding

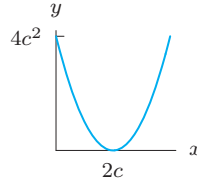
- 1 False
 3 False
 5 False
 7 False
 9 True
 11 True
 13 False
 15 False
 17 True
 19 True
 21 True
 23 False
 25 True
 27 True
 29 True
 31 True
 33 False
 35 True
 37 True
 39 True
 41 True

Section 3.1

- S1 $-200t$
 S3 $u(u-2)$
 S5 $(3x-4)(x+1)$
 S7 $(4x-1)(4x+1)$
 S9 $x = -6$ or $x = -1$
 1 Yes; $f(x) = 2x^2 - 28x + 99$
 3 Yes; $g(m) = -2m^2 + \sqrt{3}m + 42$
 5 Not quadratic
 7 Yes; $T(n) = (\sqrt{3} - 1/2)n^2 + \sqrt{5}$
 9 $x \approx -0.541$ and $x \approx 5.541$
 11 $x = 2, 3/2$
 13 $x = 2, x = -1$
 15 $x = (-1 \pm \sqrt{6})/5$
 17 No zeros
 19 $y = (7/4)(x-1)(x-4)$
 21 3 sec
 23 $f(x) = a(x-1)(x-2)$ for any constant a
 25 For example $y = (x+2)(x-3)$



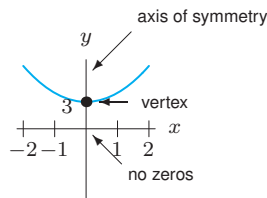
27



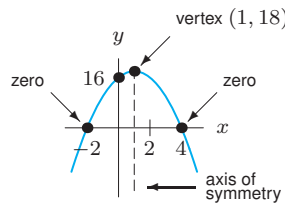
- 29 $y = -(5/12)x^2 - (5/3)x + 5$
 31 $k = -30, r = 8, s = 0.2$
 33 (a) 4 meters per second
 (b) 2 seconds
 (c) Concave up
 35 -2.4% in 2004
 37 (a) 5 km
 (b) 4430 m
 (c) $h \approx -0.000000255d^2 + 5$

Section 3.2

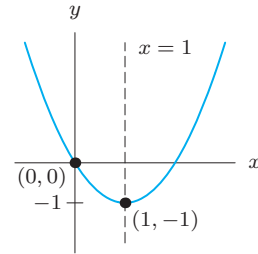
- S1 $(y-6)^2 - 36$
 S3 $(c+3/2)^2 - 37/4$
 S5 $r = 4, 2$
 S7 $q = 1/5 \pm \sqrt{41}/5$
 S9 $n = -5, 1$
 1 $(1, 2); x = 1$; opens upward
 3 Vertex: $(-11/2, -137/4)$
 Axis of symmetry: $t = -11/2$
 5 (a) $a = 1, b = 0, c = 3$
 Axis of symmetry: y -axis
 Vertex: $(0, 3)$
 No zeros
 y -intercept: $y = 3$



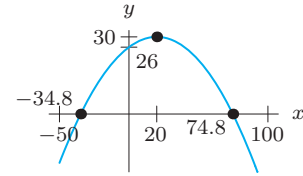
- (b) $a = -2, b = 4, c = 16$
 Axis of symmetry: $x = 1$
 Vertex: $(1, 18)$
 Zeros: $x = -2, 4$
 y -intercept: $y = 16$



- 7 $k = 4$
 9 $y = -(3/16)(x-4)^2 + 7$
 11 $y = \frac{7}{9}(x-3)^2 - 5$
 13 $f(x) = (x+4)^2 - 13$;
 Vertex: $(-4, -13)$; axis: $x = -4$
 15 $p(t) = 2(t - 0.03)^2 + 0.0982$, vertex
 $(0.03, 0.0982)$, axis of symmetry $t = 0.03$
 17 $(1/2)x^2 - (1/2)x - 6$;
 $(1/2)(x-1/2)^2 - (49/8)$;
 $(1/2)(x-4)(x+3)$
 19 $2s^2 - 7s - 15$;
 $2(s-7/4)^2 - (169/8)$;
 $2(s-5)(s+3/2)$
 21 $y = (1/4)(x-4)^2 + 2$
 23 $y = (-2/49)(x-4)^2 + 2$
 25 (a)



- (b) $y = (x-1)^2 - 1$ or $y = x^2 - 2x$
 (c) Range: $y \geq -1$
 (d) The other zero is $(2, 0)$
 27 Vertex: $(20, 30)$



- 29 12.5 cm by 12.5 cm; $k/4$ by $k/4$
 31 (b) Maximum height: $t = T/2$

Chapter 3 Review

- 1 $f(x) = -2x^2 + 13x - 15$; $a = -2, b = 13, c = -15$
 3 $w(n) = 3n^2 + 6n + 0$; $a = 3, b = 6, c = 0$
 5 $x = -1/3$
 7 No zeros
 9 2 and 5
 11 There are no real zeros
 13 $y = -3(x-1)^2 - 2$
 15 $(1/4)(x-7)^2 + 3$
 17 $y = 4(x+1)(x-2)$
 19 $y = (x+1)(x-3)$

- 21 $y = -(x - 2)^2$
 23 Vertex is $(3/4, -2/3)$, axis of symmetry is $x = 3/4$, y -intercept $y = 11/24$, concave up
 25 Vertex is $(0.6, 0)$, axis of symmetry is $x = 0.6$, y -intercept is $y = 0.36$, concave up
 27 $y = 0.3(x - 6)(x + 4)$, zeros at $x = 6$ and $x = -4$, vertex at $(1, -7.5)$
 29 $y = -3(x - 6)(x - 2)$, vertex is $(4, 12)$, zeros at $x = 6$ and $x = 2$
 31 Rates of change: $-4, 0, 4$; Concave up
 33 $1/2$ second

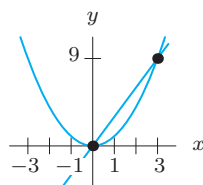
Ch. 3 Understanding

- 1 True
 3 False
 5 False
 7 False
 9 False
 11 True
 13 False
 15 True

Ch. 3 Skills: Factoring

- 1 $6x - 14$
 3 $12x + 12y$
 5 $2x^2 + 5x$
 7 $-50r^2 - 60r^2s$
 9 $5xz - 10z - 3x + 6$
 11 $x^2 + 4x - 12$
 13 $yz + 3y + z + 3$
 15 $5xz - 10z - 3x + 6$
 17 $x - 25$
 19 $Pp^2 - 6Ppq + 9Pq^2$
 21 $-2x - 2\sqrt{2x} - 1$
 23 $2(x + 3)$
 25 $5(z - 6)$
 27 $5(2w - 5)$
 29 $3u^2(u^5 + 4)$
 31 $7rs(2r^3s - 3t)$
 33 $(x - 2)(x - 1)$
 35 Cannot be factored
 37 Cannot be factored
 39 $(2x + 1)(x + 2)$
 41 $(x + 7)(x - 4)$
 43 $x(x + 3)(x - 1)$
 45 $(x + 2y)(x + 3z)$
 47 $(ax - b)(ax + b)$
 49 $(B - 6)(B - 4)$
 51 Cannot be factored.
 53 $(t - 1)(t + 7)$
 55 $(a - 2)(a^2 + 3)$
 57 $(d + 5)(d - 5)(c + 3)(c - 3)$
 59 $(r + 2)(r - s)$
 61 $xe^{-3x}(x + 2)$
 63 $P(1 + r)^3$

- 65 $(k + 2m)(d - 3e)$
 67 $(2g - 3h)(4s + 5m)$
 69 $x = (-3 \pm \sqrt{249})/8$
 71 $x = 7/4$
 73 $t = 3 \pm \sqrt{6}$
 75 $x = 2, x = -4/3$
 77 $N = 3, N = 1$
 79 $x = 1 \pm \sqrt{2}$
 81 $t = 3 \pm \sqrt{6}$
 83 $a = -10, \pm 2\sqrt{5}/5$
 85 $z = -7/2$
 87 $L = \pm 1/2$
 89 $r = \pm 5$
 91 $x = 0, x = 36$
 93 $x = -4/3, x = 2$
 95 $b = \sqrt[5]{C/A}$
 97 $x = 4m$
 99 $x = 1/2$ and $y = 2$, or $x = -1/2$ and $y = -2$
 101 $x = -3$ and $y = -5$, or $x = 1$ and $y = 3$
 103 $(0, 0)$ and $(3, 9)$



- 105 $(-5, 25), (3, 9)$

Ch. 3: Completing Square

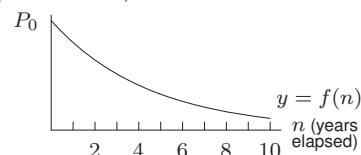
- 1 $(x + 4)^2 - 16$
 3 $2(r + 5)^2 - 50$
 5 $(a - 1)^2 - 5$
 7 $3(r + 3/2)^2 - 43/4$
 9 $(x - 1)^2 - 4$
 11 $-(x - 3)^2 + 7$
 13 $(-3, -6)$
 15 $(-4, 18)$
 17 $(1/2, -23/4)$
 19 $(1, -2)$
 21 $(7/4, -25/8)$
 23 $g = 6, -4$
 25 $d = 2, -1$
 27 $s = -5/2 \pm \sqrt{27}/2$
 29 $p = -9/10 \pm \sqrt{101}/10$
 31 $y = -1/2, -2$
 33 $w = (-1 \pm \sqrt{17})/2$
 35 $q = (-3 \pm \sqrt{15})/2$
 37 $s = (-3 \pm \sqrt{13})/2$
 39 $u = (3 \pm \sqrt{5})/5$

- 41 $y = 1 \pm \sqrt{7}$
 43 $w = 3, 2, -2$
 45 $m = (-5 \pm \sqrt{3})/7$

Section 4.1

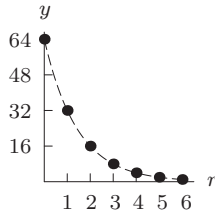
- S1 0.06
 S3 0.12%
 1 Yes; $g(w) = 2(1/2)^w$
 3 Yes; $f(x) = (1/4)9^x$
 5 Yes; $q(r) = -4(1/3)^r$
 7 Yes; $Q(t) = 2^t$
 9 Not exponential
 11 1.28 (per decade)
 13 0.20 (per century)
 15 $a = 34.3; b = 0.788; r = -21.2\%$
 17 $a = 0.0022; b = 0.0811; r = -91.89\%$
 19 \$109,272.70
 21 (a) (ii)
 (b) (i)
 (c) (iv)
 (d) (ii)
 (e) (iii)
 (f) (i)
 23 (a) $Q = 35(0.92)^t$
 (b) 15.204
 25 (a) $Q = 5.35(1.008)^t$
 (b) 5.794
 27 (a) $Q = 0.2(0.995)^t$
 (b) 0.190
 29 $P = 70(1.019)^t$
 31 $f(n) = P_0(0.8)^n$

P (number infected)



- 33 (a) $P = 7.50(1.035)^t$
 (b) $\approx \$14.92$
 35 (a) $C = 100(0.84)^t$
 (b) 41.821 mg
 37 (a) 14.026 m; 19.371 m
 (b) 2030-55 larger; graph concave up
 39 (a) $P = 1.15(1.0135)^t$
 (b) 1.230 billion; 1.315 billion
 (c) 15.525 million people per year
 (d) About 29 people per minute
 41 (a) 31,532 megawatts; 62.3 megawatts
 (b) 8.1%; 0.2%
 43 $5 \cdot 4^{-\frac{1}{8}t}$; $a = 5, k = -1/6$
 45 (a) $N = 13.4(1.05)^t$
 (b) 17.957 million; 11.024 million

47 (a) $N(r) = 64(1/2)^r$



- (b) 6
49 9.712%

- 51 (a) \$444 per month
(b) \$286.20 per month
(c) \$506.40 per month
(d) \$11,232
(e) \$23,112

53 366.875 miles

55 0.5

57 b_0

59 t_0 decreases

- 61 (a) $R = Nr$
(b) $A = R/P = Nr/P$
(c) $N_{\text{new}} = 1.02N$
 $r_{\text{new}} = 1.03r$
(d) $R_{\text{new}} = 1.0506R$; 5.06%
(e) $A_{\text{new}} = (0.9728)A$; average revenue falls by 2.7%

Section 4.2

S1 b^{10}

S3 $6a^7b^{10}$

S5 5.6; 6.354

S7 $x = 1.710$

S9 $x = 1.393$

- 1 (a) $p = 2.50 + 0.03t$
(b) $p = 2.50 - 0.07t$
(c) $p = 2.50(1.02)^t$
(d) $p = 2.50(0.96)^t$

3 B, C, D exponential

5 $Q = 70.711(0.966)^t$

7 $f(x) = 2(1/3)^x$

9 $Q = 0.7746 \cdot (0.3873)^t$

11 $y = 50(0.833)^x$

13 $y = 2(3/2)^x$

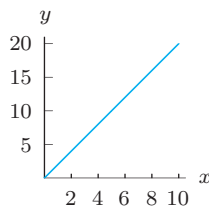
15 $y = 160(0.983)^x$

17 Not exponential

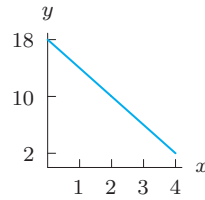
19 $g(t) = 5.7(0.315)^t$

21 f is exponential, h is linear, g is neither

- 23 (a) $g(x)$ is linear
(b) $g(x) = 2x$



- 25 (a) $i(x)$ is linear
(b) $i(x) = 18 - 4x$

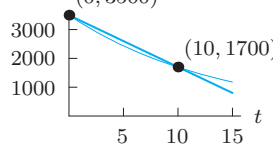


- 27 $x < -1.69$ and $x > 2$
29 $p = 20(1.0718)^x$; $q = 160(0.8706)^x$
31 Exponential,
 $R(t) = 2.001(1.030)^t$
33 (a) $P = 1154.160(1.20112)^t$
(b) \$1154.16
(c) 20.112%

35 $P = 1046(0.798)^t$; decreasing by 20.2%/yr

- 37 (a) $W = 43.45 - 0.126t$; 40.43 seconds
(b) $W = 43.45(0.997057)^t$; 40.48 seconds

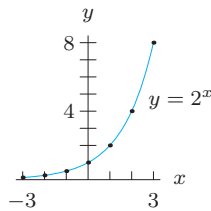
- 39 (a) $P = 3500 - 180t$; -180 fish/year
(b) $P = 3500(0.93)^t$; -7%/year
(c)



- 41 (a) Linear
(b) $L = 0.25t + 75.85$
(c) 88.35 years
43 (a) $N = 84 + 11.3684t$;
increasing by 11.3684 million people per year
(b) $N = 84(1.0693)^t$;
increasing by 6.93% per year
(c) Linear: 425.0520 million; Exponential: 626.9982 million
45 (a) Neither
(b) Not possible

Section 4.3

1 (b)



- 3 $h(x)$ top; $g(x)$ middle; $f(x)$ bottom
5 Yes
7 No
9 No

- 11 D
13 D
15 (a) 13 ft^3
(b) 3.2 weeks

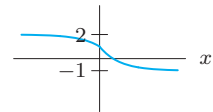
- 17 $q = 5.662$
19 $t = 2.452$

21 Zero

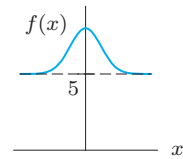
23



25



27



- 29 (a) $-\infty$
(b) $-\infty$

- 31 (a) All
(b) b
(c) b, a, c, p
(d) $a = c$
(e) d and q

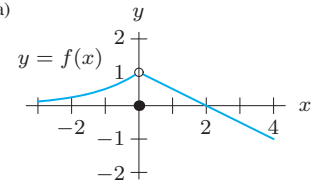
- 33 Increasing: $b > 1, a > 0$ or $0 < b < 1, a < 0$;
Decreasing: $0 < b < 1, a > 0$ or $b > 1, a < 0$;
Concave up: $a > 0, 0 < b < 0$ or $b > 1$.

35 y_0 decreases, $y_0 > b$

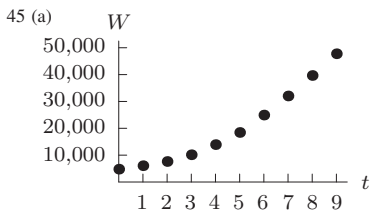
- 37 (a) $P = 651(0.9925)^t$
(b) 603,790
(c) $t = 22.39$

- 41 (a) $P \approx 0.538$ millibars
(b) $h \approx 0.784$ km

43 (a)



- (b) $f(x) < 1$
(c) $(0, 0)$ $(2, 0)$
(d) As $x \rightarrow +\infty, f(x) \rightarrow -\infty$
As $x \rightarrow -\infty, f(x) \rightarrow 0$
(e) Increasing for $x < 0$, decreasing for $x > 0$



- (b) $W = 4710(1.306)^t$; answers may vary
 (c) 30.6%/yr

Section 4.4

- 1 (a) 8.300%
 (b) 8.322%
 (c) 8.328%
- 3 165.3%
- 5 (a) \$1270.24
 (b) \$1271.01
 (c) \$1271.22
- 7 (a) \$505
 (b) \$505.02
 (c) \$505.03
- 9 (a) \$525
 (b) \$525.62
 (c) \$525.64
- 11 (a) Nom: 1% Eff: 1%
 (b) Nom: 1% Eff: 1.004%
 (c) Nom: 1% Eff: 1.005%
- 13 (a) Nom: 3% Eff: 3%
 (b) Nom: 3% Eff: 3.034%
 (c) Nom: 3% Eff: 3.045%
- 15 34.392%
- 17 7.352%
- 19 1.628%
- 21 (i) (b)
 (ii) (a)
 (iii) (c)
 (iv) (b), (c) and (d)
 (v) (a) and (e)

Section 4.5

- S1 1.073
 S3 1.433
 S5 2.3; 7.636
 S7 161.6; 202.027
 S9 $f(t) = 27e^{0.12t}$
 S11 $Q = 1,096.633e^{-3t}$
 S13 $m(x) = \frac{7}{\sqrt{3}}e^{-0.3x}$
 S15 $H(r) = \frac{1}{6}e^{0.65r}$
 1 Bottom to top:
 $y = e^x$, $y = 2e^x$, $y = 3e^x$
 3 (a)=(II); (b)=(III); (c)=(IV); (d)=(I)
 5 $f(x) = e^{-x}$
 $g(x) = e^x$
 $h(x) = -e^x$
 7 (a)=(I); (b)=(II); (c)=(III); (d)=(IV)
 9 0
- 11 2
 13 $a > 0$, $k > 0$
 15 (a) $Q_0 = 2.7$
 (b) Decreasing
 (c) -88%
 (d) Not continuous
 17 (a) $Q_0 = 0.01$
 (b) Decreasing
 (c) -20%
 (d) Continuous
 19 (a) $Q_0 = 1$
 (b) Increasing
 (c) 100%
 (d) Not continuous
 21 (a) $Q = 8(1.12)^t$; 24.847
 (b) $Q = 8e^{0.12t}$; 26.561
 23 (a) (i) 23.183
 (ii) 23.645
 (b) Continuous growth faster
 25 (a) $P = 3000 + 200t$
 (b) $P = 3000(1.06)^t$
 (c) $P = 3000e^{0.06t}$
 (d) $P = 3000 - 50t$
 (e) $P = 3000(0.96)^t$
 (f) $P = 3000e^{-0.04t}$
 27 (a) $P(t) = 22,000e^{0.071t}$
 (b) $\approx 7.358\%$
 31 54,931 years
 33 (a) \$24,102.64
 (b) 124,323 years
 35 Eff. yield: 20.925%
 Cont. rate: 19%
 37 5.127%
 39 (a) (i) 6.14%
 (ii) 6.17%
 (iii) 6.18%
 (iv) 6.18%
 (b) 1.0618
 The highest possible APR is 6.18%.
 41 From best to worst: B, C, A
 43 (a) $G = 145.8e^{0.051t}$
 (b) 5.23%
 (c) $G = 145.8(1.0523)^t$
 (d) The two formulas have the same graph
 45 \$143.70
 47 $a = b > 1$
 $0 < k < 1$
 $l < 0$
 49 (a) $A = 50e^{-0.14t}$
 (b) 12.330 mg
 (c) 2025
 51 \$27,399.14
 53 (a) 2.708333333
 (b) 2.718055556
 (c) 2.718281828; thus (a) is correct to 2 correct digits, while (b) is correct to 4 digits
 (d) 13 terms

