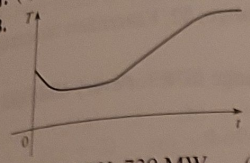
H Answers to Odd-Numbered Exercises

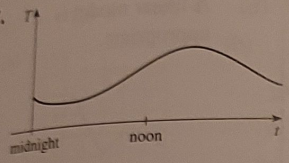
CHAPTER 1

EXERCISES 1.1 ■ PAGE 19

1. Yes
3. (a) 3 (b) -0.2 (c) 0, 3 (d) -0.8 (e) $[-2, 4]$, $[-1, 3]$ (f) $[-2, 1]$
5. $[-85, 115]$ **7.** No
9. Yes, $[-3, 2]$, $[-3, -2) \cup [-1, 3]$
11. (a) 13.8°C (b) 1990 (c) 1910, 2005 (d) [13.5, 14.5]
13.



15. (a) 500 MW; 730 MW (b) 4 AM; noon; yes
17.



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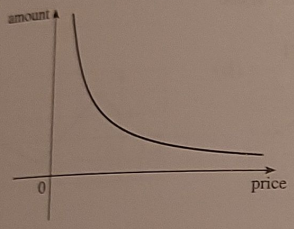

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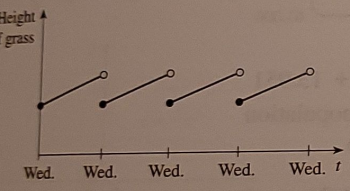
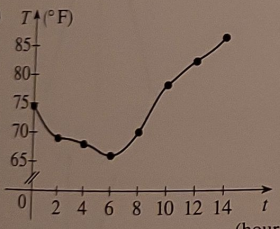
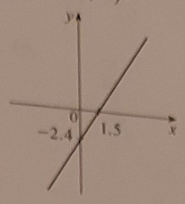


23. (a)

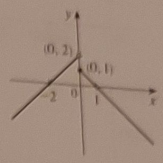


(b) 74°F

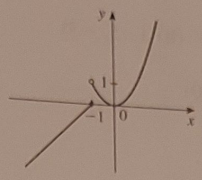
25. $12, 16, 3a^2 - a + 2, 3a^2 + a + 2, 3a^2 + 5a + 4, 6a^2 - 2a + 4, 12a^2 - 2a + 2, 3a^4 - a^2 + 2, 9a^4 - 6a^3 + 13a^2 - 4a + 4, 3a^2 + 6ah + 3h^2 - a - h + 2$
27. $-3 - h$ **29.** $-1/(ax)$
31. $(-\infty, -3) \cup (-3, 3) \cup (3, \infty)$ **33.** $(-\infty, \infty)$
35. $(-\infty, 0) \cup (5, \infty)$ **37.** $[0, 4]$
39. $(-\infty, \infty)$



41. $-1, 1, -1$



43. $-2, 0, 4$



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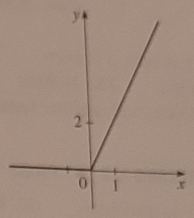

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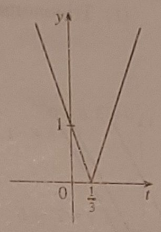
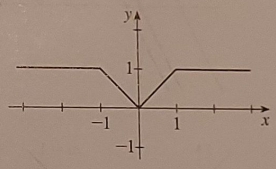
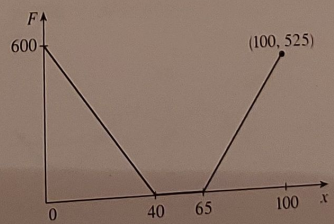
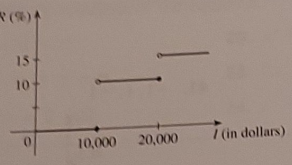


49.

