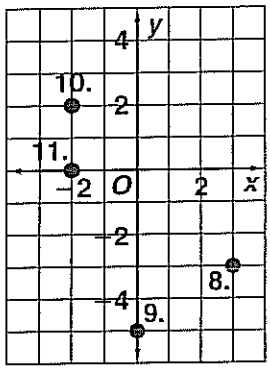
DIAGNOSING READINESS page 234

1. Let n = number of pens and t = total price; $t = 0.59n$.
2. Let h = height of house and t = height of tower; $t = h + 200$. **3.** Let s = length of a side and p = perimeter; $p = 3s$. **4.** $3(-1) - 2(2) = -3 - 4 = -7$
5. $-(-3)^2 + 3(-3) = -9 - 9 = -18$ **6.** $\frac{3+3}{3} = 2$
7. $-1 - [(-1)^2 - 1] \div 2 = -1 - 0 \div 2 = -1$

8–11.



12.
$$|r + 2| = 2$$
$$r + 2 = 2 \quad \text{or} \quad r + 2 = -2$$
$$r + 2 - 2 = 2 \quad | \quad r + 2 - 2 = -2 - 2$$
(We'll skip showing that step from now on.)
$$r = 0 \quad \text{or} \quad r = -4$$

13.
$$-3|d - 5| = -6$$
$$\frac{-3|d-5|}{-3} = \frac{-6}{-3}$$
$$|d - 5| = 2$$
$$d - 5 = 2 \quad \text{or} \quad d - 5 = -2$$
$$d = 7 \quad \text{or} \quad d = 3$$

14. No solution; an absolute value cannot be negative.

15.
$$\frac{4}{w} = \frac{5}{8}$$
$$4 \cdot 8 = 5w$$
$$\frac{32}{5} = \frac{5w}{5}$$
$$6\frac{2}{5} = w$$

16.
$$\frac{c}{2.2} = \frac{3}{11}$$
$$11c = 3(2.2)$$
$$\frac{11c}{11} = \frac{6.6}{11}$$
$$c = 0.6$$

17.
$$\frac{4}{0.5} = \frac{36}{p}$$
$$4p = 0.5(36)$$
$$\frac{4p}{4} = \frac{18}{4}$$
$$p = 4.5$$

18.
$$-\frac{29}{2} = \frac{d}{4}$$
$$-4 \cdot 29 = 2d$$
$$\frac{-4 \cdot 29}{2} = \frac{2d}{2}$$
$$-58 = d$$

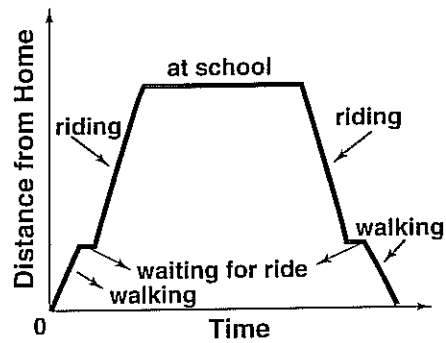
5-1 Relating Graphs to Events pages 236–240

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

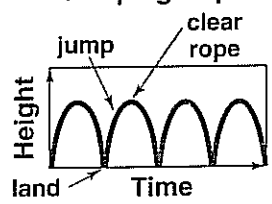
1. C **2.** D **3.** E **4.** A **5.** (0, 0) **6.** (−4, −2) **7.** (−3, 3)

Check Understanding 1–2. Labels may vary. Samples are given.

1.



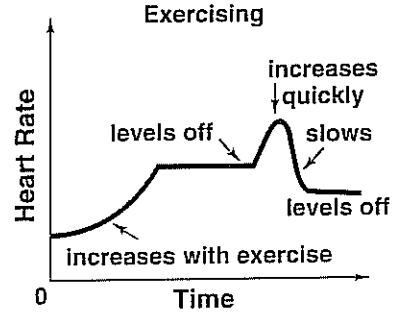
2.



3A. The height of water in the straight-sided cup A will increase steadily with time, as in curve III. **3B.** The water in the bowl B will rise at a decreasing rate, as in curve I, because it will take more water to fill an inch of the bowl near the top. **3C.** The water in curved vessel C will rise quickly at the bottom where it is narrow, slowly at the middle where it is wide, and then quickly at the narrow top, as in curve II.

Exercises 1–4. Labels may vary. Samples are given.

1.