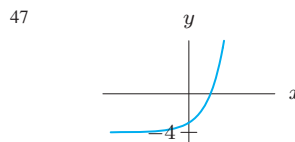
Chapter 4 Review

- 1 550
 3 495
 5 411.8

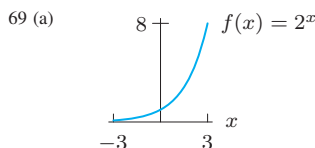
- 7 $P = 2200(0.968)^t$
 9 20%; 2%
 11 Linear: $p(r) = 10 + 3r$
 13 Neither
 15

Yr	2010	2011	2012	2013	2014
\$	95	101.65	108.77	116.38	124.53

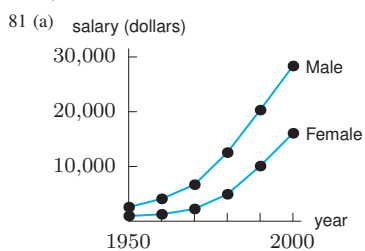
- 17 (a) 4.2%
 (b) $\approx 4.28\%$
 (c) $\approx 4.29\%$
 19 $h(x) = 3(5)^x$
 21 $g(x) = 2(4)^x$
 23 $g(x) = 14.20(0.6024)^x$
 25 (a) $f(x) = \frac{31}{8}x + \frac{49}{4}$
 (b) $f(x) = 5(2)^x$
 27 $y = (1/2)^x$
 29 $y = \frac{1}{5}(3)^x$
 31 $y = 2(0.8)^x$
 33 (a) $P(t) = 2.58 + 0.09t$,
 increases by 90,000 people per year
 (b) $P(t) = 2.68(1.026)^t$,
 increases by 2.6% per year
 35 0
 37 15
 39 $-\infty$
 41 $N = 10(1.13)^t$; 13%/yr
 43 (a) $S = 128.4(1.13)^t$
 (b) Increasing by 13%/yr
 (c) No



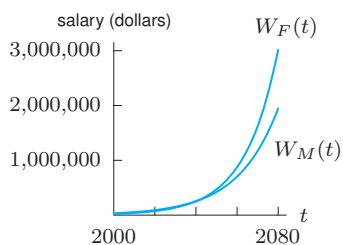
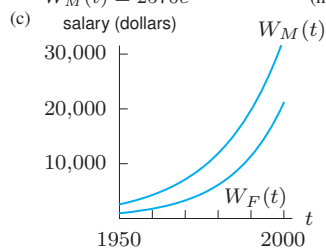
- 49 f
 51 $y = 2$
 55 (a) Initial balance = \$1100
 Effective yield = 5%
 (b) Initial balance = \$1500
 Effective yield $\approx 5.13\%$
 57 $p(x) = 7e^x \sqrt{e}/20$
 59 $s(w) = (v - 4t + kv)j^w$
 $a = v - 4t + kv$, $b = j$
 61 $g(n) = 1000(0.7071)^n$
 65 $d > b$
 67 f matches (ii) and (iv); g matches (i) and (iii)



- (b) 0.69
 (c) 1.10
 (d) $e \approx 2.72$
- 71 $V = 12,000e^{0.042t}$
 73 $y = -13.1x + 2090$
 75 $a = 12,000$; $k = -12.2\%$; $b = 0.8851$;
 $r = -11.49\%$
- 77 (a) $15,269(1.122)^t$
 (b) 108,066
 (c) Not useful
- 79 t_0 decreases



(b) $W_F(t) = 953e^{0.062(t-1950)}$ (women)
 $W_M(t) = 2570e^{0.051(t-1950)}$ (men)



- (d) Yes, in about 2060
 (e) Not reliable
- 83 50.7%
- Ch. 4 Understanding**
- 1 True
 3 True
- 5 False
 7 True
 9 True
 11 False
 13 False
 15 True
 17 True
 19 False
 21 True
 23 False
 25 True
 27 False
 29 True
 31 False

Ch. 4 Tools: Exponents

- 1 25
 3 10,000
 5 5
 7 1
 9 4
 11 4
 13 16
 15 -121
 17 2100
 19 2
 21 32
 23 100,000
 25 -6
 27 4
 29 $1/(3\sqrt{3})$
 31 $1/625$
 33 0.5
 35 y^4
 37 $x^{5/2}y^2$
 39 $5x^{3/2}z^2$
 41 $x^{3/2}$
 43 $8s^{7/2}$
 45 $4\sqrt{3}u^5v^6y^{5/2}$
 47 $16S^2xt^2$
 49 $A^3/(3B^3)$
 51 $(M+2)^2$
 53 $3a$
 55 $25(2b+1)^{20}$
 57 -8
 59 Not a real number
 61 $1/512$
 63 Not a real number
 65 $x = \pm 1.690$
 67 (2.5, 31.25)
 69 False
 71 True
 73 True
- 75 $x = r + s$
 77 $x = 5/a$
 79 $x = 3/a$
 81 $x = b/a$

Section 5.1

- S1 $x = 6$
 S3 $z = 3/2$
 S5 No solution
 S7 $t = 14/9$
 S9 $t = -1/8$
- 1 $19 = 10^{1.279}$
 3 $26 = e^{3.258}$
 5 $P = 10^t$
 7 $8 = \log 100,000,000$
 9 $v = \log \alpha$
- 11 (a) 3
 (b) 1.5
 (c) 0
 (d) $1/2$
 (e) 5
 (f) 2
 (g) $-1/2$
 (h) 100
 (i) 1
 (j) 0.01
- 13 $(\log 11)/(\log 2) = 3.459$
 15 $(\ln 100)/(0.12) = 38.376$
 17 $(\log(48/17))/(\log(2.3)) = 1.246$
- 19 (a) $2x$
 (b) x^3
 (c) $-3x$
- 21 (a) 3, 3
 (b) 5, 5
 (c) -1, -1
 (d) -1, -1
 (e) 2, 2
 (f) 3, 3
 Both answers equal
- 23 (a) True
 (b) False
 (c) False
 (d) True
 (e) True
 (f) False
- 25 $x = 57.002$
 27 $x = (a - \log M)/(\log N)$
 29 $x = 2.714$
- 31 (a) 10; 15%
 (b) $t \approx 10.5$
 (c) $t = (\ln 0.2)/(-0.15) = 10.730$
- 33 (a) $\log 15 - \log 5$
 (b) $2 \log 5$
 (c) $\log 15 + \log 5$
- 35 $(\log(91/46))/(\log(1.1))$
 37 $(\ln 6/0.044)$
 39 $x = \ln 10 - 4$
 41 $\log(35/2)/\log(2/27)$
 43 $t = \ln(500/400)/0.02$
 45 $\ln 10 - 4$

47 $(\ln Q - \ln P)/k$

49 $x = -2, \frac{1}{3}, \text{ or } -\frac{1}{3}$

51 $-2, 1/3, -1/3$

53 The log increases by 0.3010

55 $\log \sqrt{vw} = (\log v + \log w)/2$

57 $B > A$

Section 5.2

S1 $(5x)^{-1}$

S3 $t^2/2$

S5 $x = (\log 9)/(\log 4) = 1.585$

S7 $x = \ln(13/2) = 1.872$

S9 $x = 93/2$

1 $y = 25(1.0544)^t,$
5.44%/yr, 5.3%/yr

3 $y = 6000e^{-0.1625t},$
-15%/yr, -16.25%/yr

5 $Q = 4 \cdot 1096.633^t$

7 $Q = (14/5)1.030^t$

9 $Q = 12e^{-0.105t}$

11 $Q = 14e^{-0.208t}$

13 $a = 230, r = 18.2\%, k = 16.72\%$

15 $a = 0.81, r = 100\%, \text{ and } k = 69.31\%$

17 $a = 12.1, r = -22.38\%, k = -25.32\%$

19 $a = 5.4366, b = 0.4724, r =$
 $-52.76\%, k = -3/4$

21 $t \approx 3.466$

23 About 26 years

25 About 12.3 years

27 6.301 minutes

29 (a) 7.70%

(b) 6.18%

31 27.756 years

33 (a) 4.729%

(b) 4.621%

35 -34.7% per hour

37 23.1%/yr; $W = 90e^{0.231t}$

39 (a) 10; 30; and 70 yrs

(b) 14.207; 28.413; and 42.620 yrs

41 (a) 4 hours

(b) -17.3% per hour; $Q = 150e^{-0.173t}$

45 (a) 300; 600

(b) 34.739 years

47 (a) 27.465 years

(b) 28.011 years

49 (a) $R(t) \approx 200(0.8909)^t$ (b) ≈ 4.422 hours

(c) concave up

51 5092.013 years ago

53 (a) $f(x) = \frac{1}{2}(4)^x$

$g(x) = 4\left(\frac{1}{3}\right)^x$

$h(x) = x + 2$

(b) $x = \log 8 / \log 12$ (c) $x = 1.378$ or $x = -1.967$

57 (a) 20, 395, 954

(b) 5.615 years, 7.2 years

(c) 1000 toads

59 $t = -10 \ln(-2 \ln 0.5) = -3.266$

61 (a) $v = \log 1.12, w = \log 6.3$

(b) $t = w/v; t = 16.241$

Section 5.3

S1 -4

S3 $\log 100,000 = 5$

S5 $x = e^{-12}$

S7 $\ln x + 3 \ln(7 - x)$

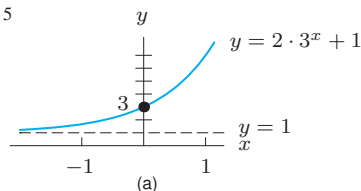
S9 $\ln x^5$

1 $y = 0, y = 0, x = 0$

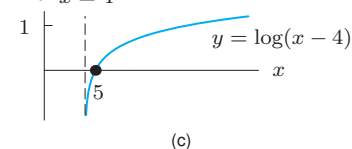
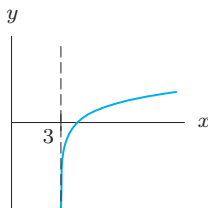
3 $A: y = 10^x, B: y = e^x$

$C: y = \ln x, D: y = \log x$

5



7 $y = x - 4$

9 Vertical asymptote at 3,
Domain $(3, \infty)$ 

11 (a) 0

(b) $-\infty$ 13 (a) $-\infty$ (b) $-\infty$

15 0.1 moles/l

17 3.162×10^{-5} moles/l21 (a) $t(x)$ (b) $r(x)$ (c) $s(x)$ 23 100 watts/cm²

25 37

27 79,432,823

29 $M_2 - M_1 = \log(W_2/W_1)$ 31 (a) $10^{-2}, 10^{-4}, 10^{-7}$

(b) Less

33 (a) 0.005 moles/liter

(b) 3.3×10^{-4} moles H⁺ ions
 1.987×10^{20} ions

35 $y = b^x, 0 < b < 1$

37 $y = \ln x$

39 $y = -b^x, b > 1$

Section 5.4

S1 1.455×10^6

S3 6.47×10^4

S5 3.6×10^{-4}

S7 $10^4 < \log 12,500 < 10^5$

S9 $10^{-1} < 1/3 < 10^0$

1 Log

3 Linear

7 (a) $y = -3582.145 + 236.314x; r \approx$
0.7946(b) $y = 4.797(1.221)^x; r \approx 0.9998$

(c) Exponential is better fit

9 $10^{-3.65}$ million years ago

11 A: \$1.58

B: \$6.31

C: \$31.62

D: \$630.96

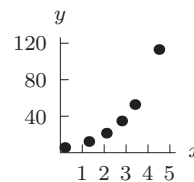
E: \$10,000.00

F: \$125,892.54

G: \$6,309,573.45

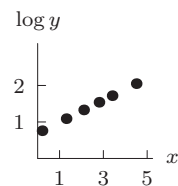
Answers are approximate.

17 (a)

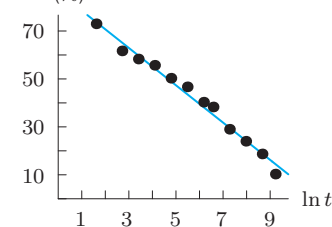


(b) Exponential

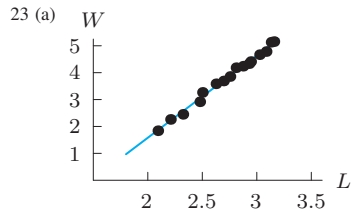
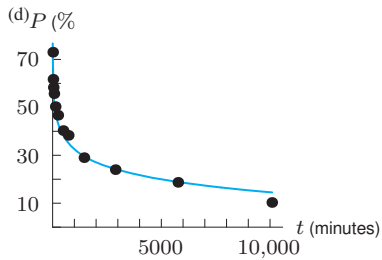
(c) Linear



19 Yes

21 (a) $a \approx -7.787, b \approx 86.283$ (b) P (%)

- (c) 69,918.342 minutes \approx 45 days
0.172 minutes \approx 10 seconds

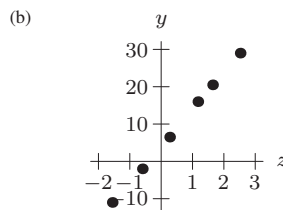
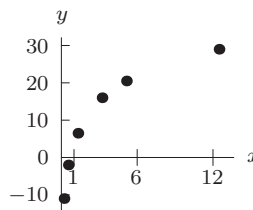


- (b) $W = 3.06L - 4.54$
(c) $w = 0.011t^{3.06}$

Chapter 5 Review

- 1 $Q = 7(0.0000454)^t$
3 $Q = 4e^{1.946t}$
5 $Q = 4e^{2.703t}$
7 $(\log 3)/(\log 1.04)$
9 $(\log(14/3))/(\log 1.081)$
11 $(\log(12/5))/(3 \log 1.014)$
13 $(\log 1.6)/(\log 1.031)$
15 47
17 2.324
19 $(1/0.049) \cdot \ln(25/13) \approx 13.345$
21 $x = 1000$
23 $2(x + 1)$
25 $\ln(AB)$
27 Domain: $x > 20$; Asymptote: $x = 20$
29 Domain: $x < 300$; Asymptote: $x = 300$
31 Domain: $x > -15$; Asymptote: $x = -15$
33 3.7
35 2.2
37 0.6
39 (a) $q + 4p$
(b) $-q$
(c) p/q
(d) $3q$
41 (a) $\ln 8 - 3 \approx -0.9206$
(b) $\log 1.25/\log 1.12 \approx 1.9690$
(c) $-\frac{\ln 4}{0.13} \approx -10.6638$
(d) 105
(e) $\frac{1}{3}e^{3/2} \approx 1.4939$
(f) $e^{1/2}/(e^{1/2} - 1) \approx 2.5415$
(g) -1.599 or 2.534
(h) 2.478 or 3
(i) 0.653

- 43 158.5 times larger
45 15.85 times larger
47 (a) Initial balance: \$1100
Effective yield: 5%
(b) Initial balance: \$1500
Effective rate: 5.127%/yr
(c) Continuous rate: 4.879%/yr
49 (a) 1412 bacteria
(b) 10.011 hours
(c) 1.005 hours
51 (a) 7 years
(b) 10.4%
53 $\ln(1.5)/0.2 = 2.027$
55 $t = (\ln 2)/0.22$
57 (a) Domain: all x
Range: $y > 0$
Asymptote: $y = 0$
(b) Domain: all $x > 0$
Range: all y
Asymptote: $x = 0$
59 (a) Log function



- (c) Linear; $y = 4 + 9.9z$
(d) $y = 4 + 9.9 \ln x$
(e) $x = 0.67e^{0.1y}$;
Exponential function of y
61 (a) $Q(t) = 2e^{-0.04t}$
(b) 3.921%
(c) After 51.986 hours
(d) 54.931 hrs after second injection
63 (a) $\approx 33.517\%$
(b) $k \approx 4.082\%$, continuous hourly decay rate
65 (a) 10
(b) 50
(c) 10^{50}
67 $\sqrt[8]{k}$

Ch. 5: Understanding

- 1 False
3 True
5 True
7 True

- 9 True
11 False
13 False
15 False
17 True
19 False
21 False
23 True
25 True
27 True
29 True
31 True
33 False
35 False
37 False

Ch. 5 Skills: Logs

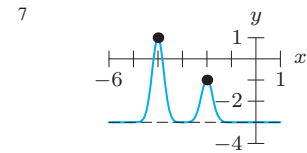
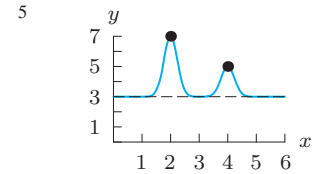
- 1 0
3 8
5 0
7 2
9 $\log 0.0001 = -4$
11 $\ln 0.135 = -2$
13 $10^{-2} = 0.01$
15 $e^{x^2} = 4$
17 Cannot be rewritten
19 $\log(x^2 + 1) - 3 \log x$
21 Cannot be rewritten
23 Cannot be rewritten
25 $\log 12x$
27 $\log(\sqrt{x}y^4)$
29 $\log((x+1)^3(x+4)^2)$
31 $\log(9 - x^2)$
33 Cannot be simplified
35 0
37 $4z$
39 $-\ln(e^x + 1)$
41 $x = (\log 3)/(\log 5) \approx 0.683$
43 $x = -(\ln 9)/5 \approx -0.439$
45 $x = (\log 77)/(6 \log 19 - 4 \log 7) \approx 0.440$
47 $x = (10^{3/2} - 17)/9 \approx 1.625$
49 $x = (e + 1)/6 \approx 0.620$

Section 6.1

- S1 2
S3 -1
S5 $x = 0$
S7 $x = -8$
S9 (a) Shift right 4 units
(b) Shift down 7 units
(c) Shift left $\sqrt{2}$ units
(d) Shift right 3 units and up 5 units
1 (a) $-3, 0, 2, 1, -1$
One unit right

- (b) $-3, 0, 2, 1, -1$
One unit left
- (c) $0, 3, 5, 4, 2$
Up three units
- (d) $0, 3, 5, 4, 2$
One right and three up

- 3 (a) $(3, 1)$
- (b) $(-2, -4)$
- (c) $(6, -6)$



11 $-50 \leq R(s) - 150 \leq 50$

13 $(1/2)n^2 + 1$

15 $(1/2)n^2 - 3.7$

17 $(1/2)n^2 + \sqrt{13}$

19 $(1/2)n^2 + 3n + 23/2$

21 $3^w - 3$

23 $3^w + 1.8$

25 $3^{w+2.1} - 1.3$

27 (a) (i) 248

(ii) 142

(iii) 4

(iv) 12

(v) 378

(vi) -18

(vii) 248

(viii) 570

(ix) 13

(b) (i) $x = 2$

(ii) $x = 8$

(iii) $x = 7$

(c) $x = 1, 4$

29 $y = f(x - 2) - 6$

31 (a) $g(x) + 3$

(b) $g(x - 2)$

33 (a) Population 100 people larger than original

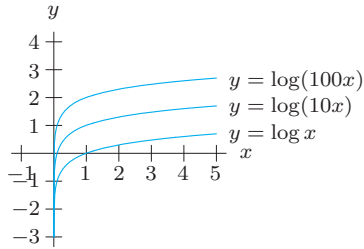
(b) Population same as 100 years earlier

35 Average for 7 mos, 10 mos

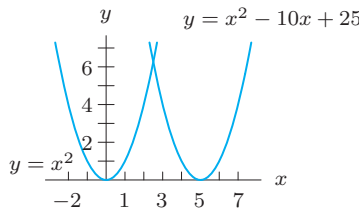
Above average

37 Up 1, right 3

39 Vertical shifts



41 Shift $y = x^2$ right by 5 units to get $y = (x - 5)^2 = x^2 - 10x + 25$



43 Shift up 3

45 Shift left 4

47 Shift left b , down a

49 (a) $T(d) = S(d) + 1$

(b) $P(d) = S(d - 1)$

51 $w(x) = v(x - 5) - 7; h = 5, k = -7$

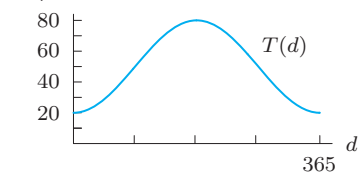
53 (a) $t(x) = 20 + 7x$ for $x \geq 0$

(b) $n(x) = t(x) + 5$

(c) $p(x) = t(x - 2) + 10$ for $x \geq 2$

55 (a)