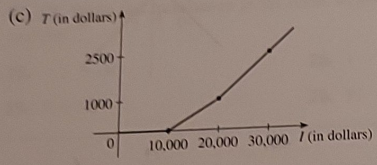


51. $f(x) = \frac{5}{2}x - \frac{11}{2}, 1 \le x \le 5$ **53.** $f(x) = 1 - \sqrt{-x}$
55. $f(x) = \begin{cases} -x + 3 & \text{if } 0 \le x \le 3 \\ 2x - 6 & \text{if } 3 < x \le 5 \end{cases}$
57. $A(L) = 10L - L^2, 0 < L < 10$
59. $A(x) = \sqrt{3}x^2/4, x > 0$ **61.** $S(x) = x^2 + (8/x), x > 0$
63. $V(x) = 4x^3 - 64x^2 + 240x, 0 < x < 6$
65. $F(x) = \begin{cases} 15(40 - x) & \text{if } 0 \le x < 40 \\ 0 & \text{if } 40 \le x \le 65 \\ 15(x - 65) & \text{if } x > 65 \end{cases}$



67. (a) 

(b) \$400, \$1900

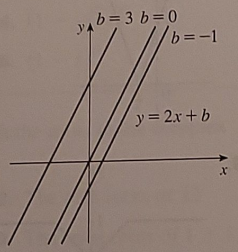
(c) 

69. f is odd, g is even **71.** (a) $(-5, 3)$ (b) $(-5, -3)$
73. Odd **75.** Neither **77.** Even
79. Even; odd; neither (unless $f = 0$ or $g = 0$)

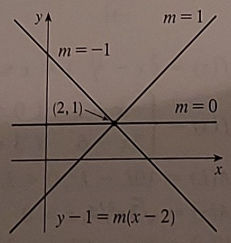
EXERCISES 1.2 ■ PAGE 33

1. (a) Logarithmic (b) Root (c) Rational
(d) Polynomial, degree 2 (e) Exponential (f) Trigonometric
3. (a) h (b) f (c) g
5. $\{x \mid x \neq \pi/2 + 2n\pi, n \text{ an integer}\}$

7. (a) $y = 2x + b$, where b is the y-intercept.

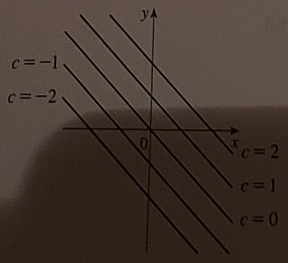


(b) $y = mx + 1 - 2m$, where m is the slope.

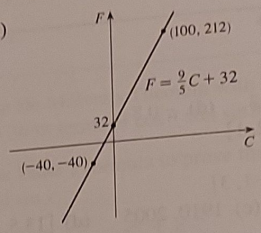


(c) $y = 2x - 3$

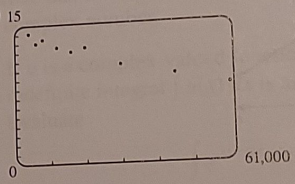
9. Their graphs have slope -1.



11. $f(x) = -3x(x + 1)(x - 2)$
13. (a) 8.34, change in mg for every 1 year change
(b) 8.34 mg

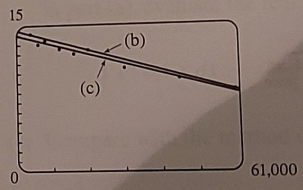
15. (a) 

(b) $\frac{9}{5}$, change in °F for every 1°C change; 32, Fahrenheit temperature corresponding to 0°C

17. (a) $T = \frac{1}{6}N + \frac{307}{6}$ (b) $\frac{1}{6}$, change in °F for every chirp per minute change (c) 76°F
19. (a) $P = 0.434d + 15$ (b) 196 ft
21. (a) Cosine (b) Linear
23. (a) 

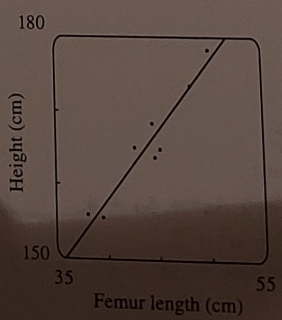
A linear model is appropriate.