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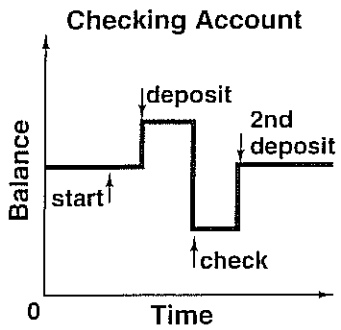

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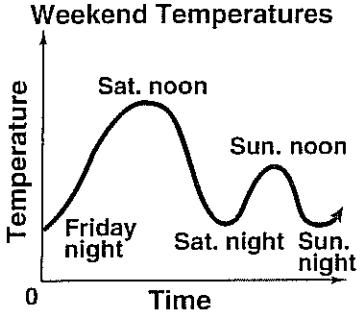
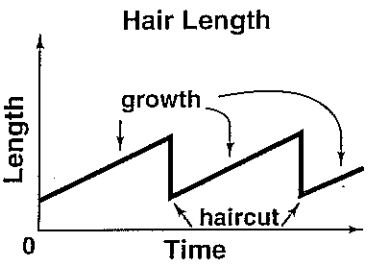
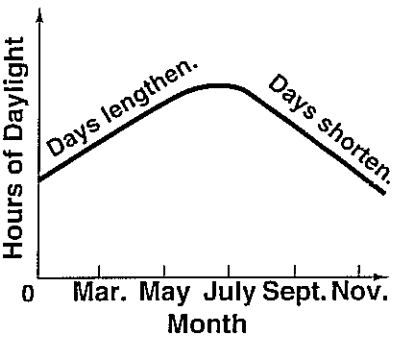


4.

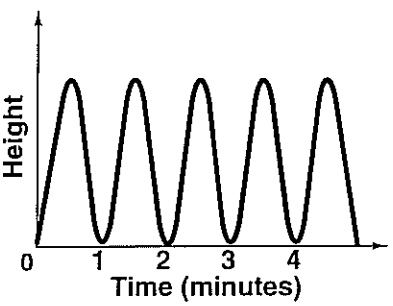


5–8. Graphs may vary. Samples are given.

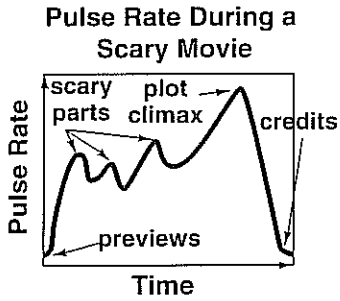
5.



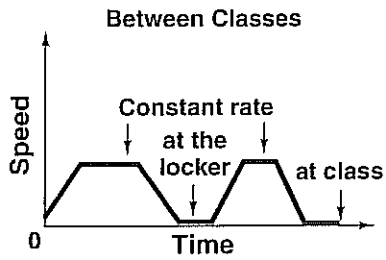
6.



7.

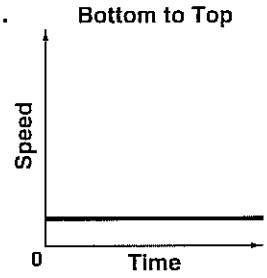


8.

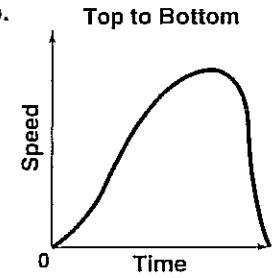


9. C; the temperature increases steadily and alternates cooling and warming as the oven turns off and on during a cooking cycle. **10.** The pressure dropped from 7 A.M. to 3 P.M., stayed about the same until 9 P.M., and then generally rose until 7 A.M. the next day.

11a.

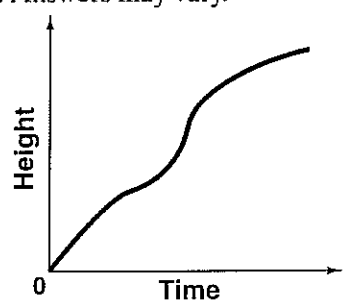


11b.



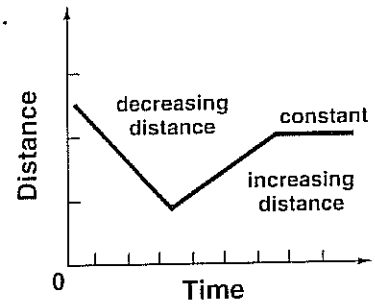
No; the graphs are different because you have a constant speed traveling up but not down. **12a.** Curve for puppy is blue; curve for human baby is red. **12b.** The baby is more developed and weighs more at birth and gains weight steadily for a number of years. The puppy is less developed at birth, and its weight levels off at an earlier age. **13.** Answers may vary.

Sample:



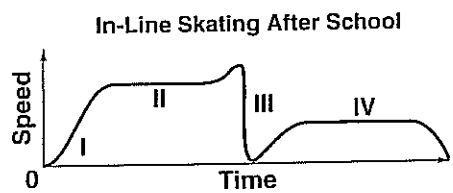
14. At first the graph shows the bicyclist speeding up, which would correspond to going down a hill; then the speed decreases as it would on starting up a hill; then the speed is steady at a low rate which could correspond to continuing up a hill of constant slope.

15a.



15b. section showing the distance decreasing **15c.** In the first two sections the distance is changing at a constant rate, so the student is walking at a constant speed. (In the third section the distance is constant so the student is not walking.)