Temperature, °F



57 $H(t) - 37$

Section 6.2

S1 20.086

S3 0.050

S5 (a) $f(-x) = 2x^2$

(b) $-f(x) = -2x^2$

S7 (a) $f(-x) = -2x^3 - 3$

(b) $-f(x) = -2x^3 + 3$

S9 (a) $f(-x) = 3x^4 + 2x$

(b) $-f(x) = -3x^4 + 2x$

1 (a) $(-2, -3)$

(b) $(2, 3)$

3 -7

5 Domain: $t < 0$

Range: $-4 \leq Q(-t) \leq 7$

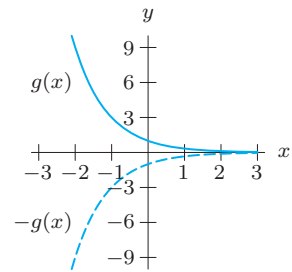
7 Domain: $t < 0$

Range: $-7 \leq -Q(-t) \leq 4$

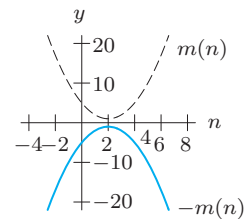
9 $y = -e^x$

13 Reflected across x -axis;

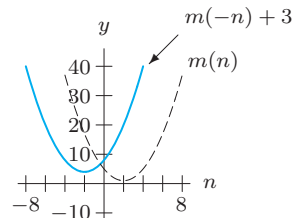
$-g(x) = -(1/3)^x$



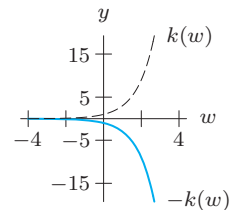
15 $-m(n) = -(n^2 + 4n - 5)$



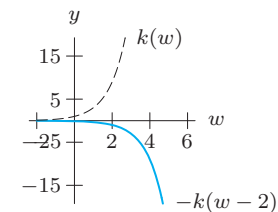
17 $m(-n) + 3 = n^2 + 4n + 8$



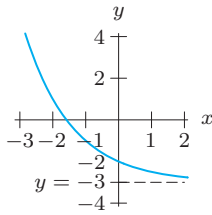
19 $-k(w) = -3^w$



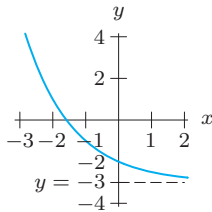
21 $-k(w - 2) = -3^{w-2}$



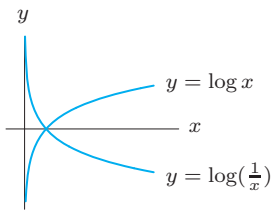
- 23 Odd
 25 Neither
 27 (a) $y = 2^{-x} - 3$



- (b) $y = 2^{-x} - 3$

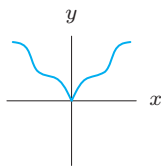


- (c) Yes
 29 (a) $g(-x) = -\sqrt[3]{x}$
 (c) Odd
 31 Reflections across x -axis

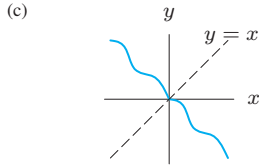
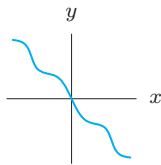


- 33 (i) b
 (ii) c
 (iii) d
 (iv) e
 (v) a

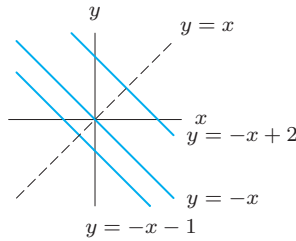
- 35 (a)



- (b)



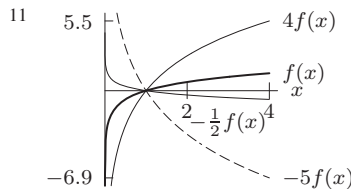
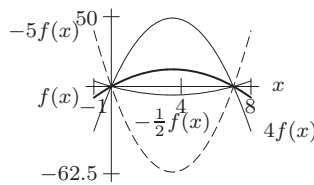
- 37 (a) Odd
 (b) Unless $f(x) = 0$ or $g(x) = 0$, $k(x)$ is neither.
 (c) Even
 39 $y = x$, $y = -x + b$, where b is an arbitrary constant



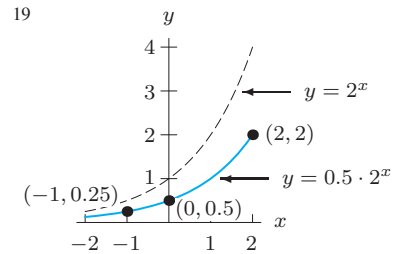
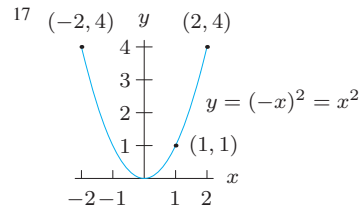
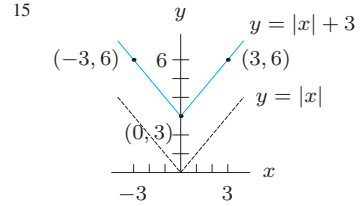
- 43 No
 45 If $f(x)$ is odd, then $f(0) = 0$
 49 Yes, $f(x) = 0$

Section 6.3

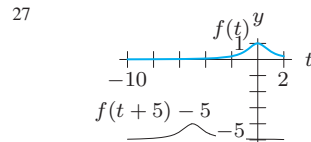
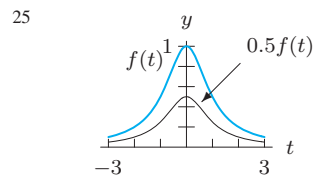
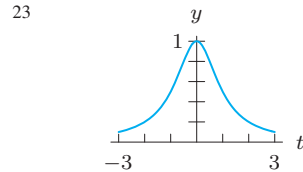
- S1 (a) 72
 (b) -18
 (c) 177
 (d) $25/4$
 S3 (a) $-(1/3)f(x) = -(1/3)\sqrt{x}$
 (b) $5f(-x) = 5\sqrt{-x}$
 (c) $6f(x-8) = 6\sqrt{x-8}$
 (d) $(1/4)f(2-x) = (1/4)\sqrt{2-x}$
 1 $y = 10f(x-2)$
 3 $-0.25 \leq 0.25C(x) \leq 0.25$
 5 $R(n) = -5P(n)$
 7 $T(n) = 1/4P(n+7)$
 9



- 13 (d) All three



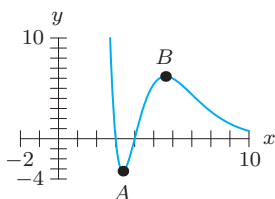
- 21 Stretch vertically by a factor of 2, Shift left 1 unit



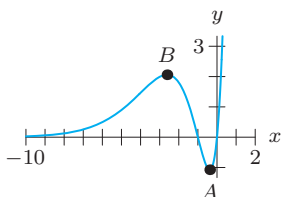
- 29 I is (b)
 II is (d)
 III is (c)
 IV is (h)

31 $1.3C(t)$

33



35



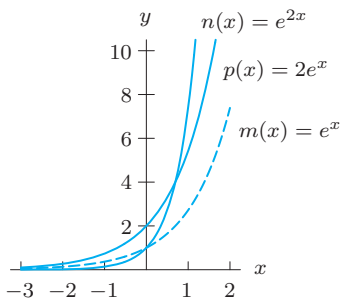
- 37 (a) $h(x) = 1/2f(x)$
 (b) $k(x) = f(-x)$
 (c) $m(x) = f(x) - 4$
 39 (a) $y = -2f(x)$
 (b) $y = f(x) + 2$
 (c) $y = 3f(x - 2)$

43 -7

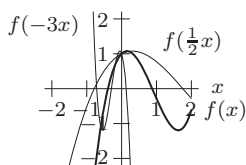
Section 6.4

- S1 $8x^3 - 5$
 S3 $(-x^3)/27 - 5$
 S5 $4e^{2t}$
 S7 $4e^{12t} + 11$
 1 (1, 3)
 3 Same function values for $x = -6, -4, -2, 0, 2, 4, 6$

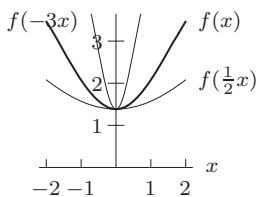
5



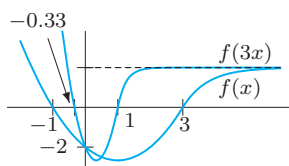
7



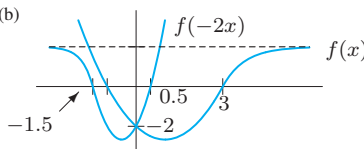
9



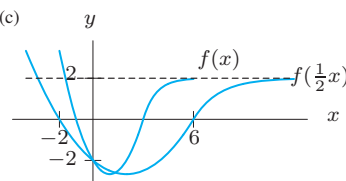
11 (a)



(b)

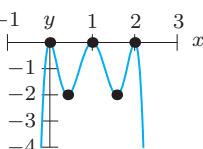


(c)



- 13 (a) Domain: $-6 \leq x \leq 6$;
 Range: $0 \leq l(2x) \leq 3$
 (b) Domain: $-24 \leq x \leq 24$;
 Range: $0 \leq l((1/2)x) \leq 3$

15



17 $T(1000x)$

19 (a) $A(s/60)$

(b) $A(60h)$

21 $r(t)$: half the level
 $s(t)$: half the rate

23 (a) III

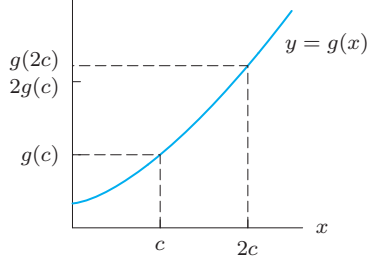
(b) II

(c) I

(d) IV

25 $y = -f(-1/2x)$

27 y



- 29 (a) $-24 \leq x \leq 8$
 (b) $-3/4$

- 31 (a) $-2 \leq x \leq 6$
 (b) 3

Section 6.5

S1 -3

S3 $10/3$

- S5 (a) -1
 (b) $8\sqrt[3]{-2}$
 (c) 5
 (d) -16
 (e) $-2\sqrt[3]{2}$
 (f) $\sqrt[3]{5}$

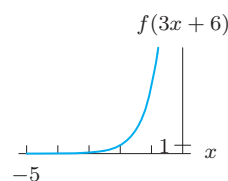
S7 $A = 1, B = -2, h = 0, k = 9$

S9 $A = 6, B = -1/3, h = -27, k = 0$

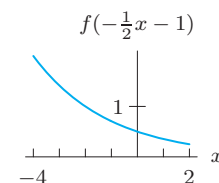
1 A horizontal compression by a factor of $1/3$ and then a horizontal shift right by $2/3$ units.

- 3 (a) (3, -14)
 (b) (6, -26)
 (c) (18, 17)
 (d) $(-33, -25/2)$

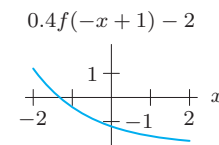
7 (a)



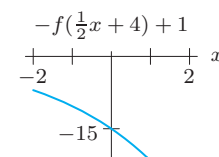
(b)



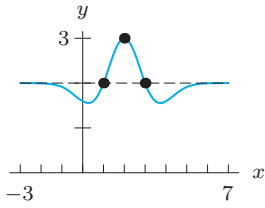
(c)



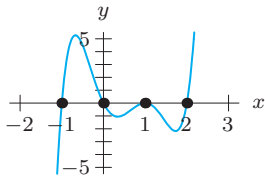
(d)



9

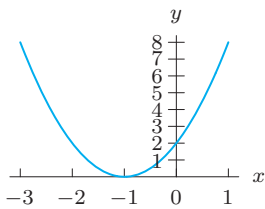


11

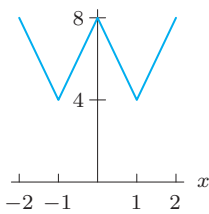


13 $t = -2.5, y = 5$

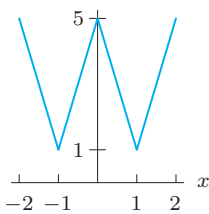
15



17 (a)



(b)



(c) The graphs are not the same.

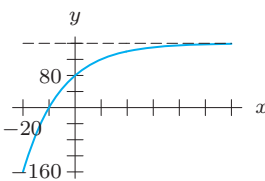
19 No; down 10 units

21 $g(x) = -3f(x + 4) + 6$

23 $h(x) = -2f(-x + 3) - 4$

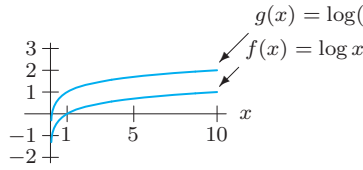
25 $(-9, 7), (3, 0), (39, -4)$

27



29 All four transformations are equivalent.

31 (a) +1



(b) $\log(10x) = 1 + \log x$

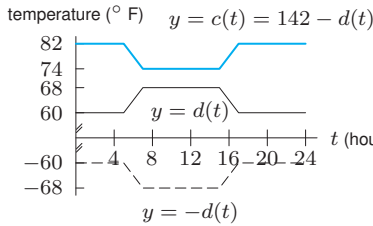
(c) $k = \log a$

33 A vertical compression by a factor of e^{-k} .

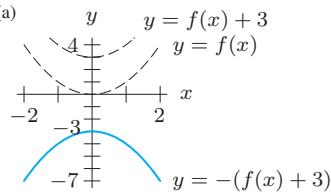
35 (a) Vertical; stretch by 2, shift by 8

(b) Vertical; shift by 4, stretch by 2

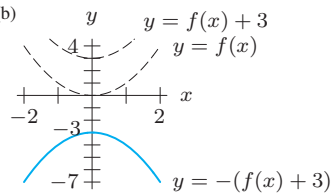
37 (b) $d(t)$ reflected about the t -axis and then raised 142



39 (a)



(b)



41 (a) $y = mx, m > 1$

(b) $y = mx + b, m > 1$ and b an arbitrary constant

43 Yes; $g(x) = (rb + j) + (rms) \cdot x, B = rb + j, M = rms$

45 Yes; $g(x) = (ras^2) \cdot (x - h/s)^2 + (rk + j), A = ras^2, H = h/s, K = rk + j$

Chapter 6 Review

1 (a) 4

(b) 1

(c) 5

(d) -2

3 (a) (6, 5)

(b) (2, 1)

(c) (1/2, 5)

(d) (2, 20)

5 Odd

7 Neither

9 Even

11 (a) $f(2x) = 1 - 2x$

(b) $f(x + 1) = -x$

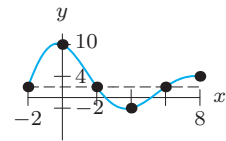
(c) $f(1 - x) = x$

(d) $f(x^2) = 1 - x^2$

(e) $f(1/x) = (x - 1)/x$

(f) $f(\sqrt{x}) = 1 - \sqrt{x}$

13



15 $y = f(t + 4) - 8$

17 (a) A horizontal reflection about the y -axis.

(b) A horizontal shift 6 units to the right.

19 (a) VI

(b) V

(c) III

(d) IV

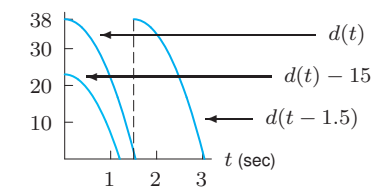
(e) I

(f) II

21 (a) $-16t^2 + 23$

$-16t^2 + 48t + 2$

(b) height (feet)



(d) 1.541 secs

1.199 secs

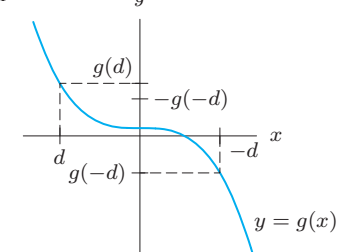
(e) 3.041 secs

23 $y = -(x + 1)^3 + 1$

25 $y = (1/2)h(x + 6) + 1$

27 $p \approx 15, q \approx 7190$

31



- 33 $y = 3h(x)$
 35 $y = -h(2 - 2x)$
 37 $y = 2f(x/2) + 3$

41

d	20	45	70	95
$h(d)$	5.5	5.2	5.1	5.1
d	120	145	170	195
$h(d)$	5.3	5.5	5.75	6

43

d	25	50	75	100
$n(d)$	8.25	7.8	7.65	7.65
d	125	150	175	200
$n(d)$	7.95	8.25	8.63	9

45

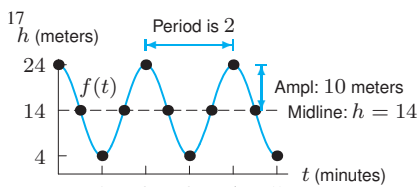
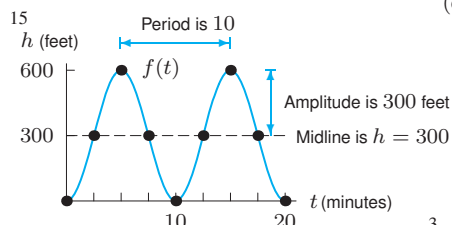
d	25	50	75	100
$q(d)$	10.25	9.8	9.65	9.65
d	125	150	175	200
$q(d)$	9.95	10.25	10.63	11

Ch. 6: Understanding

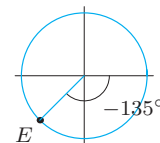
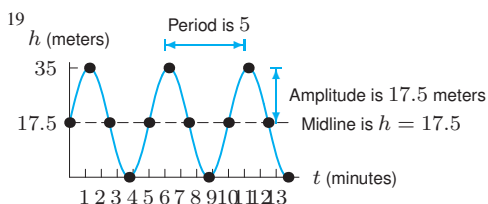
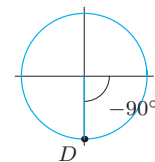
- 1 True
 3 True
 5 True
 7 False
 9 True
 11 False
 13 False
 15 True
 17 True
 19 False
 21 False
 23 True

Section 7.1

- 1 (I), (II), (IV)
 3 90 m
 5 90 m
 7 b
 9 41
 11 12 o'clock position; 165 m
 13 6 o'clock position; 15 m



- 5 $D = (0, -1)$, $E = (-0.707, -0.707)$,
 $F = (-0.707, 0.707)$



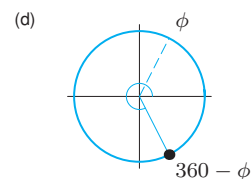
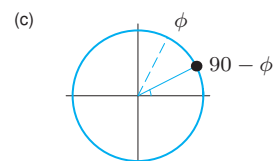
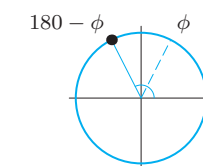
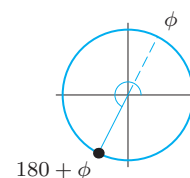
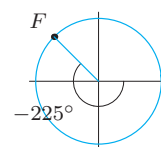
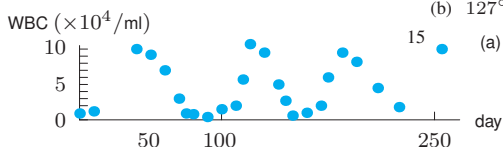
- 21 12 o'clock; descending; 4 minutes;
 30 meters; 5 meters; 10 minutes

- 23 3 (or 9) o'clock; descending;
 5 minutes; 40 meters; 0 meters;
 11.25 minutes