(b) $y = -0.000105x + 14.521$



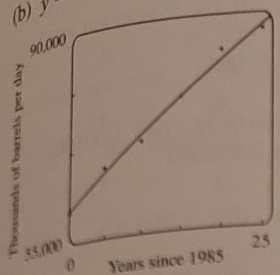
(c) $y = -0.00009979x + 13.951$
(d) About 11.5 per 100 population
(e) About 6% (f) No

25. (a) See graph in part (b).
(b) $y = 1.88074x + 82.64974$



(c) 182.3 cm

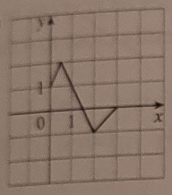
27. (a) A linear model is appropriate. See graph in part (b).
(b) $y = 1116.64x + 60{,}188.33$



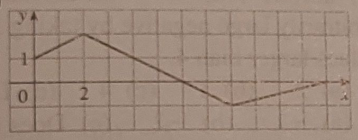
(c) In thousands of barrels per day: 79,171 and 90,338
29. Four times as bright
31. (a) $N = 3.1046A^{0.308}$ (b) 18

EXERCISES 1.3 ■ PAGE 42

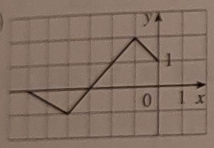
1. (a) $y = f(x) + 3$ (b) $y = f(x) - 3$ (c) $y = f(x - 3)$
(d) $y = f(x + 3)$ (e) $y = -f(x)$ (f) $y = f(-x)$
(g) $y = 3f(x)$ (h) $y = \frac{1}{3}f(x)$
3. (a) 3 (b) 1 (c) 4 (d) 5 (e) 2
5. (a)



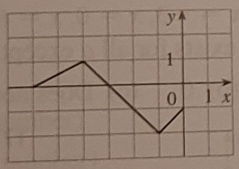
(b)



(c)

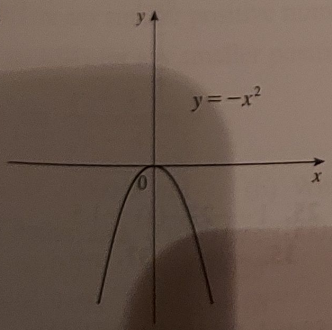


(d)



7. $y = -\sqrt{-x^2 - 5x - 4} - 1$

9.



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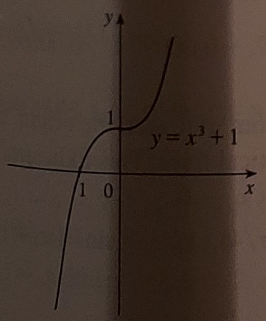
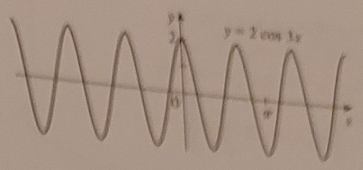


13.



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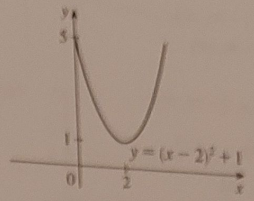

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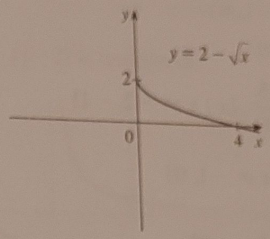

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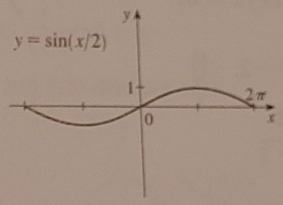

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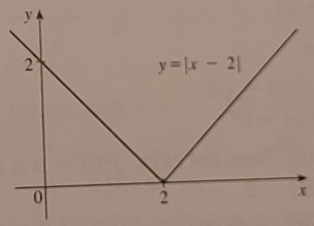