16. A; one's growth rate is not steady, as shown in B. Also, as one gets older one's height decreases slightly. **17a.** Check students' work. **17b.** A graph of daily high temperatures at the equator would show little change. **18.** \$3; the price of \$3 covers any time up to and including 2 hours (solid red dot). **19.** 121 minutes is a little more than 2 hours, for which the price is \$6. **20.** \$6 is the price for any time more than (open circle) 2 hours, up to and including 4 hours (solid red dot). **21.** Yes; the horizontal line segments look like the treads in a sequence of steps. **22a.** Answers may vary. Sample: The student started skating and got up to cruising speed. After a while, the student sped up going downhill, lost control, and crashed. After quickly getting up, the student decided not to go as fast. **22b.** Answers may vary. Sample:



I — speeding up
II — cruising
III — crash
IV — slower speed

23. Section I might be going to a bus stop but it is steep, so it probably corresponds to Molly getting a ride to the bus stop. Section V is less steep which looks like walking to a bus stop on the way home. The answer is D.

24. Section VI is for roughly an hour; the answer is H.

25. Glass II would show sand rising at an increasing rate with time, and glass III would show a constant rate of rise with time, so these are rejected. Glasses I and IV would show a rate of rise that decreases with time. I would level off soon, so glass IV seems the best choice.

26. $P(\text{red 1 and blue 6}) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$ **27.** $P(\text{red 3 and blue 5}) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$ **28.** $P(\text{red} > 4 \text{ and blue 5}) = P[(\text{red 5 or 6}) \text{ and blue 5}] = \frac{2}{6} \cdot \frac{1}{6} = \frac{1}{18}$ **29.** $P(\text{red odd and blue 3}) = P(\text{red 1, 3, or 5 and blue 3}) = \frac{3}{6} \cdot \frac{1}{6} = \frac{1}{12}$

30. $P(\text{red and blue even}) = P(\text{red 2, 4, or 6 and blue 2, 4, or 6}) = \frac{3}{6} \cdot \frac{3}{6} = \frac{1}{4}$ **31.** $P(\text{1 and 1, 2 and 2, 3 and 3, 4 and 4, 5 and 5, or 6 and 6}) = \frac{6 \text{ outcomes}}{36 \text{ possibilities}} = \frac{1}{6}$

32.
$$5x + 2 < 37$$
$$5x < 35$$
$$\frac{5x}{5} < \frac{35}{5}$$
$$x < 7$$

33.
$$x + 4 > 2x - 4$$
$$4 > x - 4$$
$$8 > x$$

34.
$$8x + 4 - 3x \geq 3x$$
$$5x + 4 \geq 3x$$
$$2x + 4 \geq 0$$
$$2x \geq -4$$
$$x \geq -2$$

35.
$$7 > -4x - 9$$
$$16 > -4x$$
$$\frac{16}{-4} < \frac{-4x}{-4}$$
$$-4 < x$$

36.
$$7(x + 1) \leq 6(x - 1)$$
$$7x + 7 \leq 6x - 6$$
$$x + 7 \leq -6$$
$$x \leq -13$$

37.
$$-2 + 5x < 8 - 10x$$
$$-2 + 15x < 8$$
$$15x < 10$$
$$x < \frac{10}{15}$$
$$x < \frac{2}{3}$$

38.
$$4t = 44$$
$$t = \frac{44}{4} = 11$$

39.
$$x - 8 = 9$$
$$x - 8 + 8 = 9 + 8$$
$$x = 17$$

40.
$$\frac{d}{3} = 15$$
$$3\left(\frac{d}{3}\right) = 3 \cdot 15$$
$$d = 45$$

41.
$$-9 = m + 6$$
$$-15 = m$$

42.
$$y + 18 = 2$$
$$y = -16$$

43.
$$\frac{k}{7} = 42$$
$$7\left(\frac{k}{7}\right) = 7 \cdot 42$$
$$k = 294$$

44.
$$1.2q = 7.2$$
$$\frac{1.2q}{1.2} = \frac{7.2}{1.2}$$
$$q = 6$$

45. $g + 22 = 25$

$g = 3$

46. $-1 = p - 8$

$7 = p$

47. $3x = 123$

$\frac{3x}{3} = \frac{123}{3}$

$x = 41$

48. $b - 78 = 101$

$b = 179$

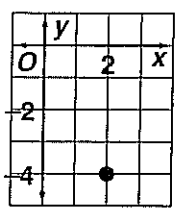
$2c = \frac{1}{2}$

$\frac{2c}{2} = \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$

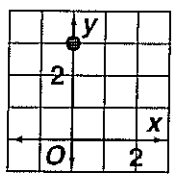
5-2 Relations and Functions pages 241–246

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

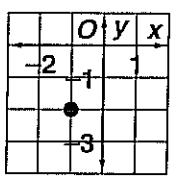
1.



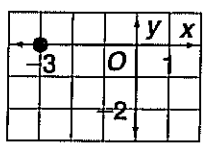
2.



3.



4.