- 27 (a) Weight B
 (b) Weight A
 (c) Weight A

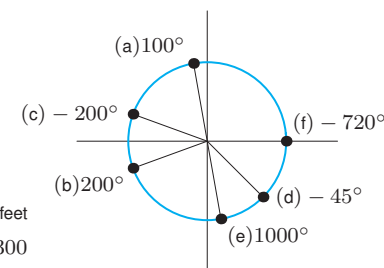
- 29 Midline: $y = 5.55$;
 Amplitude: $5.15 \text{ WBC} \times 10^4 / \text{mL}$;
 Period: 72 days

- 7 (a) 0.923
 (b) 0.385
 9 (a) 0.447
 (b) 0.894
 13 (a) 307°
 (b) 127°



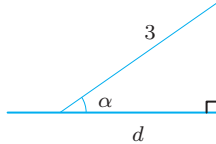
Section 7.2

- 1 (a) $(-0.174, 0.985)$
 (b) $(-0.940, -0.342)$
 (c) $(-0.940, 0.342)$
 (d) $(0.707, -0.707)$
 (e) $(0.174, -0.985)$
 (f) $(1, 0)$

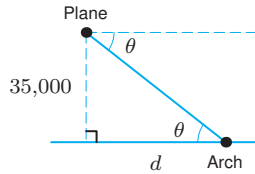


- 3 -720°

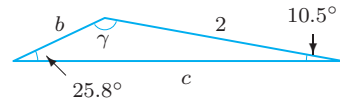
- 19 (a) 72°
 (b) 180°
 (c) 216°
 21 (a) All are equal
 (b) $KP = 1/2$
 (c) $OP = \sqrt{3}/2$
 (d) $(\sqrt{3}/2, 1/2)$
 (e) $\cos 30^\circ = \sqrt{3}/2$;
 $\sin 30^\circ = 1/2$
 (f) $\cos 60^\circ = 1/2$;
 $\sin 60^\circ = \sqrt{3}/2$
 23 $d = 3 \cos \alpha$ meters



- (c) $\sqrt{117}/2$
 11 $r = 7 \sin 17^\circ$; $q = 7 \cos 17^\circ$
 13 $r = 6/\cos 37^\circ$; $q = 6 \tan 37^\circ$
 15 $r = 9/\tan 77^\circ$; $q = 9/\sin 77^\circ$
 17 0
 19 Undefined
 21 1
 23 0
 25 $h = 400$ feet; $x = 346.410$ feet
 27 $d = 35000/\tan \theta$ feet



- 9 $A = 25.922^\circ$, $B = 37.735^\circ$, $C = 116.343^\circ$
 11 $b = 31.762$, $A = 38.458^\circ$, $C = 60.542^\circ$
 13 $c = 10.954$, $A = 54.010^\circ$, $B = 45.990^\circ$
 15 $c = 7.2605$; $A = 21.4035^\circ$; $B = 126.597^\circ$
 17 $a = 15.860$, $b = 2.569$, $C = 66^\circ$
 19 $a = 10.026$, $b = 6.885$, $C = 61^\circ$
 21 $a = 2.079$, $b = 3.090$, $B = 18^\circ$
 23 $a = 1.671$, $b = 4.639$, $B = 166^\circ$
 25 $a = 13.667$, $A = 90.984^\circ$, $C = 17.016^\circ$
 27 $a = 12.070$, $A = 135.109^\circ$, $C = 27.891^\circ$
 or
 $a = 3.231$, $A = 10.891^\circ$, $C = 152.109^\circ$
 29 $b = 0.837$ m, $c = 2.720$ m; $\gamma = 143.7^\circ$



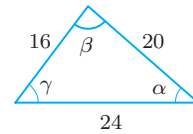
Section 7.3

- 1 Mid: $y = 2$; Amp: 1
 3 Mid: $y = -3$; Amp: 7
 5 Mid: $i(t) = 223$ cm; Amp: 20 cm
 7 (0, 3.8)
 9 (-3.8, 0)
 11 (0, 3.8)
 13 (3.687, -0.919)
 15 $(3.8\sqrt{2}/2, 3.8\sqrt{2}/2)$ or $(2.687, 2.687)$
 17 $(-3.8\sqrt{2}/2, -3.8\sqrt{2}/2)$
 $(-2.687, -2.687)$
 19 (3.742, -0.660)
 21 $(-5\sqrt{3}, -5)$
 23 period 50, midline $y = 12$, amplitude 5
 25 period 24, midline $y = -500$, amplitude 2000
 27 period 25, midline $y = 30$, amplitude 25
 29 $g(x) = \cos x$, $a = 90^\circ$, $b = 1$
 33 $f(x) = \sin(x + 90^\circ)$
 $g(x) = \sin(x - 90^\circ)$
 35 (60, 0), (7.5, 0)
 $(60 \cos \theta, 60 \sin \theta)$
 $(7.5 \cos \theta, 7.5 \sin \theta)$
 37 $h(\theta) = 2.5 + 2.5 \sin \theta$.

29 $d \approx 15.877$ feet

Section 7.5

- 1 61.164°
 3 7.012°
 5 no solution
 7 89.190°
 9 $\theta = 60^\circ$
 11 $\theta = 60^\circ$
 13 $\theta = 45^\circ$
 15 $c = 34.409$; $A = 35.538^\circ$, $B = 54.462^\circ$
 17 $B = 62^\circ$; $a = 9.389$; $b = 17.659$
 19 The angle is k ; a represents the value
 21 The angle is c ; the value is $1/d$
 23 The angle is n ; the value is p
 25 (a) 0.009
 (b) 30°
 (c) 114.593
 27 (a) $\sqrt{2} + 1$
 (b) $2\sqrt{2} + 1$
 (c) 90.008°
 29 $\theta = 33.557^\circ$
 31 No solution
 33 9°
 35 30°
 37 15.859°
 39 39.806°
 41 $\approx 39.806^\circ$
 43 (a) $a = 4$; $c = 2$; $B = 60^\circ$
 (b) $A \approx 73.740^\circ$; $B \approx 16.260^\circ$; $b = 7$
 31 $\alpha \approx 41.410^\circ$, $\beta \approx 82.819^\circ$, $\gamma \approx 55.771^\circ$



- 33 (a) $\sin \theta = 0.282$
 (b) $\theta \approx 16.374^\circ$
 (c) 12.077 cm^2
 35 B closer by 2.387 miles
 37 396.004 miles
 39 (18.876, 10.071)
 43 (a) First; 3.062 feet closer
 (b) 157.279 feet to home
 113.218 feet to third
 45 158.926 feet
 47 4 rolls

Section 7.4

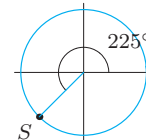
- 1 0, 1, 0
 3 (a) $\tan \theta = 2$
 (b) $\sin \theta = 2/\sqrt{5}$
 (c) $\cos \theta = 1/\sqrt{5}$
 5 (a) $\sqrt{45}/7$
 (b) $2/7$
 (c) $\sqrt{45}/2$
 7 (a) $8/12$
 (b) $\sqrt{80}/12$
 (c) $8/\sqrt{80}$
 9 (a) $\sqrt{117}/11$
 (b) $2/11$

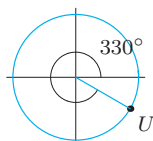
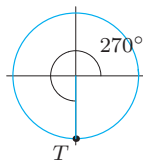
Section 7.6

- 1 $x \approx 19.121$
 3 $b \approx 5.120$, $c \approx 6.497$; $\beta = 52^\circ$
 5 $a \approx 11.818$, $b \approx 2.084$; $\theta = 80^\circ$
 7 $a = 10.450$; $\theta = 16.560^\circ$, $\psi = 143.440^\circ$

Chapter 7 Review

- 1 Yes
 3 No
 5 No
 7 Yes
 9 $S = (-0.707, -0.707)$, $T = (0, -1)$,
 $U = (0.866, -0.5)$





- 11 $S = (-3.536, -3.536)$
 $T = (0, -5)$
 $U = (4.330, -2.5)$
- 13 $(4.944, -15.217)$
- 15 44.971°
- 17 59.036°
- 19 $\theta = 30^\circ$
- 21 $\theta = 45^\circ$
- 23 Angle is y ; value is x
- 25 Angle is d ; value is $1/c$
- 27 (a) 30°
 (b) -30°
 (c) 150°
- 29 (i) is B ; (ii) is C ; (iii) is A
- 31 Period: 6; Amp: 5; Mid: $y = 0$
- 33 Midline: $h = 2$;
 Amplitude: 1;
 Period: 1
- 35 419.856 feet
- 37 $\phi = 53.130^\circ$; $\theta = 36.870^\circ$
- 39 5; 67.380°, 22.620°
- 41 $\theta \approx 22.620^\circ$
- 43 Approximately 80 meters
- 45 $h = 200 \tan \theta$

Ch. 7: Understanding

- 1 True
 3 True
 5 True
 7 True
 9 False
 11 False
 13 False
 15 True
 17 False
 19 False
 21 True
 23 False
 25 True
 27 True

Ch. 7 Skills: Special Angles

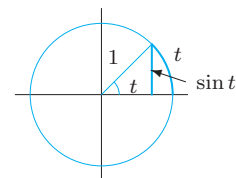
- 1 $1/2$
 3 $-\sqrt{3}/2$
 5 $1/2$
 7 $\sqrt{3}/2$
 9 $1/\sqrt{2}$
 11 $-\sqrt{3}/2$
 13 $1/\sqrt{2}$
 15 $-1/\sqrt{2}$
 17 $-\sqrt{3}/2$
 19 They are equal
 21 5
 23 $20/\sqrt{3}$
 25 5, 5, $5\sqrt{2}$
 27 $7/\sqrt{2}, 7/\sqrt{2}, 7$
 29 $45^\circ-45^\circ-90^\circ, 4\sqrt{2}$
 31 $(3\sqrt{2}, -3\sqrt{2})$

Section 8.1

- 1 $\pi/3$
 3 1.7453 radians
 5 $5\pi/6$
 7 $-3\pi/2$
 9 630°
 11 $16,200/\pi \approx 5156.620^\circ$
 13 $8100/\pi \approx 2578.310^\circ$
- 15 (a) I
 (b) II
 (c) II
 (d) III
 (e) IV
 (f) IV
 (g) I
 (h) II
 (i) II
 (j) III
- 17 -4π
- 19 8.54π
- 21 $6.2\pi/4 \approx 4.869$
- 23 $6.2a\pi/180$
- 25 (a) $\sqrt{3}/2$
 (b) $-1/\sqrt{2}$
 (c) 1
 (d) $\sqrt{3}/2$
- 27 5π feet
- 29 $\pi/9$ radians or 20°
- 31 $r = \sqrt{65}$; $\theta = 0.5191 \text{ rad} = 29.7449^\circ$;
 $s = 4.185$; $P = (7, 4)$
- 33 $r = 12$; $\theta = 1.3 \text{ rad} = 74.485^\circ$;
 $s = 15.6$; $P = (3.2100, 11.5627)$
- 35 $\theta = 0.4 \text{ rad} = 22.918^\circ$; $P = (0.9211r, 0.3894r)$
- 37 (a) Negative
 (b) Negative
 (c) Positive
 (d) Positive
- 39 $\sin \theta = 0.6$;

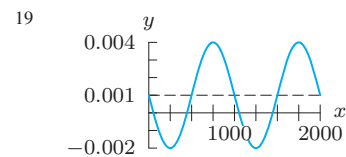
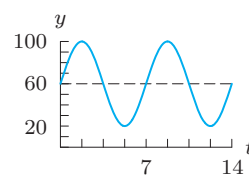
$$\cos \theta = -0.8$$

- 41 $(-0.99, 0.14)$
- 43 $m = 5 \cos(4/5)$
 $n = 5 \sin(4/5)$
 $p = 5\sqrt{2(1 - \cos(4/5))}$
- 45 (a) 1718.873°
 (b) 0.00914 radians
- 47 7π inches
- 49 t

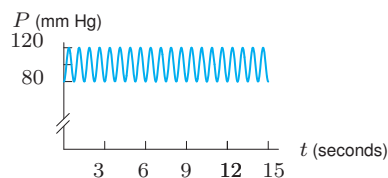


Section 8.2

- 1 Mid: $y = 0$; Amp: 6; Per: 2π
- 3 Mid: $y = 1$; Amp: $1/2$; Per: $\pi/4$
- 5 Hor: $-4/3$; Phs: -4
- 7 Both f and g have periods of 1, amplitudes of 1, and midlines $y = 0$
- 9 $h(t) = 4 \sin(2\pi t)$
- 11 $g(t) = -2 \cos(t/2) + 2$
- 13 $y = 4000 + 4000 \sin((2\pi/60)x)$
- 15 $y = -2 \sin(\pi\theta/6) + 2$
- 17



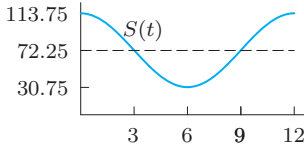
- 21 $f(x) = \sin x$, $a = \pi/2$, $b = \pi$,
 $c = 3\pi/2$, $d = 2\pi$, $e = 1$
- 23 Amplitude: 20
 Period: $3/4$ seconds



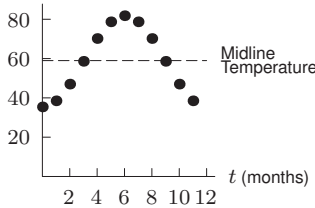
- 25 $3/10$, $g(x) = 10 \sin((\pi/5)x - 3\pi/5)$

- 27 $f(t) = 14 + 10 \sin(\pi t + \pi/2)$
 29 $f(t) = 20 + 15 \sin((\pi/2)t + \pi/2)$
 31 (a) $12^\circ/\text{min}$
 (b) $\theta = (12t - 90)^\circ$
 (c) $f(t) = 225 + 225 \sin(12t - 90)^\circ$
 (d) Amp = Midline = 225 feet
 Period = 30 min
 33 (a) $P = f(t) = -450 \cos(\pi t/6) + 1750$
 (c) $t_1 \approx 1.9; t_2 \approx 10.1$
 35 $y = 3f(x)$
 37 $y = -f(2x)$
 39 Amplitude: 41.5;
 Period: 12 months

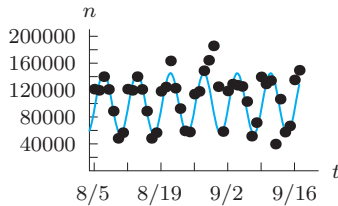
blanket sales (thousands)



- 41 $f(t) = -100 \cos(\pi t) + 100$ (for $0 \leq t \leq 1$)
 $10 \cos(4\pi t) + 190$ (for $1 < t \leq 2$)
 43 (a) $T(^\circ F)$



- (b) $23.2^\circ; 12$ months
 (c) $T = f(t) = -23.2 \cos((\pi/6)t) + 58.6$
 (d) $T = f(9) \approx 58.6^\circ$
 45 (a) Not exactly regular
 (b) Usage repeats each week
 (c) $n = 45,000 \cos(2\pi(t - 2)/7) + 100,000$



Section 8.3

1 1

- 3 $-\sqrt{3}$
 5 $-1/\sqrt{3}$
 7 $-1/\sqrt{3}$
 9 $2/\sqrt{3}$
 11 $(\cos(2\theta))^2 + (\sin(2\theta))^2 = 1$
 13 1
 15 $\cos t$
 17 1
 19 (a) $(-x, -y)$
 21 $\sec \theta = 2$
 $\tan \theta = \sqrt{3}$
 23 $\sec \theta = 3/\sqrt{8}$
 $\tan \theta = 1/\sqrt{8}$
 25 $f(\theta) = (1/2) \tan \theta$
 27 $\cos \theta = \sqrt{1 - y^2}$
 29 (a) $\sin \phi = -0.8866, \tan \phi = -1.9166$
 (b) $\cos \theta = -0.8062, \tan \theta = 0.7339$
 31 $\cos \theta = \sqrt{9 - x^2}/3,$
 $\tan \theta = x/\sqrt{9 - x^2}$
 33 $\sin \theta = \sqrt{4 - x^2}/2,$
 $\tan \theta = \sqrt{4 - x^2}/x$
 35 (a) (i) Is identity
 (ii) Not identity
 (b) Three
 37 (a) $\dots, -3\pi/2, -\pi/2, \pi/2, 3\pi/2, \dots;$
 It has t -intercepts.
 (b) $\dots, -2\pi, -\pi, 0, \pi, 2\pi, \dots;$
 It has t -intercepts.

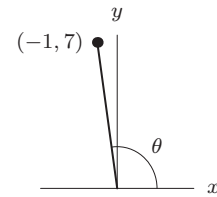
Section 8.4

- 1 1.570
 3 1.330
 5 -1.447
 7 $\theta = 0.708, 2.434$
 9 $t = 1.813, 4.473$
 11 (a) 1.88, 4.41
 (b) 1.88, 4.41
 13 $\pm 1.159, \pm 5.124, \pm 7.442, 11.407, 13.725$
 15 $\pi/6, 5\pi/6$
 17 $\pi/3, 5\pi/3$
 19 $3\pi/4, 7\pi/4$
 21 $0, \pi, 2\pi$
 23 0.340, 2.802
 25 0.152, 1.418, 3.294, 4.560
 27 1.914, 4.653
 29 (a) $65^\circ, 295^\circ$
 (b) $65^\circ, 245^\circ, 425^\circ, 605^\circ$
 31 0.305, 2.837
 33 4.069, 5.356, 10.352, 11.639
 35 $\theta = \pi/6 + 2\pi k, 11\pi/6 + 2\pi k, k$ an integer
 37 $\theta \approx 1.893$
 39 $t = \pi/6, 5\pi/6, 7\pi/6, \text{ or } 11\pi/6$
 41 $t = \pi/2, 3\pi/2, \pi/6, \text{ or } 5\pi/6$

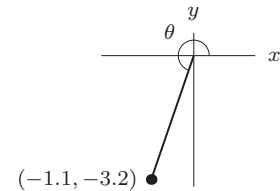
- 43 (a) $f(t) = 40,000 \cos(\frac{\pi}{6}t + \frac{\pi}{6}) + 60,000$
 (b) $f(3) = \$40,000$
 (c) Mid-March and mid-September
 45 $P: x \approx 0.819;$
 $Q: x \approx 3.181$
 47 (a) $\pi/3$
 (b) π
 (c) ≈ 0.1
 49 (a) $t_1 \approx 0.161$ and $t_2 \approx 0.625.$
 (b) $t_1 = \arcsin(3/5)/4$ and
 $t_2 = \pi/4 - \arcsin(3/5)/4$
 51 (a) $\pi/3$
 (b) $2\pi/3$
 (c) $1/2$
 (d) $\pi/3$
 53 (b) $t^2 = 2 \sin t$ for $t = 0$ and $t \approx 1.40$
 (d) $k \approx 20$
 55 $\theta = \arctan(m_1) - \arctan(m_2)$

Section 8.5

- 1 IV
 3 II
 5 III
 7 I
 9 IV
 11 90° to 180°



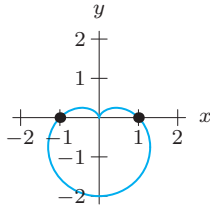
- 13 180° to 270°



- 15 $(1, \pi)$
 17 $(2, 5\pi/6)$
 19 $(-\sqrt{6}/2, -\sqrt{6}/2)$
 21 $(-\sqrt{3}, 1)$
 23 $x^2 + y^2 = 6x$
 25 $y = x^2 - 2x$
 27 $r = \sqrt{5}$
 29 $r = 1/\sqrt{2 \cos \theta \sin \theta}$
 31 $H: x = 3, y = 0; r = 3, \theta = 0$
 $M: x = 0, y = 4; r = 4, \theta = \pi/2$
 33 $H: x = 3/2, y = 3\sqrt{3}/2; r = 3, \theta = \pi/3$
 $M: x = 0, y = 4; r = 4, \theta = \pi/2$

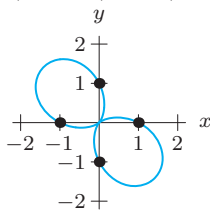
- 35 $H: x = -1.5, y = -3\sqrt{3}/2; r = 3, \theta = 4\pi/3$
 $M: x = 0, y = 4; r = 4, \theta = \pi/2$
 37 $H: x \approx -2.974, y \approx 0.392; r = 3, \theta = 172.5\pi/180$
 $M: x = 4, y = 0; r = 4, \theta = 0$
 39 $0 \leq r \leq 2$ and $-\pi/6 \leq \theta \leq \pi/6$