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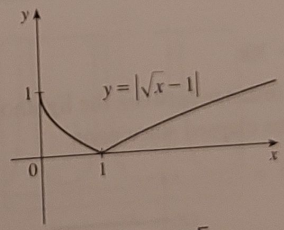
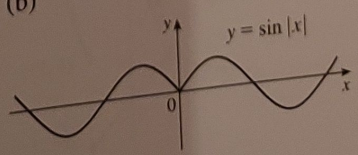


25. $L(t) = 12 + 2\sin\left[\dfrac{2\pi}{365}(t - 80)\right]$

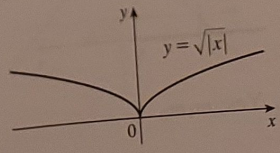
27. $D(t) = 5\cos[(\pi/6)(t - 6.75)] + 7$

29. (a) The portion of the graph of $y = f(x)$ to the right of the y-axis is reflected about the y-axis.

(b)



(c)



31. (a) $(f+g)(x) = x^3 + 5x^2 - 1, (-\infty, \infty)$
(b) $(f-g)(x) = x^3 - x^2 + 1, (-\infty, \infty)$
(c) $(fg)(x) = 3x^5 + 6x^4 - x^3 - 2x^2, (-\infty, \infty)$
(d) $(f/g)(x) = \dfrac{x^3 + 2x^2}{3x^2 - 1}, \left\{x \mid x \neq \pm\dfrac{1}{\sqrt{3}}\right\}$

33. (a) $(f \circ g)(x) = 3x^2 + 3x + 5, (-\infty, \infty)$
(b) $(g \circ f)(x) = 9x^2 + 33x + 30, (-\infty, \infty)$
(c) $(f \circ f)(x) = 9x + 20, (-\infty, \infty)$
(d) $(g \circ g)(x) = x^4 + 2x^3 + 2x^2 + x, (-\infty, \infty)$

35. (a) $(f \circ g)(x) = \sqrt{4x - 2}, \left[\frac{1}{2}, \infty\right)$
(b) $(g \circ f)(x) = 4\sqrt{x+1} - 3, [-1, \infty)$
(c) $(f \circ f)(x) = \sqrt{\sqrt{x+1} + 1}, [-1, \infty)$
(d) $(g \circ g)(x) = 16x - 15, (-\infty, \infty)$

37. (a) $(f \circ g)(x) = \dfrac{2x^2 + 6x + 5}{(x+2)(x+1)}, \{x \mid x \neq -2, -1\}$

(b) $(g \circ f)(x) = \dfrac{x^2 + x + 1}{(x+1)^2}, \{x \mid x \neq -1, 0\}$

(c) $(f \circ f)(x) = \dfrac{x^4 + 3x^2 + 1}{x(x^2+1)}, \{x \mid x \neq 0\}$

(d) $(g \circ g)(x) = \dfrac{2x+3}{3x+5}, \left\{x \mid x \neq -2, -\frac{5}{3}\right\}$

39. $(f \circ g \circ h)(x) = 3\sin(x^2) - 2$

41. $(f \circ g \circ h)(x) = \sqrt{x^6 + 4x^3 + 1}$

43. $g(x) = 2x + x^2, f(x) = x^4$

45. $g(x) = \sqrt[3]{x}, f(x) = x/(1+x)$

47. $g(t) = t^2, f(t) = \sec t \tan t$

49. $h(x) = \sqrt{x}, g(x) = x - 1, f(x) = \sqrt{x}$

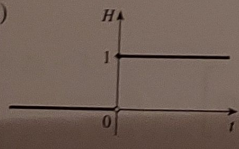
51. $h(t) = \cos t, g(t) = \sin t, f(t) = t^2$

53. (a) 4 (b) 3 (c) 0 (d) Does not exist; $f(6) = 6$ is not in the domain of g. (e) 4 (f) -2

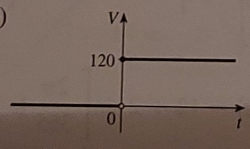
55. (a) $r(t) = 60t$ (b) $(A \circ r)(t) = 3600\pi t^2$; the area of the circle as a function of time