5. -17 **6.** -1 **7.** 108

Check Understanding **1.** domain = $\{-2, -1, 4\}$; range = $\{-2, 1, 3\}$ **2a.** Function; for every x there's only one y. **2b.** Not a function; for $x = 0$ we have $y = 2$ and $y = -3$. **3a.** Not a function; for $x = 3$ we have $y = -2$ and $y = 3$. **3b.** Function; no domain value corresponds to more than one range value. **4a.** $y = 2(2.1) + 1 = 4.2 + 1 = 5.2$ **4b.** $f(2.1) = (2.1)^2 - 4 = 4.41 - 4 = 0.41$ **4c.** $g(2.1) = -2.1 + 2 = -0.1$ **5a.** $f(-2) = -2 - 6 = -8$; $f(0) = 0 - 6 = -6$; $f(5) = 5 - 6 = -1$; range = $\{-8, -6, -1\}$ **5b.** $y = -4(-2) = 8$; $-4(0) = 0$; $-4(5) = -20$; range = $\{-20, 0, 8\}$ **5c.** $g(-2) = (-2)^2 + 1 = 4 + 1 = 5$; $g(0) = 0^2 + 1 = 1$; $g(5) = 5^2 + 1 = 25 + 1 = 26$; range = $\{1, 5, 26\}$

Exercises **1.** domain = $\{4, 5, 6\}$; range = $\{3, 6, 7, 19\}$ **2.** domain = $\{-3, -2, 0, 4\}$; range = $\{5, 7, 8, 22\}$ **3.** domain = $\{-2, 2, 3\}$; range = $\{-3, -2, 3\}$ **4.** domain = $\{1\}$; range = $\{-7, 0, 5, 6.1, 10\}$ **5.** domain = $\{-3.1, 1.2, 8.4\}$; range = $\{-5.2, 0, 4\}$ **6.** domain = $\left\{-\frac{2}{3}, \frac{1}{2}, 4, 5\right\}$; range = $\left\{-1, 0, \frac{3}{5}\right\}$ **7.** yes; no vertical line-ups **8.** No; for $x = 5$ we have $y = 0$ and $y = 1$. **9.** No; for $x = 3$ we have $y = -1$ and $y = 2$. **10.** yes; no repeats **11.** no; five y's for one x **12.** no; two y's at $x = 5$ **13.** yes; no duplication **14.** no; duplication **15.** $y = -3 + 7 = 4$ **16.** $y = 11(-3) - 1 = -34$ **17.** $f(-3) = (-3)^2 = 9$ **18.** $f(-3) = -4(-3) = 12$ **19.** $f(-3) = 15 - (-3) = 18$ **20.** $y = 3(-3) + 2 = -7$ **21.** $y = \frac{1}{4}(-3) = -\frac{3}{4}$ **22.** $f(-3) = -(-3) + 2 = 5$ **23.** $5(0.5) - 2 = 0.5$; $5 \cdot 11 - 2 = 53$; range = $\{0.5, 53\}$ **24.** $5(-1.2) - 2 = -6 - 2 = -8$; $5 \cdot 0 - 2 = -2$; $5 \cdot 4 - 2 = 18$; range = $\{-8, -2, 18\}$ **25.** $5(-5) - 2 = -27$; $5(-1) - 2 = -7$; $5 \cdot 0 - 2 = -2$; $5 \cdot 2 - 2 = 8$; $5 \cdot 10 - 2 = 48$; range = $(-27, -7, -2, 8, 48\}$ **26.** $5\left(-\frac{1}{2}\right) - 2 = -4\frac{1}{2}$; $5\left(\frac{1}{4}\right) - 2 = -\frac{3}{4}$; $5\left(\frac{2}{5}\right) - 2 = 0$; range = $\left\{-4\frac{1}{2}, -\frac{3}{4}, 0\right\}$ **27.** no; two y's for $x = 1$ **28.** no; two y's for $x = 33$ **29.** yes; no duplication in x's; domain = $\{-4, -1, 0, 3\}$; range = $\{-4\}$ **30.** no; two different lengths for age = 4 years **31.** The student got confused because there are two different x's for the same y. But the test is, are there two different y's for the same x? No, there aren't; the relation is a function. **32a.** $p = 6(0) - 300 = -300$; $6(15) - 300 = 90 - 300 = -210$; $6(50) - 300 = 300 - 300 = 0$; $6(62) - 300 = 372 - 300 = 72$; range = $\{-300, -210, 0, 72\}$ **32b.** The domain is the number of cameras sold at \$6 each; the range is the markup (before considering overhead costs).