41 (b)



- (c) Cartesian:
 $(\sqrt{3}/4, 1/4);$
 $(-\sqrt{3}/4, 1/4)$ or polar:
 $r = 1/2, \theta = \pi/6$ or $5\pi/6$

(d)



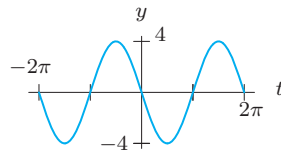
- 43 Looks the same
 45 Rotated by 90° clockwise
 47 $\pi/4 \leq \theta \leq 5\pi/4;$
 $0 \leq \theta \leq \pi/4$ and $5\pi/4 \leq \theta \leq 2\pi$

Section 8.6

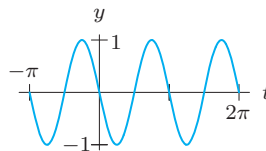
- 1 $5e^{i\pi}$
 3 $0e^{i\theta}$, for any θ .
 5 $5e^{i4.069}$
 7 $-5 + 12i$
 9 $-3 - 4i$
 11 $-\frac{1}{2} + i\frac{\sqrt{3}}{2}$
 13 $\frac{\sqrt{3}}{2} + \frac{i}{2}$
 15 $\sqrt{2} + i\sqrt{2}$
 17 $\frac{\sqrt{3}}{2} + \frac{i}{2}$
 19 $\sqrt{2}/2 + i\sqrt{2}/2$
 21 $\sqrt{2}\cos\frac{\pi}{12} + i\sqrt{2}\sin\frac{\pi}{12}$
 23 $2.426 + 4.062i$
 25 $A_1 = 2 - i$
 $A_2 = -2 + 2i$
 27 (a) $e^{i\pi/2}$
 33 $2e^{\pi i/3} = 1 + 1.732i, 2e^{\pi i} = -2,$
 $2e^{5\pi i/3} = 1 - 1.732i$
 35 $2^{1/6}e^{\pi i/12} = 1.084 + 0.291i,$
 $2^{1/6}e^{3\pi i/4} = -0.794 + 0.794i,$
 $2^{1/6}e^{17\pi i/12} = -0.291 - 1.084i$
 37 1
 39 $(\sqrt{2})/2 + i(\sqrt{2})/2$

Chapter 8 Review

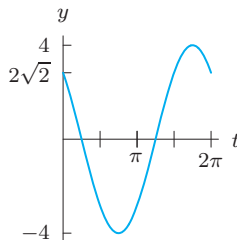
- 1 $11\pi/6$
 3 $-5\pi/4$
 5 270°
 7 $900/\pi = 286.479$
 9 -12π
 11 (a) II
 (b) III
 (c) IV
 (d) I
 (e) III
 13 $3\cos 2A$
 15 $6.2 \cdot 13\pi/4 \approx 63.303$
 17 (a) $C(t)$
 (b) $D(t)$
 (c) $A(t)$
 (d) $B(t)$
 19 Mid: $y = 7$; Amp: 1; Per: 2π
 21 I
 23 I
 25 $(1.571, 0)$
 27 $(0, 0)$
 29 Amplitude: 4
 Period: 2π
 Phase shift: 0
 Horizontal shift: 0



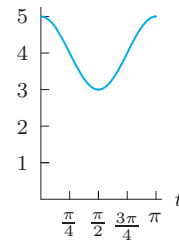
- 31 Amplitude: 1
 Period: π
 Phase shift: $-\pi/2$
 Horizontal shift: $-\pi/4$ (left)



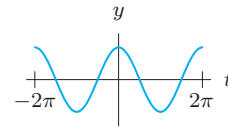
- 33 Amp: 30; mid: $y = 60$; per: 4
 35 Amp: 40; mid: $y = 50$; per: 16
 37 $y = \sin x$ for $f(x), k(x); y = \cos x$ for $g(x), h(x)$
 39



41



43 Appear to be same

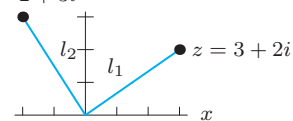


- 45 (a) OE
 (b) OA
 (c) DB
 (d) OF
 (e) OC
 (f) GH

47 $-1/2$ 49 $\tan \theta = -3/4$

51 1.168

- 53 (a) $y = (-1/\sqrt{3})x + 2$
 (b) $2\sqrt{3}$

55 (a) $z = -2 + 3i$ 

- 57 (a) $y = 600 - 300\cos(2\pi x/80)$
 (b) $x = 14.5279, 65.4721, 94.5279$

- 59 $f_1(x) = 6\cos((1/2)(x - 3\pi)) + 2,$
 $f_2(x) = -6\cos((1/2)(x - \pi)) + 2,$
 $f_3(x) = 6\sin((1/2)(x - 2\pi)) + 2,$
 $f_4(x) = -6\sin((1/2)(x - \pi)) + 2;$
 answers may vary

- 61 $f_1(x) = 5\cos((\pi/6)(x + 2)) + 3,$
 $f_2(x) = -5\cos((\pi/6)(x - 4)) + 3,$
 $f_3(x) = 5\sin((\pi/6)(x - 7)) + 3,$
 $f_4(x) = -5\sin((\pi/6)(x - 1)) + 3;$
 answers may vary

63 $\pi/6, 7\pi/6$

65 0.616, 2.526, 3.757, 5.668

67 69.115 miles

69 0.516°

71 0.1345 radians

73 $f(t) = -900\cos((\pi/4)t) + 2100$

75 $y = 30 \sin(10.5t - \pi/2) + 150$

Ch. 8 Understanding

- 1 False
- 3 False
- 5 False
- 7 True
- 9 False
- 11 True
- 13 False
- 15 True
- 17 False
- 19 True
- 21 True
- 23 True
- 25 False
- 27 False
- 29 False
- 31 False
- 33 True
- 35 True
- 37 True
- 39 True
- 41 True
- 43 False
- 45 True
- 47 False
- 49 True
- 51 False
- 53 True
- 55 False
- 57 True
- 59 False
- 61 True
- 63 False
- 65 False
- 67 False
- 69 True
- 71 True
- 73 False
- 75 True
- 77 True
- 79 True

Section 9.1

- 1 $\sin t - \cos t$
- 3 $\cos t + 3 \sin t$
- 5 $2 \sin \alpha$
- 7 $\cos t - \sin t$
- 9 0
- 11 $\tan \sqrt{\theta}$
- 13 $(3/4) \tan(\phi + 1)$
- 15 $(10/3) \tan\left(\frac{2}{k+3}\right)$

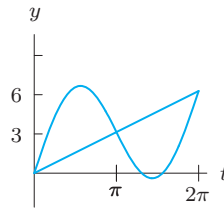
- 17 $\cos^2 \theta + \sin^2 \theta = 1$;
 $\cos 2\theta = \cos^2 \theta - \sin^2 \theta$
 $= 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta$
- 27 $\pi/6, 5\pi/6, \pi/2, 3\pi/2$
- 29 0, $\pi/3, 2\pi/3, \pi, 4\pi/3, 5\pi/3, 2\pi$
- 31 Not an identity
- 33 Not an identity
- 35 Not an identity
- 37 Identity
- 39 Identity
- 41 Identity
- 43 Not an identity
- 45 Not an identity
- 47 (a) $\theta = 60^\circ, 180^\circ, \text{ and } 300^\circ$
(b) $\theta = \frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6}$
- 49 (a) $\sqrt{1-y^2}$
(b) $y/(\sqrt{1-y^2})$
(c) $1-2y^2$
(d) y
(e) $1-y^2$
- 51 $\sin 2\theta = \frac{2x}{9} \sqrt{9-x^2}$
- 53 (a) $2x\sqrt{1-x^2}/(2x^2-1)$
(b) $2x/(1+x^2)$
- 55 $\sin 4\theta = 4(\sin \theta \cos \theta)(2 \cos^2 \theta - 1)$
- 61 $\cos\left(\cos^{-1}\left(\frac{1}{2}\right)\right) = \frac{1}{2}$;
 $\cos^{-1}\left(\cos\left(\frac{5\pi}{3}\right)\right) = \frac{\pi}{3}$

Section 9.2

- 1 $10 \sin(t - 0.644)$
- 3 $\sqrt{2} \sin(t + 3\pi/4)$
- 5 $\sin 15^\circ = \cos 75^\circ = (\sqrt{6} - \sqrt{2})/4$
 $\cos 15^\circ = \sin 75^\circ = (\sqrt{6} + \sqrt{2})/4$
- 7 $\sqrt{6}/2$
- 9 $(\sqrt{6} + \sqrt{2})/4$
- 11 (a) 1.585
(b) 0.053
(c) 1.216
(d) -0.069
- 19 $x = 2\pi/5, 4\pi/5, 6\pi/5, 8\pi/5, \pi/3, \pi, 5\pi/3$

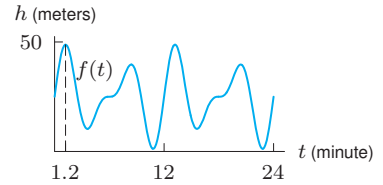
Section 9.3

- 1 All integral multiples of π



- 3 (a) $P = 5000 + 300t$
(b) $P = 3200(1.04)^t$

- (c) $P(t) = -900 \cos(2\pi t/5) + 2100$
- 5 (a) $m = 2.5; b = 20; A = 10$
(b) Roughly in January and December
(c) Roughly between May and September
- 7 (a) $y = 1$
(b) f oscillates faster and faster between -1 and 1 as t increases.
(c) ≈ 0.540
(d) $t_1 = \ln(\pi/2)$
(e) $t_2 = \ln(3\pi/2)$
- 11 (a) $h = f(t)$
 $= 25 + 15 \sin(\pi t/3) + 10 \sin(\pi t/2)$
(b) $f(t)$ is periodic with period 12



(c) $h = f(1.2) = 48.776 \text{ m}$

Chapter 9 Review

- 1 $1 - \cos t - \sin t$
- 3 $4 \tan t$
- 5 $\tan t$
- 7 $\cos t - \sin t$
- 9 $\sin \theta$
- 11 $2 \cos \phi$
- 13 Both are right
- 15 (a) y
(b) $y/\sqrt{1+y^2}$
(c) $\tan^{-1} y$
Other answers possible
(d) $2y/(1+y^2)$
- 17 $\cos \theta = \sqrt{8835}/94$
 $\tan \theta = 1/\sqrt{8835}$
- 19 No; the ratio is $3/4$
- 21 $\theta = \pi/6, 5\pi/6, \text{ and } 3\pi/2$
- 23 $120/169$
- 29 1.231, 5.052, π
- 31 $\cos 3\theta = 4 \cos^3 \theta - 3 \cos \theta$
- 33 $\sin(\ln(xy)) \approx 0.515$
- 35 (a) P_2
(b) P_2
(c) P_1
(d) P_2

Ch. 9 Understanding

- 1 True
- 3 True
- 5 True
- 7 True
- 9 True
- 11 False
- 13 True

- 15 True
 17 True
 19 False
 21 True
 23 False
 25 True
 27 False
 29 True

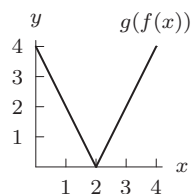
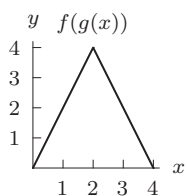
Section 10.1

- 1 $2^{x/(x+1)}$
 3 $\sin(4\sqrt{x}); \sqrt{\sin 4x}$
 5 $w(x) = 4x + 3$
 7 $s(0) = 2, s(1) = 5, s(2) = 8,$
 $s(3) = 3, s(4) = 1, s(5) = 4$
 9 $9x$
 11 $27x^2 - 2$
 13 $3888x^2 - 1728x + 192$
 15 $\ln(x^2 + 4)$
 17 $\cos 2x$
 19 Area in terms of time
 21 Revenue in terms of fertilizer
 23 $u(x) = 1/(x-1),$
 $v(x) = x^2$
 25 $g(x) = \sqrt{x}, h(x) = 1 + \sqrt{x}$
 27 $g(x) = 1/x^2, h(x) = x + 4$
 29

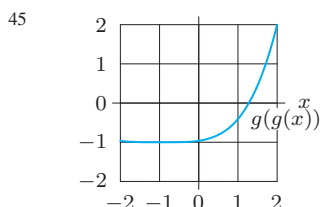
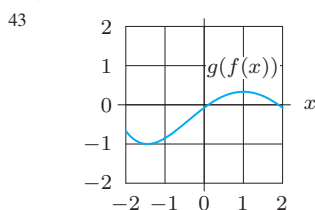
x	$f(x)$	$g(x)$	$h(x)$
0	2	1	3
1	1	0	0
2	4	3	2
3	0	4	1
4	3	2	4

- 31 $f(x) = 2x$
 33 $f(x) = \ln x$
 35 $(\sqrt{x+h} - \sqrt{x})/h$
 37 $(2^{x+h} - 2^x)/h$
 39 (a) 4
 (b) 1
 (c) 4
 (d) 0

41 (a)



- (b) $0 < x < 2$
 (c) $2 < x < 4$

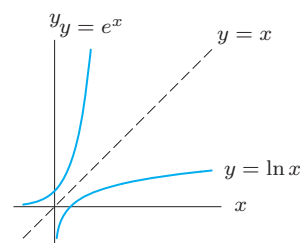


- 47 $v(x) = x + 1/x$
 49 (a) $u(x) = (1+x)/(2+x)$
 (b) $u(x) = x/(1+x)$
 51 (a) $v(x) = -x$
 (b) $u(x) = \sqrt{1-x}$
 53 (a) $v(x) = \sin x$
 (b) $u(x) = \sin^2(\sqrt{x})$
 55 (a) (i) 3
 (ii) 4
 (iii) 3
 (iv) 4
 (b) 5
 57 $1/2$
 59 All real numbers;
 All real numbers greater than or equal to zero
 61 $g(x) = 2^x$
 63 $g(x) = -1$, provided $x \neq -3$
 65 (a) and (e)

Section 10.2

- 1 Not invertible
 3 Not invertible
 5 Not invertible
 11 Yes, $f(f^{-1}(x)) = f^{-1}(f(x)) = x$
 13 Yes, $f(f^{-1}(x)) = f^{-1}(f(x)) = x$
 15 $f^{-1} = x - 5$
 17 $h^{-1} = x^2$
 19 $f^{-1}(x) = (x+7)/3$
 21 $l^{-1} = \sqrt{(1-x^2)}/2$
 23 $n^{-1} = \sqrt{\sqrt{x}-1}$
 25 $j^{-1}(x) = (x^2-1)^2$
 27 $k^{-1}(x) = (3-2x)^2/(x+1)^2$
 29 $h^{-1}(x) = (5+4 \cdot 10^x)/(10^x-1)$
 31 $g^{-1}(x) = \arcsin(\ln x / \ln 2)$
 33 Time at which pop is P ; years
 35 (a) $f^{-1}(R) = (1/5)R - 30$
 37 (a) $f(3) = 5^3 = 125; f^{-1}(1/25) = -2$

- (b) $f^{-1}(10) \approx 1.43086$
 39 $f^{-1}(3) < f(3) < 0 < f(0) < f^{-1}(0) < 3$
 41 $f^{-1}(P) = 50 \ln(P/10)$
 43 (a) $f(t) = 800 - 14t$ gals
 (b) (i) 800 gals
 (ii) 57.143 days
 (iii) 28.571 days
 (iv) 14t
 45 (a) $f(g(x)) = g(f(x)) = x$; inverses
 (b) Line $y = x$

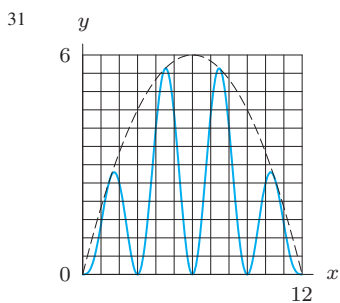


- 47 (a) $P(t) = 150(1.1)^t$
 (b) $P^{-1}(N) = (\log(N) - \log(150))/(\log(1.1))$
 (c) 10.3 years
 49 (a) $H(t) = 200e^{-1.15129t}$
 (b) Dropped 50.021°C in the first 15 mins,
 37.532°C in the next 15 mins
 (c) $H^{-1}(y) = -\ln(y/200)/1.15129$
 (d) About 3 hours and 12 minutes
 (e) Brick's temperature approaches room temperature
 51 $f^{-1}(x) = (0.5x^{-1} - A^{-1})^{-1}$
 53 $W(-1/e) = -1, W(0) = 0, W(e) = 1$
 55 (a) $f(t) = 7.112(1.08998)^t$
 (b) $f^{-1}(P) = (\log(P/7.112))/(\log 1.08998)$
 (c) $f(25) = 61.299$
 $f^{-1}(25) = 14.590$
 57 (a) $C(0) = 99\%$
 (b) $C(x) = (99-x)/(100-x)$
 (c) $C^{-1}(y) = (99-100y)/(1-y)$

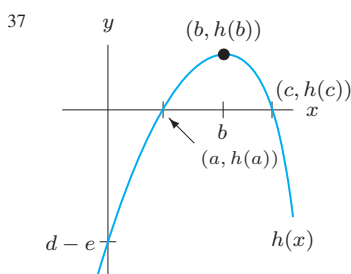
Section 10.3

- 1 (a) $f(x) + g(x) = 3x^2 + x + 1$
 (b) $f(x) - g(x) = -3x^2 + x + 1$
 (c) $f(x)g(x) = 3x^3 + 3x^2$
 (d) $f(x)/g(x) = (x+1)/(3x^2)$
 3 (a) $f(x) + g(x) = 2x$
 (b) $f(x) - g(x) = 10$
 (c) $f(x)g(x) = x^2 - 25$
 (d) $f(x)/g(x) = (x+5)/(x-5)$
 5 (a) $f(x) + g(x) = x^3 + x^2$
 (b) $f(x) - g(x) = x^3 - x^2$
 (c) $f(x)g(x) = x^5$
 (d) $f(x)/g(x) = x$

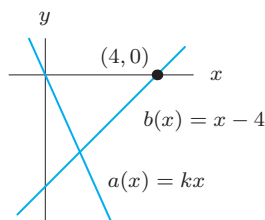
- 7 $f(x) = x$
 9 $h(x) = 7x - 5$
 11 $k(x) = 1 - 2x + x^2$
 13 $f(x) = e^x(2x + 1) = 2xe^x + e^x$
 15 $h(x) = 4e^{2x} + 4e^x + 1$
 17 $\sin x + x^2$
 19 $(\sin x)/x^2$
 21 $\sin^2 x$
 25 (a) $p(t) = f(t) + g(t)$
 (b) $m(t) = g(t) \cdot h(t)$
 27 4550



35 \$17.50



- 39 (a) Yes



- (b) The function has no zeros

- 41 $H(x) = (e^{-x^2})/(x^4)$,
 $h(x) = (-2x^5e^{-x^2} - 4x^3e^{-x^2})/(x^8)$
 43 (b) $p(t) = (f_{CA}(t) \cdot g_{CA}(t) + f_{FL}(t) \cdot g_{FL}(t))/(f_{US}(t) \cdot g_{US}(t))$
 45 40
 47 $g(2000) = 100$, the dollar cost per square foot for building 2000 square feet of office space
 49 $g(q) < g(p) < f(p) < f(q)$

51 $j(x) = x/h(x)$

Chapter 10 Review

- 1 $2^{x^2}; 4^x$
 3 $1/(x^2 - 2)$
 5 $\sqrt{x^2 + 1}$
 7 $1/(x - 2)$
 9 (a) Not invertible
 (b) Not invertible
 (c) Invertible
 11 $h^{-1}(x) = x/(1 - 2x)$
 13 $g^{-1}(x) = \frac{1}{3} \ln(x - 1)$
 15 $h^{-1}(x) = \frac{1}{2}(1 - e^x)$
 17 $g^{-1}(x) = (3x + 2)/(1 - 2x)$
 19 $f^{-1}(x) = (11x - 3)^2/(1 + x)^2$
 21 $s^{-1}(x) = 10^{(3/x) - 2}$
 23 Not invertible
 25 Not invertible
 27 $r^{-1}(y) = \ln(y + 7)$
 31 $2e^x - 1$
 33 $4x - 3$
 35 $\sqrt{x}e^{2x-1}$