57. (a) $s = \sqrt{d^2 + 36}$ (b) $d = 30t$
(c) $(f \circ g)(t) = \sqrt{900t^2 + 36}$; the distance between the lighthouse and the ship as a function of the time elapsed since noon

59. (a)

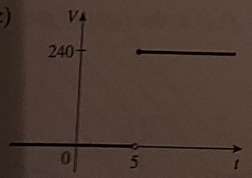


(b)



$V(t) = 120H(t)$

(c)



$V(t) = 240H(t-5)$

61. Yes; $m_1 m_2$

63. (a) $f(x) = x^2 + 6$ (b) $g(x) = x^2 + x - 1$

65. Yes

EXERCISES 1.4 ■ PAGE 49

1. (a) $-44.4, -38.8, -27.8, -22.2, -16.\overline{6}$
(b) -33.3 (c) $-33\frac{1}{3}$

3. (a) (i) 2 (ii) 1.111111 (iii) 1.010101 (iv) 1.001001
(v) 0.666667 (vi) 0.909091 (vii) 0.990099
(viii) 0.999001 (b) 1 (c) $y = x - 3$

5. (a) (i) -32 ft/s (ii) -25.6 ft/s (iii) -24.8 ft/s
(iv) -24.16 ft/s (b) -24 ft/s

7. (a) (i) 29.3 ft/s (ii) 32.7 ft/s (iii) 45.6 ft/s
(iv) 48.75 ft/s (b) 29.7 ft/s

9. (a) 0, 1.7321, -1.0847, -2.7433, 4.3301, -2.8173, 0, -2.1651, -2.6061, -5, 3.4202; no (c) -31.4

EXERCISES 1.5 ■ PAGE 59

1. Yes

3. (a) $\lim_{x \to -3} f(x) = \infty$ means that the values of $f(x)$ can be made arbitrarily large (as large as we please) by taking x sufficiently close to -3 (but not equal to -3).
(b) $\lim_{x \to 4^+} f(x) = -\infty$ means that the values of $f(x)$ can be made arbitrarily large negative by taking x sufficiently close to 4 through values larger than 4.

5. (a) 2 (b) 1 (c) 4 (d) Does not exist (e) 3

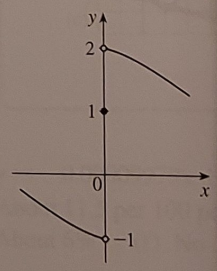
7. (a) -1 (b) -2 (c) Does not exist (d) 2 (e) 0
(f) Does not exist (g) 1 (h) 3

9. (a) $-\infty$ (b) ∞ (c) ∞ (d) $-\infty$ (e) ∞
(f) $x = -7, x = -3, x = 0, x = 6$

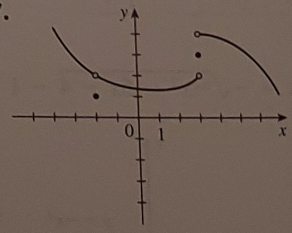
11. $\lim_{x \to a} f(x)$ exists for all a except $a = -1$.

13. (a) 1 (b) 0 (c) Does not exist

15.



17.



19. $\frac{1}{2}$ **21.** $\frac{1}{2}$ **23.** 1.5 **25.** 1 **27.** (a) -1.5
29. ∞ **31.** ∞ **33.** $-\infty$ **35.** $-\infty$ **37.** $-\infty$
39. ∞ **41.** $-\infty$; ∞

43. (a) 0.998000, 0.638259, 0.358484, 0.158680, 0.038851, 0.008928, 0.001465; 0
(b) 0.000572, -0.000614, -0.000907, -0.000978, -0.000993, -0.001000; -0.001

45. No matter how many times we zoom in toward the origin, the graph appears to consist of almost-vertical lines. This indicates more and more frequent oscillations as $x \to 0$.

47. $x \approx \pm 0.90, \pm 2.24$; $x = \pm\sin^{-1}(\pi/4), \pm(\pi - \sin^{-1}(\pi/4))$

49. (a) 6 (b) Within 0.0649 of 1