33.

x	y
14	60
13	58
16	60
14	63

The data represent the ages of four students in years (x) and their heights in inches (y). **34.** $f(-1) = 4(-1) + 1 = -3$; $4(0.5) + 1 = 2 + 1 = 3$; $4(3.7) + 1 = 14.8 + 1 = 15.8$; range = $\{-3, 3, 15.8\}$ **35.** $g(-1) = -4(-1) + 1 = 5$; $-4(0.5) + 1 = -2 + 1 = -1$; $-4(3.7) + 1 = -14.8 + 1 = -13.8$; range = $\{-13.8, -1, 5\}$ **36.** $y = |-1| - 1 = 1 - 1 = 0$; $|0.5| - 1 = 0.5 - 1 = -0.5$; $|3.7| - 1 = 3.7 - 1 = 2.7$; the range is $\{-0.5, 0, 2.7\}$. **37.** $s(-1) = (-1)^2 - 1 = 1 - 1 = 0$; $s(0.5) = (0.5)^2 - 1 = 0.25 - 1 = -0.75$; $3.7^2 - 1 = 13.69 - 1 = 12.69$; the range is $\{-0.75, 0, 12.69\}$. **38.** yes **39.** No; one vertical pencil crosses the red curve at two points. **40.** yes **41a.** Answers may vary. Sample: The cost, which amounts to 0.15 ¢ per minute, appears far too little. **41b.** Answers may vary. Sample: The student failed to convert 2 hours to 120 minutes. **41c.** Time = 1 hour = 120 minutes; $c = 0.09 \cdot 120 = 10.80$; the cost is \$10.80. **41d.** Domain = whole numbers from 1 to 240; range = positive numbers from 0.09 to 21.60; a call for over 4 hours could be described as "unreasonable." **42a.** (186,000 mi/s)(20 s) = 3,720,000 mi **42b.** (186,000 mi/s)(60 s) = 11,160,000 mi **43.** $f(3) + g(4) = (2 \cdot 3) + (4^2 + 1) = 6 + 16 + 1 = 23$ **44.** $g(3) + f(4) = (3^2 + 1) + (2 \cdot 4) = 9 + 1 + 8 = 18$ **45.** $(2 \cdot 5) - 2(1^2 + 1) = 10 - 2 \cdot 2 = 6$ **46.** $f[g(3)] = f(3^2 + 1) = f(10) = 2 \cdot 10 = 20$ **47.** Yes, a horizontal line is the graph of a function because in the vertical line test the vertical line would intersect the horizontal line at only one point. No, a vertical line is not the graph of a function; in the vertical line test most test lines would miss the sample, but there is a test line that would intersect the sample line everywhere.

48a. $[0.5] = 0; [-0.1] = -1; [-1.99] = -2; [-5.2] = -6$; **48b.** the range of y = all integers, because all values of $[x]$ must be integers **49.** $f(0.75) = 7(0.75) = 5.25$ **50.** $f(1.5) = 9 - 0.2(1.5) = 8.7$ **51.** $(-2)^2 - 7 = 4 - 7 = -3; 0^2 - 7 = -7; 1^2 - 7 = -6$; the largest of these values is -3.

52.
$$f(x) = 3x - 5$$
$$f(x) + 5 = 3x$$
$$x = \frac{f(x) + 5}{3}$$

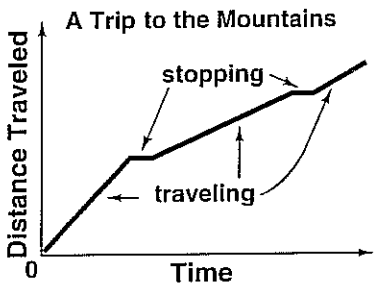
When $f(x) = -2$, $x = \frac{-2 + 5}{3} = 1$; when $f(x) = 0$, $x = \frac{5}{3}$; when $f(x) = 4$, $x = \frac{4 + 5}{3} = 3$; the greatest of these x's is 3.

53. Domain Range

65	58
74	69
80	72
93	84
98	91

This represents a function; no value in the domain is connected to two or more values in the range.

54. Labels may vary. Sample:

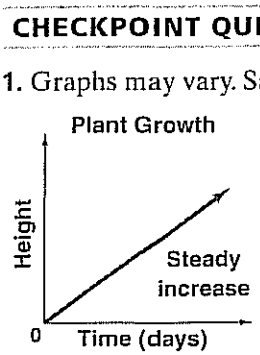


55. $(2 \text{ in.})\left(\frac{15 \text{ mi}}{1 \text{ in.}}\right) =$ 30 mi **56.** $(1.5 \text{ in.})\left(\frac{15 \text{ mi}}{1 \text{ in}}\right) =$ 22.5 mi **57.** $(0.5 \text{ in.})\left(\frac{15 \text{ mi}}{1 \text{ in.}}\right) =$ 7.5 mi **58.** $(3.25 \text{ in.})\left(\frac{15 \text{ mi}}{1 \text{ in.}}\right) =$ 48.75 mi