- 37 (a) $f(2x) = 4x^2 + 2x$
 (b) $g(x^2) = 2x^2 - 3$
 (c) $h(1 - x) = (1 - x)/x$
 (d) $(f(x))^2 = (x^2 + x)^2$
 (e) $g^{-1}(x) = (x + 3)/2$
 (f) $(h(x))^{-1} = (1 - x)/x$
 (g) $f(x)g(x) = (x^2 + x)(2x - 3)$
 (h) $h(f(x)) = (x^2 + x)/(1 - x^2 - x)$

- 39 $x/(1 + e^{2x})$
 41 $3x^2 + x$
 43 $2x\sqrt{x+2}$
 45 $3x/2 - 1/2$
 47 $x^{3/2} \tan 2x$
 49 $\tan((3x - 1)^2/2) - 27x^{3/2}$

51

t	$p(t)$	$q(t)$	$r(t)$
0	4	3	5
1	5	2	1
2	3	4	0
3	2	0	4
4	1	5	2
5	0	1	3

- 53 $u(x) = \sqrt{x}, v(x) = 3 - 5x$
 55 $u(x) = x^2, v(x) = \sin x$
 57 $u(x) = x^3, v(x) = 2x + 5$
 59 $u(x) = 3^x, v(x) = 2x - 1$
 63 (a) $r(x) = (x - 1)/(x - 2)$
 (b) $s(x) = x + 1$ and $t(x) = 1/x$
 (c) $p(p(a)) = (2a + 1)/(a + 1)$

65

x	$f(x)$	$g(x)$	$h(x)$
0	9	1	0
1	0	2	1
2	1	0	9

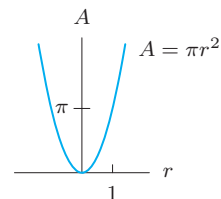
- 67 (a)
- $f^{-1}(P) = 2.5P - 50$
-
- (b)

t	$P = f(t)$
0	20
5	22
10	24
15	26
20	28

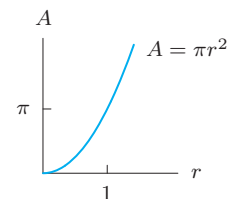
P	$t = f^{-1}(P)$
20	0
22	5
24	10
26	15
28	20

- 69 Velocity for time
- t
- ; mph

- 71 $1 - t^2$
 73 $x = (\ln 3 / \ln 2) - 5$
 75 $x = e^{1.8} - 3$
 77 $x = (19 - \sqrt{37})/2$
 79 (a) $A = \pi r^2$
 (b)

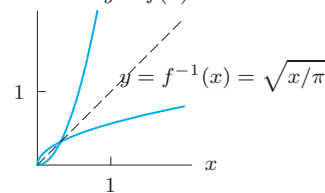


- (c)
- $r \geq 0$



- (d)
- $f^{-1}(A) = \sqrt{A/\pi}$

- (e)
- $y = f(x) = \pi x^2$

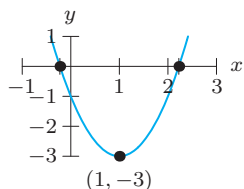


- (f) Yes
 81 (a) $f(g(a)) = a$
 (b) $g(f(c)) = b$
 (c) $f^{-1}(b) - g^{-1}(b) = -c$
 (d) $0 < x \leq a$

83 $2\sqrt{x} - 9$

85 $(3 \pm \sqrt{17})/4$

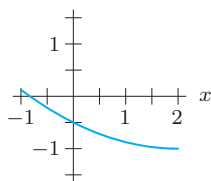
87



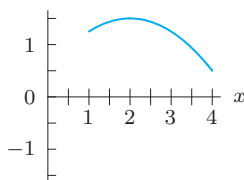
- 89 (a) Only to $(u(x))^2$.
 (b) $u((v(x))^2)$ and $u(w(v(x)))$
 (c) (i) $1 + \sin 2x$
 (ii) 1
 (iii) $\cos(x^2) + \sin(x^2)$

91

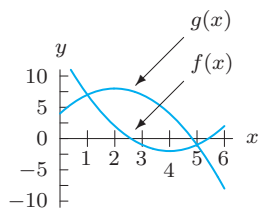
$y = f(g(x))$



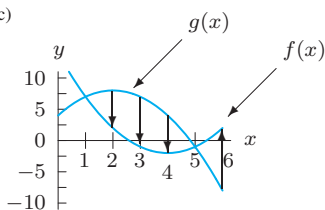
93 $y = g(f(x-2))$



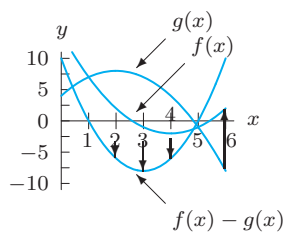
95 (a)



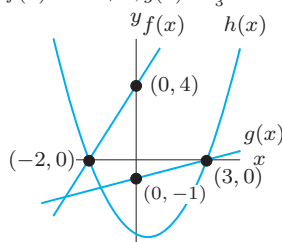
(c)



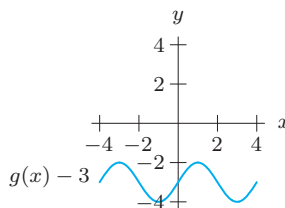
- (f) $f(x) = x^2 - 8x + 14$;
 $g(x) = -x^2 + 4x + 4$;
 $f(x) - g(x) = 2x^2 - 12x + 10$
 (g) Yes



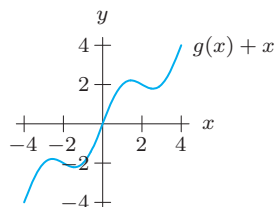
- 97 (a) $f(x) = 2x + 4, g(x) = \frac{1}{3}x - 1$
 (b)



99 (a)



(b)



101 False

103 $g(x) = (x+2)/2 = 0.5x + 1$

- 105 (a) $f(x) = e^x, g(x) = 6x, G(x) = 3x^2$
 (b) $f(x) = \sin x, g(x) = -1/(2\sqrt{x}), G(x) = \sqrt{x}$

- 107 (a) True
 (b) False
 (c) False
 (d) True

109 Increasing

111 Can't tell

- 113 (a) $f(8) = 2, f(17) = 2,$
 $f(29) = 2, f(99) = 0$
 (b) $f(3x) = 0$

- (c) No
 (d) $f(f(x)) = f(x)$
 (e) No

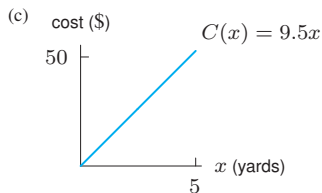
- 115 $f^{-1}(L) = -\frac{1}{k} \ln(1 - L/L_\infty)$
 $f^{-1}(L) = \text{Age of fish of length } L$
 Domain: $0 \leq L \leq L_\infty$

Ch. 10 Understanding

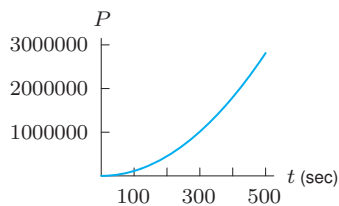
- 1 False
 3 True
 5 True
 7 True
 9 True
 11 False
 13 False
 15 True
 17 False
 19 False
 21 False
 23 False
 25 True
 27 True
 29 True
 31 False
 33 True
 35 True
 37 True

Section 11.1

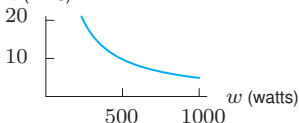
- S1 $6|t|$
 S3 $0.16x^2 y^4$
 S5 $x = 0.585$
 S7 False
 S9 False
 1 Yes; $g(x) = (-1/6)x^9$
 3 No
 5 Not a power function
 7 $y = \frac{48}{30625} \cdot x^{-2}, a = \frac{48}{30625}, p = -2$
 9 Even
 11 Fractional
 13 $y = 3x^{1.058}$
 15 $f(x) = (3/2) \cdot x^{-2}$
 17 $k = 5; c = 5d^2; c = 125$
 19 $k = 3/2; y = (3x)/2; x = 5.33$
 21 $f(x) = 3x^2$
 23 $j(x) = 2x^3$
 25 (a) 0
 (b) 0
 29 (a) $x^{-3} \rightarrow +\infty, x^{1/3} \rightarrow 0$
 (b) $x^{-3} \rightarrow 0, x^{1/3} \rightarrow \infty$
 31 Formula not unique
 33 v, w, f, g
 35 $f(x) = -1/(3\sqrt[3]{7}) \cdot x^{-4/3}$
 37 (a) $C(x) = kx$
 (b) $k = 9.5; C(x) = 9.5x$



- (d) \$52.25
- 39 (b) 16 times greater
- 41 $P = k/\sqrt{p}$
- 43 $h = 192.5v/5$; 64.167 mph
- 45 (a) $d = 1.7, 3.4, 20.4, 102$
 $d = 0.34t$
- (b) 9.8 mins
- (c) $A = 9.1, 36.3, 1307, 32685$
 $A = 0.363t^2$
- (d) $P = 11.25t^2$
- (e) 298 sec, or approx 5 min



- 47 (a) $t = 4875/w$
- (b) 19.5, 16.25, 9.75, 7.5 mins
- (c) t (mins)

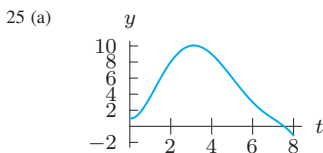


- (d) 1 min
- 49 (a) p even: all positive real numbers
 p odd: all nonzero real numbers
- (b) p even: symmetric about the y -axis
 p odd: symmetric about the origin.
- (c) p even: $y \rightarrow \infty$ as $x \rightarrow 0^-$ or $x \rightarrow 0^+$
 p odd: $y \rightarrow -\infty$ as $x \rightarrow 0^-$ and $y \rightarrow \infty$ as $x \rightarrow 0^+$
- (d) $y \rightarrow 0$ as $x \rightarrow \pm\infty$
- 51 (a) $p < 0, x \neq 0$
- (b) $p > 0, y \geq 0$;
 $p < 0, y > 0$;
 $p > 0, y$ is any real;
 $p < 0, y \neq 0$
- (c) p even: y -axis symmetry;
 p odd: origin symmetry

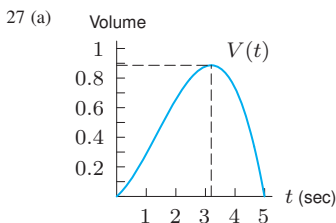
Section 11.2

- 1 No
- 3 Yes, 2
- 5 No

- 7 Degree: 3; Terms: 3;
 $x \rightarrow -\infty: y \rightarrow -\infty$;
 $x \rightarrow +\infty: y \rightarrow +\infty$
- 9 Degree: 3; Terms: 4;
 $x \rightarrow -\infty: y \rightarrow +\infty$;
 $x \rightarrow +\infty: y \rightarrow -\infty$
- 11 $x \approx 0.718, x \approx 1.702$.
- 15 $y = \frac{1}{2}x - 1$
- 17 (a) $-3 \leq x \leq -1, -5 \leq y \leq 5$
- (b) $-3 \leq x \leq 4, -35 \leq y \leq 15$
- (c) $1.25 \leq x \leq 2.35, -0 \leq y \leq 6$
- (d) $-8 \leq x \leq 8, -50 \leq y \leq 2000$
- 19 $-1.1 \leq x \leq -0.9, -0.121 \leq y \leq 0.081$
- 21 $-20 \leq x \leq 20, -7600 \leq y \leq 8400$
- 23 $-1.764 < x < 0.875$, or $x > 3.889$

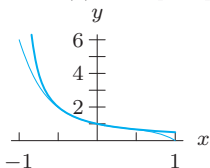


- (b) 100 people
- (c) July of 1897
- (d) 1010; February of 1893
- (e) -115.7; not reasonable



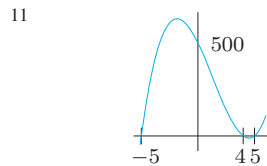
- (b) $V \approx .886$ at $t \approx 3.195$
- (c) (0, 0) and (5, 0);
Lungs empty at beginning and end

- 29 Yes
- 31 (a) False
- (b) False
- (c) False
- (d) True
- 33 (a) $p(0.5) \approx 0.65625$; 2 dec pl
- (b) $p(1) = 0, f(1) = 0.5$; poor approx
- (c)



Section 11.3

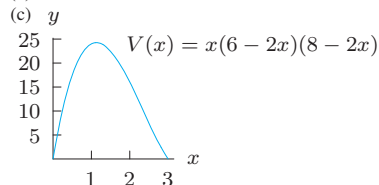
- 1 0, -4, -3
- 3 -3, 2, -7
- 5 $h(x) = x(x+2)^2(x-3)$
- 7 $f(x) = (x+2)(x-2)^3$
- 9 $y = (-1/8)(x+2)(x-2)^2(x-5)$;
 $y = (-1/20)(x+2)(x-2)(x-5)^2$



- 13 (a) $f(x) = (x+5)(x+1)(2x-1)(x-1)$
- (b) $-7 \leq x \leq 2, -150 \leq y \leq 10$

- 15 C
- 17 $f(x) = 1$
- 19 $f(x) = -\frac{1}{2}(x+3)(x-1)(x-4)$
- 21 $p(x) = x^2 + 2x - 3$
- 23 $f(x) = -(x+1)(x-1)^2$
- 25 $f(x) = kx^3(x+1)(x-2)$ for $k > 0$
- 27 $f(x) = 3x(x+1)(x-1)^2$
- 29 $h(x) = (x+2)(x+1)^2(x-1)$
- 31 $g(x) = -\frac{1}{3}(x^2)(x+2)(x-2)$
- 33 $x = \pm\frac{1}{2}$
- 35 6, 2, 3
- 37 None
- 39 $r = -1, s = 2, g(x) = k(x+5)^2$ or
 $r = -5, s = 2, g(x) = k(x+5)(x+1), k \neq 0$

- 41 (a) $V(x) = x(6-2x)(8-2x)$
- (b) $0 < x < 3$

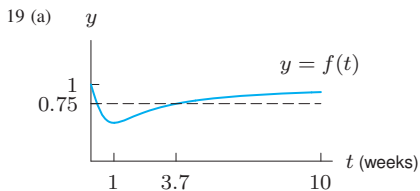


- (c) y
- (d) $\approx 24.26 \text{ in}^3$
- 43 7.83 by 5.33 by 1.585 inches

- 45 $x \geq c$ and $a \leq x \leq b$
- 47 (a) $f(x) = \frac{2}{15}(x+2)(x-3)(x-5)$
- (b) $f(x) = -\frac{2}{75}(x+2)(x-3)(x-5)^2$
- (c) $f(x) = \frac{1}{15}(x+2)^2(x-3)(x-5)$

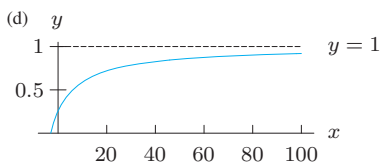
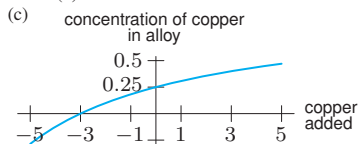
Section 11.4

- S1 $(6y^2 + 7)/y^3$
- S3 $x^3/2$
- S5 $(-18x^2 + 18x + 41)/((x-2)^2(x+1))$
- S7 $1/2$
- S9 $1/(x-1)$
- 1 Rational; $(x+2)/(x^2-1)$
- 3 Rational; $(x^3+2)/(2x)$
- 5 Not rational
- 7 Not rational
- 9 ∞
- 11 0
- 13 $y = 1$
- 15 As $x \rightarrow \pm\infty, f(x) \rightarrow 1, g(x) \rightarrow x$, and
 $h(x) \rightarrow 0$



- (c) Approaches 1
(d) About 3.73 weeks

- 21 (a) $f(x) = (3 + x)/(12 + x)$
(b) (i) 28%
(ii) 25%
(iii) $\approx 18.2\%$
(iv) 6
(v) -3

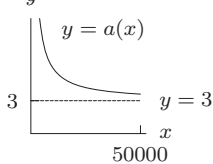


23 2011; Never

- 25 (a) $f(x) = x/(x + 5)$
(b) $f(7) = 7/12 \approx 58.333\%$
(c) $x = 0$
(d) $y = 1$

- 27 (a) $C(n_0)/n_0$
(b) Slope is average cost for n_0 units

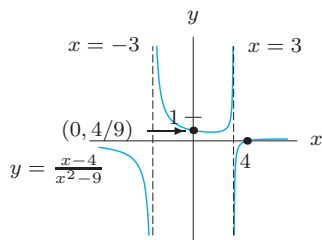
- 29 (a) $C(x) = 30000 + 3x$
(b) $a(x) = 3 + 30000/x$
(c)



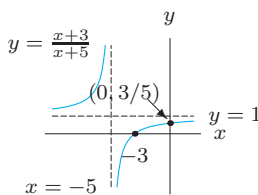
- (f) $a^{-1}(y) = 30000/(y - 3)$
(g) 15,000

Section 11.5

- 1 Zeros: $x = 4$;
Asymptote: $x = \pm 3$;
 $y \rightarrow 0$ as $x \rightarrow \pm\infty$



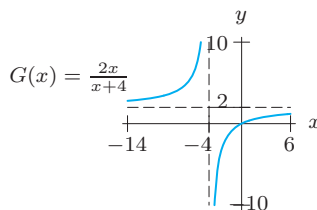
- 3 Zero: $x = -3$;
Asymptote: $x = -5$;
 $y \rightarrow 1$ as $x \rightarrow \pm\infty$



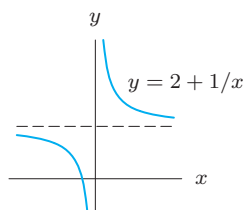
- 5 x-int: $x = \pm 2$
y-int: None
Horiz asy: $y = 0$
Vert asy: $x = 0, x = -4$

- 7 x-int: $x = 2$
y-int: $y = 1/2$
Horiz asy: $y = 1$
Vert asy: $x = 4$

- 9 (c) Horizontal: $y = 2$
Vertical: $x = -4$



11

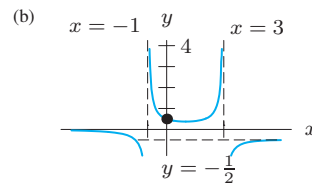
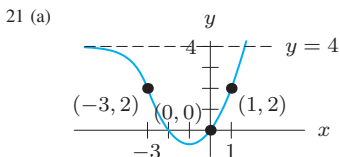


- 13 (a) $-\infty$
(b) $+\infty$

- 15 (a) (iii)
(b) (i)
(c) (ii)
(d) (iv)
(e) (vi)
(f) (v)

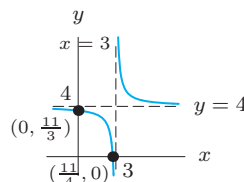
- 17 (a) 0, 0
(b) $\lim_{x \rightarrow -2^+} f(x) = \infty$;
 $\lim_{x \rightarrow -2^-} f(x) = \infty$

- 19 (a) Small
(b) Large
(c) Undefined
(d) Positive
(e) Negative

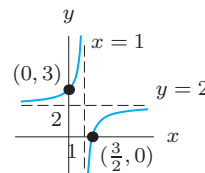


- 23 (a) $y = -1/(x + 2)$
(b) $y = -1/(x + 2)$
(c) $(0, -1/2)$

- 25 $p = 1, (0, 11/3), (11/4, 0)$
 $x = 3, y = 4$



- 27 $p = 1, (0, 3), (3/2, 0)$
 $x = 1, y = 2$



- 29 (a) $y = 1/x$
(b) $y = x/(2x - 4)$

- 31 (a) $1/x$
(b) $y = (1/x) + 2$

- 33 $y = -(x + 1)/(x - 2)$

- 35 $y = -(x - 3)(x + 2)/((x + 1)(x - 2))$

- 37 $y = (x - 2)/((x + 1)(x - 1))$

- 39 $y = x - 9; (2, -7)$

- 41 $h(x) = (x^4 - 2x^3)/(x - 2)$

- 43 $g(x) = (x - 5)/((x + 2)(x - 3))$

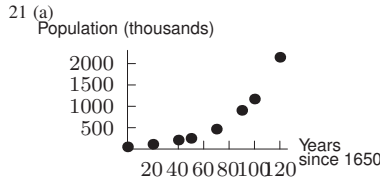
Section 11.6

- 1 $p(x) = 25^x$

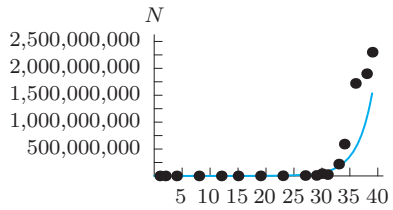
- 3 Neither
 5 $r(x) = 2(\frac{1}{9})^x$
 7 A - (i)
 B - (iv)
 C - (ii)
 D - (iii)
 11 $y = 6x^{35}$
 13 $y = 50x^{1.1}$
 15 $y = e^{-x}$
 17 (a) $f(x) = 720x - 702$
 (b) $f(x) = 2(9)^x$
 (c) $f(x) = 18x^4$
 19 (a) $f(x) = y = \frac{63}{4}x + \frac{33}{2}$
 (b) $f(x) = 3 \cdot 4^x$
 (c) $f(x) = \frac{3}{4}x^6$
 21 A: $kx^{5/7}$; B: $kx^{9/16}$;
 C: $kx^{3/8}$; D: $kx^{3/11}$
 23 $m = 2, t = 4, k = \frac{1}{4}$
 25 $y \rightarrow 0$ as $x \rightarrow \pm\infty$
 27 $y \rightarrow 0$ as $t \rightarrow \infty$
 $y \rightarrow 7/9$ as $t \rightarrow -\infty$
 29 $y \rightarrow \infty$ as $x \rightarrow \infty$
 $y \rightarrow -\infty$ as $x \rightarrow -\infty$
 31 $y \rightarrow 0$ as $x \rightarrow \infty$
 33 $y \rightarrow \infty$ as $x \rightarrow \infty$
 $y \rightarrow -\infty$ as $x \rightarrow -\infty$
 35 $y \rightarrow \infty$ as $x \rightarrow \infty$
 $y \rightarrow 0$ as $x \rightarrow -\infty$
 37 $f(x) = 2 \sin(\frac{\pi}{2}x) + 4$ (trigonometric);
 $g(x) = -\frac{5}{2}x^3$ (power function);
 $h(x) = \frac{1}{3}(\frac{1}{2})^x$ (exponential)
 39 (a) $p_5(r) = 1000[(1+r)^5 + (1+r)^4 + (1+r)^3 + (1+r)^2 + (1+r) + 1]$;
 $p_{10}(r) = 1000[(1+r)^{10} + (1+r)^9 + (1+r)^8 + (1+r)^7 + (1+r)^6 + (1+r)^5 + (1+r)^4 + (1+r)^3 + (1+r)^2 + (1+r) + 1]$
 (b) 20.279%

Section 11.7

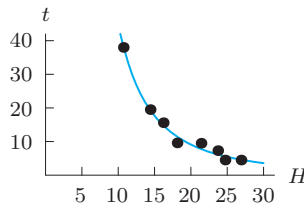
- 1 $f(x) = x^{\ln e / \ln 2}$
 3 $g(x) = 2x^{1.2}$
 5 (a) $f(x) = 201.353x^{2.111}$
 (b) $f(20) = 112,313.62$ gm
 (c) $x = 18.930$ cm
 7 $y = x^{3/2}$
 9 $y = (3/2)x$
 11 $y = e^{0.4x}$
 13 (a) $y = -83.039 + 61.514x$; superb fit
 (b) Good only for close values
 15 $a \approx 3.49$
 17 (b) $R(p) = -0.0565p^2 + 72.9981p + 4749.85$
 (c) $p = \$646, R = \$28,349$
 19 (a) $C(t) = 841.368(1.333)^t$
 (b) 33.3% per year
 (c) Slower growth; concave down



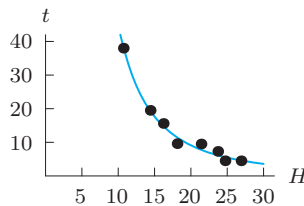
- (b) $P(t) = 56.108(1.031)^t$, answers may vary
 (c) 56.108 is 1650 population, 1.031 means 3.1% annual growth
 (d) $P(100) = 1194.308$, slightly higher
 (e) $P(150) = 5510.118$, higher
 23 (a) $N = 1148.55e^{0.3617t}$



- (b) About 1.92 years
 25 (a) $y = 0.310t^2 - 12.177t + 144.517$
 (b) $y = 3.01t^2 - 348.43t + 10,955.75$
 27 (b) Points lie on a line
 29 (a) Quadratic
 (b) $y = -34.136x^2 + 3497.733x - 39,949.714$; answers may vary
 (c) \$42,734; answers may vary
 (d) Age 10, -\$8386, not reasonable; answers may vary
 31 (a) $t = 8966.1H^{-2.3}$



(b) $r = 0.0124H - 0.1248$



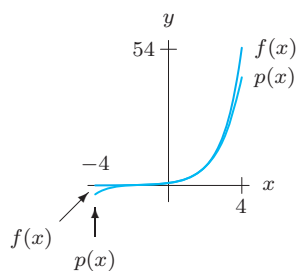
(c) $H = 0^\circ\text{C}; H = 10.1^\circ\text{C}$; model (b)

33 Yes; $k \approx 0.2; P = 0.2D^{3/2}$

Chapter 11 Review

- 1 Yes; $k = 1/6$ and $p = -7$
 3 No
 5 No
 7 Yes; $y = x^2$
 9 Even
 11 Odd
 13 Odd
 15 $k = 2\sqrt[3]{7}, p = 11/15$
 17 4th degree
 19 $y \rightarrow \infty$; like $4x^4$
 21 $y \rightarrow \infty$; like $2x^9$
 23 $x = (3 \pm \sqrt{33})/4$
 25 Not rational
 27 $y = 4/e^{-x}$
 29 (a) 2
 (b) 5/6
 31 Not a power function
 33 Graph (i): J;
 Graph (ii): L;
 Graph (iii): O;
 Graph (iv): H
 35 $y = -\frac{3}{2}(x+4)(x+2)(x-2)$
 37 $y = \frac{1}{2}(x+\frac{1}{2})(x-3)(x-4)$
 39 $y = -x(x+3)(x-2)$
 41 $y = (x+3)x^2$
 43 $y = (x+3)(x+2)(x+1) + 4$
 45 (a) $y = 1/(x-2)^2 - 1$
 (b) $y = \frac{-x^2 + 4x - 3}{(x^2 - 4x + 4)}$
 (c) $(0, -3/4), (1, 0)$ and $(3, 0)$
 47 (a) $y = -1/(x-3)^2$
 (b) $y = -1/(x^2 - 6x + 9)$
 (c) $(0, -1/9)$
 49 (a) -2, -3; None
 (b) -2, -3; No; $r(x) \rightarrow 1$ as $x \rightarrow \pm\infty$
 (c) No; Yes at $x = -2$ and $x = 3$;
 $s(x) \rightarrow 1$ as $x \rightarrow \pm\infty$
 51 (a) False
 (b) False
 (c) True
 (d) False
 53 $f(x) = (x+3)(x-2)/((x+5)(x-7))$
 55 $f(x) = (x+1)/(x-1)$
 57 $f(x) = (-1/5)(x+3)(x-2)(x-5)$
 59 $h(x) = (1/5)(x+5)(x+1)(x-4) + 7$
 61 $d = 0.1x$; 32.5 miles
 63 (a) 20 lbs; 1620 lbs
 (b) 3/10
 65 (a) 500 people
 (b) May of 1908
 (c) 790; February of 1907
 67 (b) $k \approx 0.0087$
 (c) Yes

69 (c)



Ch. 11 Understanding

- 1 False
- 3 True
- 5 True
- 7 False
- 9 True
- 11 True
- 13 False
- 15 True
- 17 False
- 19 False
- 21 True
- 23 False
- 25 True
- 27 True
- 29 True
- 31 True
- 33 True
- 35 False
- 37 False
- 39 True
- 41 True
- 43 False
- 45 False
- 47 False

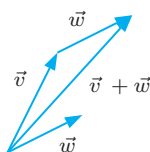
Ch. 11 Skills: Fractions

- 1 $41/35$
- 3 $(3 - 4x)/6x$
- 5 $-2(1 - 2y)/yz$
- 7 $(2 - 3x)/x^2$
- 9 $1/18$
- 11 $x/2$
- 13 $(4y^3z - 3wx)/(x^2y^4)$
- 15 $(8(y + 4))/(y - 4)$
- 17 $(-27x + 44)/((x + 1)(3x - 4))$
- 19 $(x + 20)/(x^2 - 16)$
- 21 $1/2r$
- 23 $(x - 1)/(\sqrt{x})^3 = x\sqrt{x} - \sqrt{x}/x^2$
- 25 $(4x + 1)/(b - a)$
- 27 $(r_2r_3 + r_1r_3 + r_1r_2)/(r_1r_2r_3)$
- 29 $(2a + 3)/((a + 3)(a - 3))$

- 31 $(-2x - h)/(x^2(x + h)^2)$
- 33 $-2x - h$
- 35 $1 - (1/a)$
- 37 $x^2y/(2x + 1)$
- 39 $(2x - 4x^4)/(x^3 + 1)^3$
- 41 $13/x^2 + 1/(2x^3)$
- 43 $(2/l^2) + (1/l^3) - 4/(3l^4)$
- 45 $1/6 - 1/(4x)$
- 47 $1 - 7/(x + 5)$
- 49 $1 + 1/R$
- 51 $1 + \sin x/\cos x$
- 53 False
- 55 False
- 57 True

Section 12.1

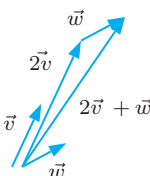
- 1 Scalar
- 3 Vector
- 5 Scalar
- 7 Vector
- 9



11



13

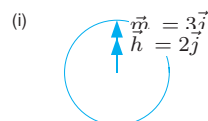


- 15 $\vec{p} = 2\vec{w}$
 $\vec{q} = -\vec{u}$
 $\vec{r} = \vec{u} + \vec{w}$
 $\vec{s} = 2\vec{w} - \vec{u}$
 $\vec{t} = \vec{u} - \vec{w}$

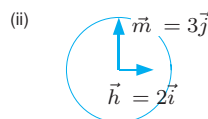
- 17 (a) 1.710 miles
(b) 5.848 miles
- 19 5.116 miles; 14.639° east of north
- 21 14,705 meters;
angle of 17.819° from horizontal
- 23 (a) 14.3373
(b) Veers right
(c) Not possible

Section 12.2

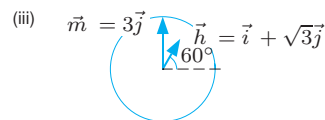
- 1 $-3\vec{i} - 4\vec{j}$
- 3 $\vec{w} \approx -0.725\vec{i} - 0.95\vec{j}$
- 5 $\vec{i} + 3\vec{j}$
- 7 $0.3\vec{i} - 1.8\vec{j} + 0.03\vec{k}$
- 9 $\sqrt{11} \approx 3.317$
- 11 7.649
- 13 $-5\vec{i} + 10\vec{j}$ knots
- 15 45° or $\pi/4$
- 17 90° or $\pi/2$
- 19 $-140.847\vec{i} + 140.847\vec{j} + 18\vec{k}$
- 21 $21\vec{j} + 35\vec{k}$
- 23 (a) 50 km/hr
(b) Horizontal: 43.301; vertical: 25
- 25 (a) $3.536(\vec{i} + \vec{j})$.
(b) $3.536\vec{i} + 4.736\vec{j}$
- 27 (a) (i) $\vec{m} = 3\vec{j}, \vec{h} = 2\vec{j}$



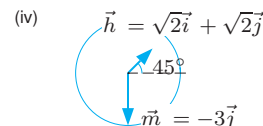
(ii) $\vec{m} = 3\vec{j}, \vec{h} = 2\vec{i}$



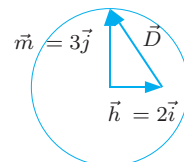
(iii) $\vec{m} = 3\vec{j}, \vec{h} = \vec{i} + \sqrt{3}\vec{j}$



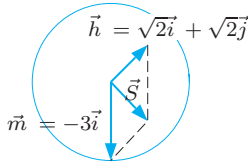
(iv) $\vec{m} = -3\vec{j}, \vec{h} = \sqrt{2}\vec{i} + \sqrt{2}\vec{j}$



(b) $3\vec{j} - 2\vec{i}$



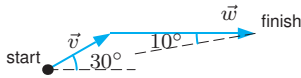
(c) $\sqrt{2}\vec{i} + (\sqrt{2} - 3)\vec{j}$



- 29 \vec{k}
31 $\vec{i} + \vec{k}$

Section 12.3

- 1 (2, 2, 4, 6, 10, 16)
3 (-4, -5, -5, -5, -4, -2)
5 (5, 6, 7, 8, 9, 10)
7 (13/6, 5/2, 10/3, 25/6, 11/2, 22/3)
9 (3.63, 1.44, 6.52, 1.43, 1.20, 0.74)
11 (3.467, 1.277, 6.357, 1.267, 1.037, 0.577)
13 (79.000, 79.333, 89.000, 68.333, 89.333)
15 3.378° north of east
17 (a) $\vec{v} = 4.330\vec{i} + 2.500\vec{j}$
For the second leg of his journey, $\vec{w} = x\vec{i}$



- (b) $x = 9.848$
(c) 14.397
19 (a) $\vec{F}_{\text{net}} = (8, 7)$
(b) $\vec{F}_4 = (-8, -7)$
21 $\vec{q}_a = 1.065\vec{i} + 1.966\vec{j}; (1.065, 1.966)$
 $\vec{q}_b = 2.703\vec{i} + 3.113\vec{j}; (2.703, 3.113)$
 $\vec{q}_c = 2.129\vec{i} + 3.933\vec{j}; (2.129, 3.933)$
 $\vec{q}_d = 0.491\vec{i} + 2.785\vec{j}; (0.491, 2.785)$

Section 12.4

- 1 -7
3 -38
5 14
7 -2
9 $28\vec{j} + 14\vec{k}$
11 238
13 108.435°
15 2100 ft-lbs
17 1.911 radians (109.471°)
19 For both, max = 11, min = 3
21 No
25 (a) $\vec{a} = (3, 2, 4); \vec{c} = (c_b, c_e, c_m)$
 $3c_b + c_e + 4c_m = 40$, or $\vec{a} \cdot \vec{c} = 40$
(c) The "freshness-adjusted" cost is cheaper at Beta
27 43.297°
29 (a) Width
(b) Height
(c) Perimeter

Section 12.5

- 1 (a) $\begin{pmatrix} 15 & 35 \\ 10 & -5 \end{pmatrix}$
(b) $\begin{pmatrix} -2 & 10 \\ 0 & -16 \end{pmatrix}$
(c) $\begin{pmatrix} 4 & 2 \\ 2 & 7 \end{pmatrix}$
(d) $\begin{pmatrix} -8 & -26 \\ -6 & 11 \end{pmatrix}$
(e) $\begin{pmatrix} 13 & 45 \\ 10 & -21 \end{pmatrix}$
(f) $\begin{pmatrix} k & -5k \\ 0 & 8k \end{pmatrix}$
3 (a) $\begin{pmatrix} 12 & 8 & 20 & 4 \\ 16 & 24 & 28 & 12 \\ 4 & 36 & 20 & 32 \\ 0 & -8 & 16 & 24 \end{pmatrix}$
(b) $\begin{pmatrix} -2 & -12 & -8 & -4 \\ -6 & -10 & 2 & -14 \\ -18 & -8 & -14 & -6 \\ -4 & -16 & -8 & -10 \end{pmatrix}$
(c) $\begin{pmatrix} 2 & -4 & 1 & -1 \\ 1 & 1 & 8 & -4 \\ -8 & 5 & -2 & 5 \\ -2 & -10 & 0 & 1 \end{pmatrix}$
(d) $\begin{pmatrix} 6 & -12 & 3 & -3 \\ 3 & 3 & 24 & -12 \\ -24 & 15 & -6 & 15 \\ -6 & -30 & 0 & 3 \end{pmatrix}$
(e) $\begin{pmatrix} 4 & 8 & 9 & 3 \\ 7 & 11 & 6 & 10 \\ 10 & 13 & 12 & 11 \\ 2 & 6 & 8 & 11 \end{pmatrix}$
(f) $\begin{pmatrix} 10 & -4 & 12 & 0 \\ 10 & 14 & 30 & -2 \\ -14 & 28 & 6 & 26 \\ -4 & -24 & 8 & 14 \end{pmatrix}$
5 (a) (51, 15, 38)
(b) (-8, -11, 33)
(c) (70, 20, 22)
(d) (11, -6, 17)
(e) 681
(f) $\begin{pmatrix} 24 & 60 & 84 \\ 48 & -72 & 36 \\ 192 & -60 & 0 \end{pmatrix}$
7 (a) Defined
(b) Not defined
(c) Not defined
(d) Not defined
(e) Defined
(f) Not defined

- 9 (a) $\mathbf{T} = \begin{pmatrix} 0.90 & 0 & 0 \\ 0.10 & 0.50 & 0.02 \\ 0 & 0.50 & 0.98 \end{pmatrix}$
(b) $\vec{p}_1 = (1.8, 0.2, 0)$,
 $\vec{p}_2 = (1.62, 0.28, 0.1)$,
 $\vec{p}_3 = (1.458, 0.304, 0.238)$
11 (a) $\mathbf{T} = \begin{pmatrix} 0.97 & 0.05 \\ 0.03 & 0.95 \end{pmatrix}$
(b) $\vec{p}_{2006} = (214, 386)$,
 $\vec{p}_{2007} = (226.88, 373.12)$.
13 (a) $\vec{v} = \begin{pmatrix} 11 \\ 19 \end{pmatrix}$
(b) $\vec{v} = \begin{pmatrix} 5 \\ 11 \end{pmatrix}$
(c) $\vec{v} = \begin{pmatrix} 2a + b \\ 3a + 2b \end{pmatrix}$
15 (a) $\lambda_2 = -1$
(b) $\lambda_3 = -1$
(c) $\mathbf{A}\vec{v} = \lambda\vec{v}$, and $\mathbf{A}\vec{v}$ is parallel to \vec{v}
17 (a) $\begin{pmatrix} 3 & 5 \\ 2 & 4 \end{pmatrix} \begin{pmatrix} a \\ b \end{pmatrix} = a \begin{pmatrix} 3 \\ 2 \end{pmatrix} + b \begin{pmatrix} 5 \\ 4 \end{pmatrix}$
(b) $\vec{v} = \begin{pmatrix} -8.5 \\ 5.5 \end{pmatrix}$
(c) $\vec{v} = -8.5\vec{c}_1 + 5.5\vec{c}_2$

Chapter 12 Review

- 1 (3, 3, 6)
3 (-3, -2, 9)
5 (7, 8, -21)
7 (4, -2, 18)
9 $-4.5\vec{i} + 8\vec{j} + 0.5\vec{k}$
11 13
13 6
15 $6\vec{i} + 6\vec{j} + 6\vec{k}$
17 $\vec{a} = \vec{b} = \vec{c} = 3\vec{k}$
 $\vec{d} = 2\vec{i} + 3\vec{k}$
 $\vec{e} = \vec{j}$
 $\vec{f} = -2\vec{i}$
19 $\|\vec{u}\| = \sqrt{6}$
 $\|\vec{v}\| = \sqrt{5}$
21 (a) Yes
(b) No
23 (a) $\vec{L} = (11, 7, 11, 7, 13)$
(b) $\vec{F} = (32, 36, 21, 8, 4)$,
 $\vec{G} = (3, 3, 2, 0, 7)$
25 $F = g \sin \theta$
29 $0.4v\vec{i} + 0.693v\vec{j}$
31 (a) $\vec{AB} = 2\vec{i} - 2\vec{j} - 7\vec{k}$
 $\vec{AC} = -2\vec{i} + 2\vec{j} - 7\vec{k}$
(b) $\theta = 44.003^\circ$
35 $\vec{AB} = -\vec{u}; \vec{BC} = 3\vec{v};$
 $\vec{AC} = \vec{AB} + \vec{BC} = -\vec{u} + 3\vec{v}; \vec{AD} = 3\vec{v}$

$$37 \quad 3\vec{n} - 3\vec{m};$$

$$3\vec{m} + \vec{n};$$

$$4\vec{m} - \vec{n};$$

$$\vec{m} - 2\vec{n}$$

Ch. 12 Understanding

- 1 False
3 False
5 False
7 False
9 True
11 True
13 False
15 True
17 True
19 False
21 True
23 False
25 True