59. $(5.5 \text{ in.})\left(\frac{15 \text{ mi}}{1 \text{ in.}}\right) = 82.5$ mi **60.** $(7.25 \text{ in.})\left(\frac{15 \text{ mi}}{1 \text{ in.}}\right) =$ 108.75 mi **61.** Mean $= \frac{\text{sum}}{\text{number}} = \frac{268}{8} = 33.5$. Median: four values are 34 or above; four values are 33 or below; median = 33.5. Modes = 32, 33, 34, and 35. Range = $35 - 32 = 3$. **62.** Mean $= \frac{-2}{10} = -0.2$. Median = 0 (there are four values above this and four below). Modes = -2 and 1. Range $= 2 - (-2) = 4$. **63.** Mean $= \frac{\text{sum}}{\text{number}} = \frac{52}{9} = 5.\overline{7}$; median = 5; mode = 5; range = $12 - 1 = 11$. **64.** Mean $= \frac{117}{8} = 14.625$; median = 14; mode = 13; range $= 20 - 9 = 11$. **65.** Mean $= -\frac{47}{8}$; median $= -7$; mode $= -7$; range $= -1 - (-9) = 8$. **66.** Mean $= \frac{\text{sum}}{\text{number}} = \frac{372}{8} = 46.5$; median, halfway between 45 and 48, is 46.5; modes = 43 and 48; range $= 52 - 42 = 10$.

CHECKPOINT QUIZ 1 *page 246*

1. Graphs may vary. Samples are given.



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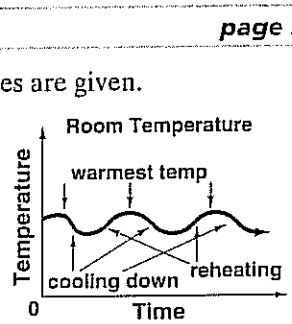
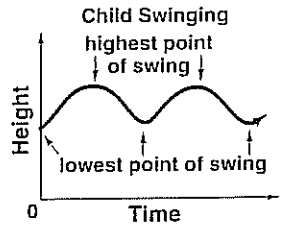


3.

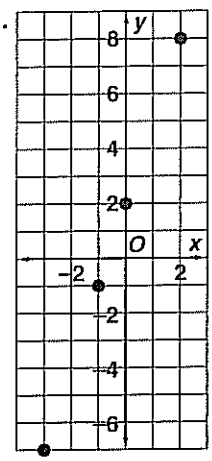


4. Yes; it passes the vertical-line test. **5.** $f(0.6) = -4(0.6) = -2.4$ **6.** $g(0.6) = 0.6 + 1.53 = 2.13$ **7.** $y = 2 - 0.5(0.6) = 1.7$ **8.** $3(0.6)^2 = 1.08$ **9.** $f(0.6) = 34 - 0.6 = 33.4$ **10.** $g(0.6) = -3 + 2 \cdot 0.6 = -1.8$

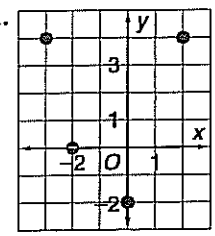
5-3 Function Rules, Tables, and Graphs *pages 247–253*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1.



2.



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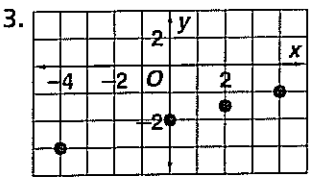
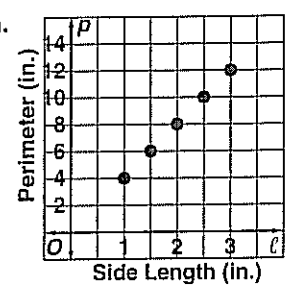


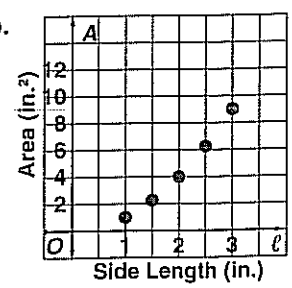
Investigation 1.

Side Length (in.)	Perimeter (in.)	Area (in.²)
1	4	1
$1\frac{1}{2}$	6	$2\frac{1}{4}$
2	8	4
$2\frac{1}{2}$	10	$6\frac{1}{4}$
3	12	9

2a.



2b.

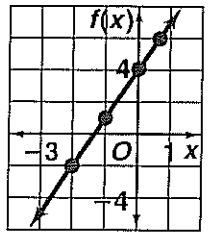


3. Graph 2a of side length and perimeter. **4.** Answers may vary. Sample: perimeter: $p = 4\ell$; area: $a = \ell^2$

Check Understanding Tables may vary. Samples:

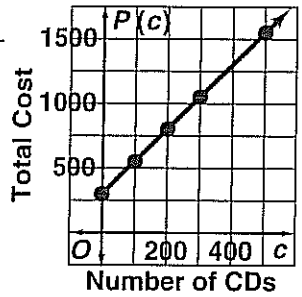
1.

x	$f(x)$
0	4
1	7
−1	1
−2	−2



2a.

c	$P(c)$
0	300
100	550
200	800
300	1050
500	1550

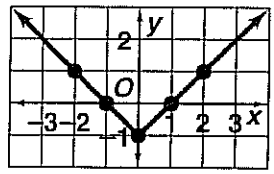


2b.
$$250 + 3c = 300 + 2.5c$$
$$250 + 0.5c = 300$$
$$0.5c = 50$$
$$c = 100$$

For 100 CDs the costs are equal. Above 100 CDs the studio in the example is more expensive. For 99 CDs or less the studio in the example is less expensive.