Section 13.1

- 1 Not arithmetic
3 Arithmetic
5 Arithmetic, $a_n = 3 + 3n$
7 Arithmetic, $a_n = -0.9 - 0.1n$
9 Not geometric
11 Geometric
13 Not geometric
15 Geometric; $4(1/2)^{n-1}$
17 Geometric; $1/(1.2)^{n-1}$
19 $1, 5/4, 7/5, 3/2$; not geometric
21 $-1, 1, -1, 1$; geometric
23 $1, 1/\sqrt{2}, 1/\sqrt{3}, 1/2$; not geometric
25 $n \geq 101$
27 10.8, 64.8, $4.8 + 1.2n$
29 7.9, 57.4, $2.4 + 1.1n$
31 1.661, $7(0.75)^{n-1}$
33 486, $2 \cdot 3^{n-1}$
35 (a) 646.7, 650.580, 654.484, 658.411
(b) 367.7, 396.748, 428.091, 461.911
(c) 2012
37 (a) 17.960, 18.314, 18.675
(b) $17.960(1.0197)^n$
(c) 36.5 years
39 Arithmetic, $d > 0$
41 Arithmetic, $d < 0$
43 2, 7, 12, 17; $a_n = -3 + 5n$
45 3, 7, 15, 31;
 $a_n = 2^{n-1} \cdot 3 + 2^{n-2} + 2^{n-3} + \dots + 1$
47 (a) 150, 187.5, 199.219, 199.997, 200,
200; converging
49 (a) \$256
(b) $d_n = 4^n$

Section 13.2

- 1 Not arithmetic
3 Not arithmetic

$$5 \quad (-1)^2 + 0^2 + 1^2 + 2^2 + 3^2 + 4^2 + 5^2$$

$$7 \quad 1 + 3 + 5 + 7 + 9 + 11$$

$$9 \quad (-1)^2 + (-1)^3 + (-1)^4 + \dots + (-1)^{10}$$

$$11 \quad \sum_{n=1}^7 3n$$

$$13 \quad \sum_{n=1}^8 (1/2)^n$$

$$15 \quad (a) \sum_{i=1}^{10} 2i$$

$$(b) 110$$

$$17 \quad a_1 = 3, d = 4$$

$$19 \quad a_1 = 2, d = 9$$

$$21 \quad 500,500$$

$$23 \quad 2625$$

$$25 \quad -132$$

$$27 \quad -561$$

$$29 \quad -111.3$$

$$31 \quad 150; 2325$$

- 33 (a) (i) 226.6, 248.7, 281.4; population at census time
(ii) 28.6, 22.1, 32.7; change in population over the decade.
(iii) 3.27; average yearly population growth over the decade.

- 35 612
37 9
39 (a) 256 feet, 400 feet, 576 feet
(b) 744 feet, 600 feet, 424 feet
41 7.906 sec
43 Last row: 106
Auditorium: 1360
45 (a) 297

Section 13.3

- 1 1,572,768
3 5.997
5 781.248
7 7.199
9 Yes, $a = 1$, ratio = $-1/2$
11 Yes, $a = 5$, ratio = -2
13 $\sum_{n=1}^6 (-1)^{n+1} (3^n)$
15 $\sum_{n=0}^5 (-1)^n 32(\frac{1}{2})^n$
17 $189/32$
19 1 if N is even and 0 is N is odd.
21 (a) $\sum_{n=1}^{25} 81(1.012)^{n-1}$
(b) 2345.291 bn barrels
23 (a) \$64,735.69
(b) \$65,358.46
25 (a) Doubles
(b) Less than doubles
(c) More than doubles
27 (a) \$59,159.48
(b) \$5927.45

Section 13.4

- 1 Yes, $a = 1$, ratio = $-x$

- 3 No. Ratio between successive terms is not constant
5 Yes, $a = e^x$, ratio = e^x
7 Yes, $a = 1$, ratio = $\sqrt{2}$
9 $1/(1+x)$, $|x| < 1$
11 10
13 $1/54$
15 4
17 $x^2/(1-x^2)$
19 $235/999$
21 $11/90$
23 $3781/4950$
25 (a) $P_n = 250(0.04) + 250(0.04)^2 + \dots + 250(0.04)^{n-1}$
(b) $P_n = 10(1 - (0.04)^{n-1})/(1 - 0.04)$
(c) $P_n = 10.417$
27 22.3 million dollars
29 \$1081.11

Chapter 13 Review

- 1 603; 59
3 (a) $1 + 5 + 9 + 13 + 17$
(b) 45
5 No
7 $1/(1-2z)$, $|z| < 1/2$
9 315
11 $n(n+1)/2$
13 24 cans at bottom
3 less per row
8 rows
15 435
17 \$25,503.33
19 (a) 300, 350, 400, 450, 500, 550, 600.
(b) 950 yards
(c) 31st day and after
21 (a) $h_n = 10(3/4)^n$
(b) $D_1 = 10$ feet
 $D_2 = h_0 + 2h_1 = 25$ feet
 $D_3 = h_0 + 2h_1 + 2h_2 = 36.25$ feet
 $D_4 = h_0 + 2h_1 + 2h_2 + 2h_3 \approx 44.688$ feet
(c) $D_n = 10 + 60(1 - (3/4)^{n-1})$
23 (a) \$1250
(b) 12.50

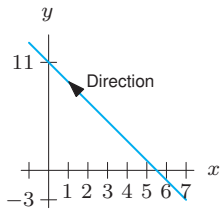
Ch. 13 Understanding

- 1 True
3 True
5 True
7 True
9 True
11 False
13 True
15 False
17 False
19 False

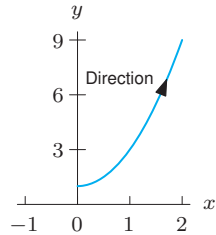
- 21 True
- 23 False
- 25 False
- 27 True
- 29 False
- 31 False
- 33 False

Section 14.1

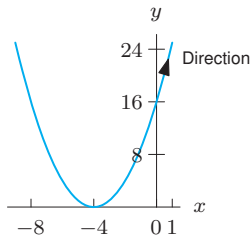
- 1 $x = 1 + 2t, y = 3 + t, 0 \leq t \leq 1$
- 3 $x = t, y = t, 0 \leq t \leq 1, x = t, y = 2 - t,$
for $1 \leq t \leq 2.$
- 5 True
- 7 False
- 9 $y = 11 - 2x$



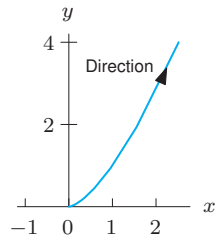
11 $y = 2x^2 + 1$



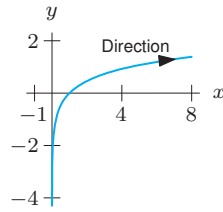
13 $y = (x + 4)^2$



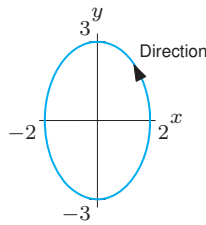
15 $y = x^{3/2}$



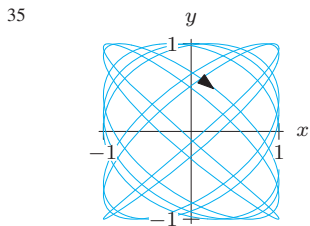
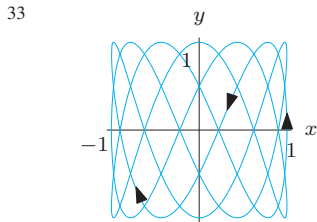
17 $y = (2/3) \ln x, x > 0$



19 $(x^2/4) + (y^2/9) = 1$

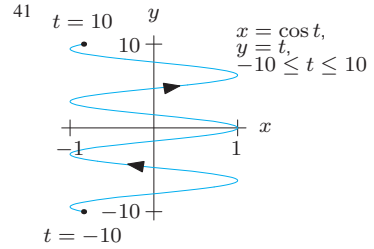


- 21 Lines from (0, 0) to (2, 0) to (2, 1) to (0, 1) to (0, 0)
- 23 Lines from (2, 0) to (1.5, 1) to (0.5, -1) to (0, 0) to (0.5, 1) to (1.5, -1) to (2, 0)
- 25 Clockwise for all $t.$
- 27 Clockwise: $t < 0,$
Counter-clockwise: $t > 0.$
- 31 (a) $x = t, y = t^2$
 $x = t + 1, y = (t + 1)^2$
- (b) $x = t, y = (t + 2)^2 + 1$
 $x = t + 1, y = (t + 3)^2 + 1$

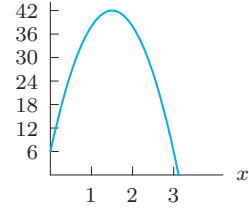


- 37 (a) Line $y = x$
- (b) Circle, with starting point (1, 0) and period 2π
- (c) Ellipse, with starting point (1, 0) and period 2π

39 $x = t, y = -4t + 7$



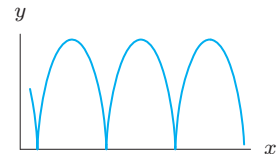
43 (a) $x = t, y = -16t^2 + 48t + 6$
(b)



- (c) 6 feet
- (d) 3 seconds
- (e) 42 feet

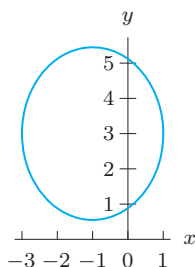
Section 14.2

- 1 Explicit
- 3 Implicit
- 5 Implicit
- 7 (0, 0); $\sqrt{10/3}$
- 9 (4, 4); 2
- 11 $x = 4 \cos t, y = -4 \sin t, 0 \leq t \leq 2\pi$
- 13 $x = 5 \sin t, y = -5 \cos t, 0 \leq t \leq 2\pi$
- 15 $x = 3 + 5 \cos t, y = 4 + 5 \sin t, 0 \leq t \leq 2\pi$
- 17 $x = -2 - \sqrt{5} \sin t, y = 1 + \sqrt{5} \cos t,$
 $0 \leq t \leq 2\pi$
- 19 True
- 21 (a) Center (2, -4), radius $\sqrt{20}$
(b) Center (-1, 2), radius $\sqrt{11}$
- 23 Parabola:
 $y = (x - 2)^2, 1 \leq x \leq 3$
- 25 $x = 4(y - 3)^2, 2 \leq y \leq 4.$
- 27 Implicit: $xy = 1, x > 0$
Explicit: $y = 1/x, x > 0$
Parametric: $x = t, y = 1/t, t > 0$
- 29 Explicit: $y = \sqrt{4 - x^2}$
Implicit: $y^2 = 4 - x^2$ or $x^2 + y^2 = 4, y > 0$
Parametric: $x = 4 \cos t, y = 4 \sin t,$ with
 $0 \leq t \leq \pi$
- 31 (a) $x = t, y = 1$
(b) $x = t + \cos t, y = 1 - \sin t$

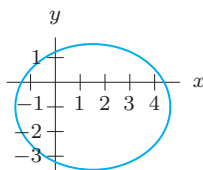


Section 14.3

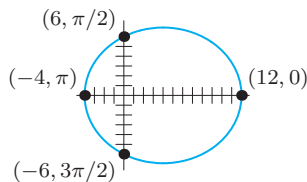
- 1 (a) $(0, 0)$; 4 ; $2\sqrt{5}$
 (b) $(x^2/4) + (y^2/5) = 1$
- 3 (a) $(1, 0)$; 16 ; 12
 (b) $((x-1)^2/64) + y^2/36 = 1$
- 5 $x = -2 \cos t$, $y = -5 \sin t$, $0 \leq t \leq 2\pi$
- 7 $x = 1 + 8 \cos t$, $y = -6 \sin t$, $0 \leq t \leq 2\pi$
- 9 Same ellipse; traced opposite direction
- 11 (a) Center $(-1, 3)$, major axis $a = \sqrt{6}$, minor axis $b = 2$



- (b) Center $(3/2, -1)$, major axis $a = \sqrt{39}/2$, minor axis $b = \sqrt{13}/2$



- 13 $((x-1)^2/4) + (y+2)^2 = 1$; $(1, -2)$; 2 ; 1
- 15 $(x+2)^2 + (y+1)^2/4 = 1$; $(-2, 1)$; 1 ; 2
- 17 $((x+1/2)^2/4) + ((y-1/2)^2/9) = 1$; $(-\frac{1}{2}, \frac{1}{2})$; 2 ; 3
- 19 $0 < k < b < h < a$
- 21 (b) Min = $r_0/(1+\epsilon)$
 Max = $r_0/(1-\epsilon)$
 (c) Center = $(8, 0)$



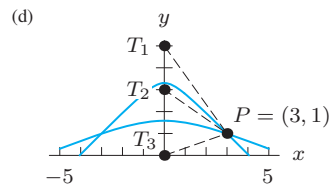
- (d) $2r_0/(1-\epsilon^2)$
- 23 (a) $\left(\frac{2x-r_m+r_e}{r_e+r_m}\right)^2 + \frac{y^2}{b^2} = 1$
 (b) $b = \sqrt{r_e r_m}$

Section 14.4

- 1 (a) $(0, 7)$; $(0, -7)$; $(0, 0)$
 (b) $y = 7x/2$; $y = -7x/2$
 (c) $(y^2/49) - (x^2/4) = 1$
- 3 (a) $(4, 4)$; $(2, 4)$; $(3, 4)$
 (b) $y = 3x - 5$; $y = -3x + 13$
 (c) $(x-3)^2 - (y-4)^2/9 = 1$
- 5 $x = 2 \tan t$, $y = 7/\cos t$;
 Upper half: $0 \leq t < \pi/2$, $3\pi/2 < t < 2\pi$
- 7 $x = 3 + 1/\cos t$, $y = 4 + 3 \tan t$;
 Left half: $\pi/2 < t < 3\pi/2$
- 9 $((x-1)^2/4) - (y-2)^2 = 1$
 $(1, 2)$; right-left; 2 ; 1
- 11 $((x+1)^2/4) - (y+3)^2 = 1$
 $(-1, -3)$; right-left; 2 ; 1
- 13 $(y-1/2)^2 - ((x-1)^2/9) = 1$
 $(1, 1/2)$; up-down; 3 ; 1
- 15 II; $k < h < 0 < a < b$.
- 17 (a) Center $(-5, 2)$; Vertices $(-5 \pm \sqrt{6}, 2)$;
 Asymptotes $y = \pm(2/\sqrt{6})(x+5) + 2$
 (b) Center $(-1, -2)$; Vertices $(-1 \pm \sqrt{14}, -2)$; Asymptotes $y = \pm(x+1) - 2$

Section 14.5

- 1 Ellipse; x -axis
- 3 Hyperbola; y -axis
- 5 Hyperbola; y -axis
- 7 $(0, \pm\sqrt{5})$
- 9 $(0, -2)$, vertical axis
- 11 (a), (b), (c)
- 13 $(\pm\sqrt{2}, 0)$
- 15 $x = -(1/4)y^2$
- 17 The mess sergeant's
- 19 $(-2, 0)$; $(-31/16, 0)$
- 21 $x = (1/8)y^2 + 1$; $x = -1$
- 23 $(0, 0)$; $(0, 0)$
- 25 $(-2, 3)$; $(-2 \pm 5/\sqrt{2}, 3)$
- 27 $x^2/3 + (y-2)^2/4 = 1$
- 29 $(\pm 2\sqrt{2}, 0)$; $(\pm\sqrt{24}, 0)$
- 31 $y^2/49 - x^2/4 = 1$; $(0, \pm\sqrt{53})$
- 33 Back to original focal point
- 35 No
- 37 9 inches
- 39 3 ft above center
- 41 (a) 5338 million km
 (b) $(x-2581)^2/2669^2 + y^2/680^2 = 1$
 (c) $x = 2581 + 2669 \cos t$,
 $y = 680 \sin t$, $0 \leq t \leq 2\pi$
- 43 (a) $(y-4)^2/0.486 - x^2/0.514 = 1$
 (b) $(y-2.5)^2/0.844 - x^2/5.406 = 1$
 (c) $y = -0.697\sqrt{1+x^2/0.514} + 4$;
 $y = -0.919\sqrt{1+x^2/5.406} + 2.5$



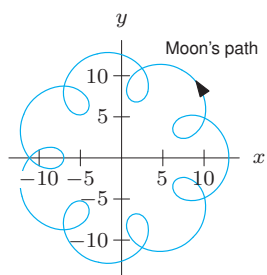
Section 14.6

- 1 $x = \sinh t$, $y = \cosh t$, $-\infty < t < \infty$
- 3 $x = -\cosh t$, $y = \sinh t$, $-\infty < t < \infty$
- 5 $x = 1 + 2 \sinh t$, $y = -1 - 3 \cosh t$,
 $-\infty < t < \infty$
- 7 $x = -1 + (\sinh t)/2$, $y = -3 - (\cosh t)/3$,
 $-\infty < t < \infty$
- 9 $x = -1 + 3 \sinh t$, $y = -3 + 2 \cosh t$,
 $-\infty < t < \infty$
- 13 $\sinh x \rightarrow (e^x)/2$ as $x \rightarrow \infty$
 $\sinh x \rightarrow -(e^{-x})/2$ as $x \rightarrow -\infty$
- 15 $x = -1 - 2 \cosh t$, $y = 1 + \sinh t$, $-\infty < t < \infty$
- 17 $x = 3 + 2 \sinh t$, $y = -\frac{1}{2} + \sqrt{2} \cosh t$,
 $-\infty < t < \infty$
- 19 $x = h + a \cosh t$ and $y = k + b \sinh t$
- 21 Yes, $\cosh 2x = \cosh^2 x + \sinh^2 x$
- 25 $\sin(ix) = i \sinh x$

Chapter 14 Review

- 1 Circle; $(0, 3)$; $\sqrt{5}$
- 3 Hyperbola, $(0, 1)$; 2 ; 3 ; left-right
- 5 Ellipse, $(5, 0)$; 2 ; 3
- 7 Hyperbola, $(-1/3, 1/2)$; $\sqrt{3}$; $\sqrt{2}$; up-down
- 9 $x = 3 \cos t$, $y = -3 \sin t$, $0 \leq t \leq 2\pi$
- 11 $x = -2 \cos t$, $y = 2 \sin t$,
 $0 \leq t \leq 2\pi$
- 13 $x = 5 \cos t$, $y = 7 \sin t$,
 $0 \leq t \leq 2\pi$
- 15 $x = -3 \cos t$, $y = -7 \sin t$,
 $0 \leq t \leq 2\pi$
- 17 $(\pm\sqrt{21}, 0)$
- 19 $(0, 1/20)$; $y = -1/20$
- 21 $x = \cos t$, $y = \sin t$
- 23 Circle; $(-1, 0)$; 1
- 25 Ellipse; $(1, -\frac{1}{3})$; 1 ; $\sqrt{2/3}$
- 27 No, since $(0, 1)$ not on curve
- 29 (a) $x = 10 \cos t$, $y = 10 \sin t$
 (b) $x = 10 \cos t + 3 \cos 8t$
 $y = 10 \sin t + 3 \sin 8t$

(c)



Ch. 14 Understanding

- 1 True
- 3 True
- 5 False
- 7 False
- 9 False
- 11 True
- 13 False
- 15 True

- 17 True
- 19 True
- 21 False
- 23 False
- 25 True
- 27 False
- 29 False
- 31 True
- 33 False