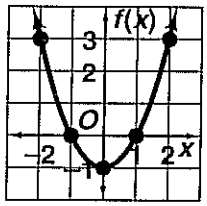
3a.

x	y
−2	1
−1	0
0	−1
1	0
2	1



3b.

x	$f(x)$
−2	3
−1	0
0	−1
1	0
2	3

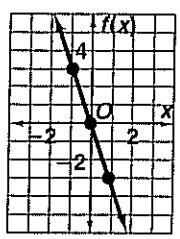


Exercises 1–3. Two points are sufficient for straight-line graphs. **1.** $f(0) = 2 \cdot 0 = 0; f(2) = 2 \cdot 2 = 4$; the graph is C. **2.** $f(0) = \frac{1}{2} \cdot 0 = 0; f(2) = \frac{1}{2} \cdot 2 = 1$; the graph is A. **3.** $f(0) = 0 + 2 = 2; f(2) = 2 + 2 = 4$; the graph is B.

4–12. Tables may vary. Samples are given.

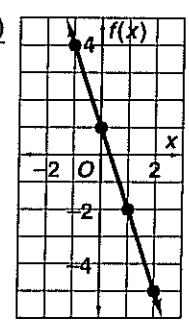
4.

x	$f(x)$
−1	3
0	0
1	−3



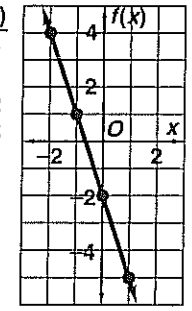
5.

x	$f(x)$
−1	4
0	1
1	−2
2	−5



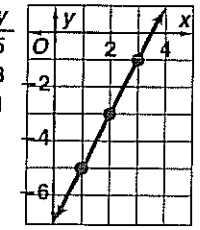
6.

x	$f(x)$
−2	4
−1	1
0	−2
1	−5



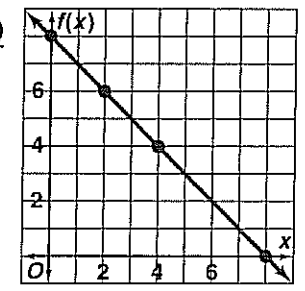
7.

x	y
1	−5
2	−3
3	−1



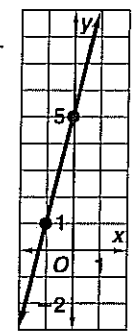
8.

x	$f(x)$
0	8
2	6
4	4
8	0



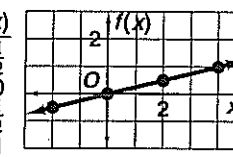
9.

x	y
−1	1
0	5
1	9



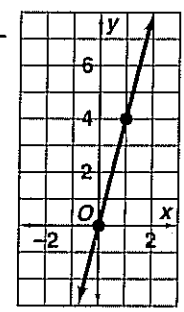
10.

x	$f(x)$
−2	$-\frac{1}{2}$
0	0
2	$\frac{1}{2}$
4	1



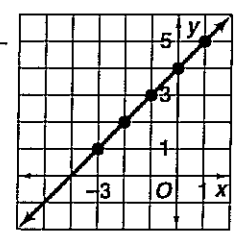
11.

x	y
−1	−4
0	0
1	4



12.

x	y
−3	1
−2	2
−1	3
0	4
1	5



13a. $M = 3.5h$

13b.

h	M
0	\$0.00
$\frac{1}{2}$	\$1.75
1	\$3.50
2	\$7.00
3	\$10.50

13c.

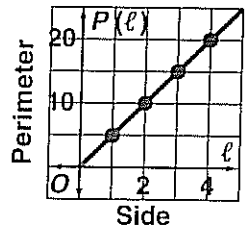
ℓ	$P(\ell)$
1	5
2	10
3	15
4	20

13d. \$30 is off the graph above.
$$30 = 3.5h$$
$$h = \frac{30}{3.5} = 8.57$$
Juan must baby-sit for about 8.5 hours.

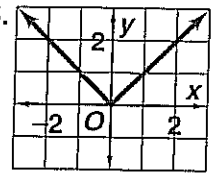
14a.

ℓ	$P(\ell)$
1	5
2	10
3	15
4	20

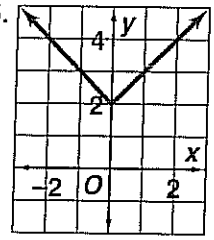
14b.



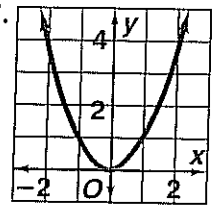
15.



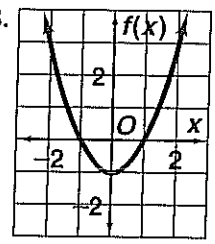
16.



17.



18.



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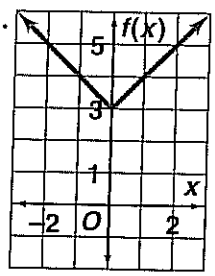
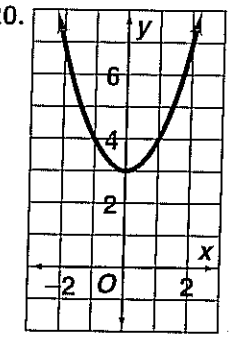
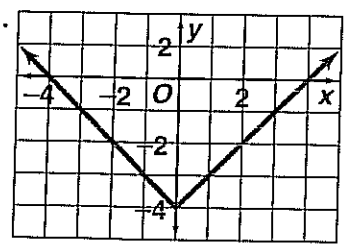


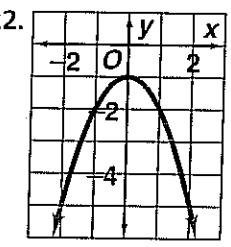
20.



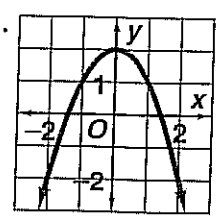
21.



22.



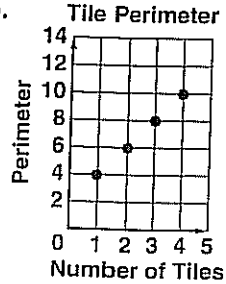
23.



24a.

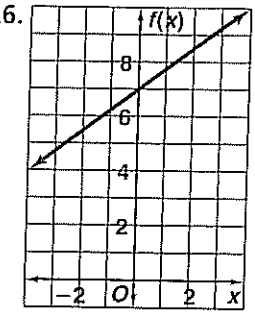
Tiles	Perimeter
1	4
2	6
3	8
4	10

24b.

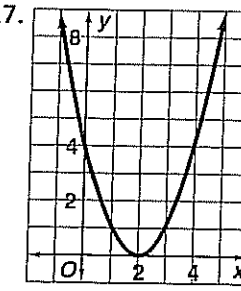


25. Answers may vary. Sample: Make a table to find values for $f(x)$ when $x = -2, 0$, and 2. Then graph the ordered pairs $(x, f(x))$ and join the graphed points with a line.

26.



27.



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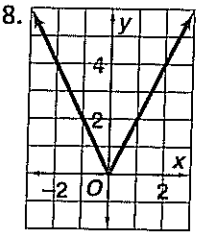

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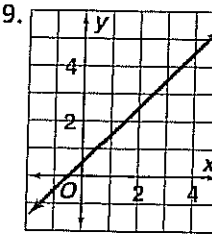
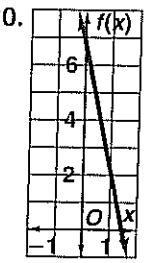
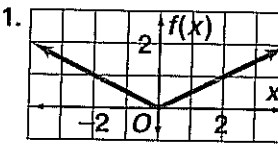


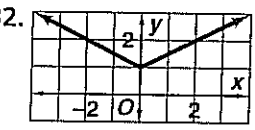
30.



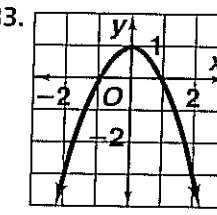
31.



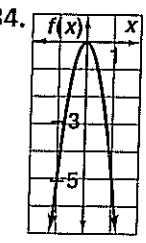
32.



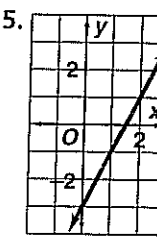
33.



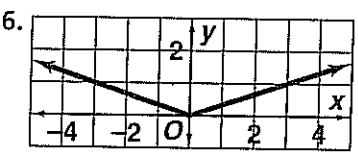
34.



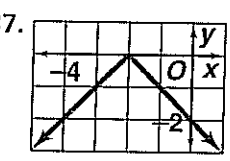
35.



36.

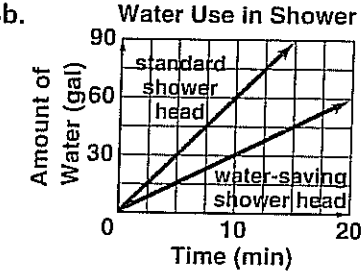


37.



38a. $6 \cdot 12.2 - 3 \cdot 6 = 73.2 - 18 = 55.2$; you save 55.2 gal.

38b.



38c, d. Check students' work.

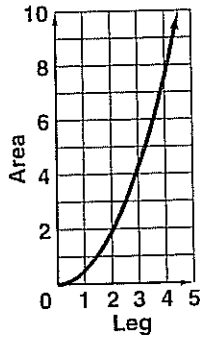
39a. Input value is to output value as independent variable is to dependent variable.

39b. Input is to output as domain is to range.

40a.

ℓ	$A(\ell)$
1	0.5
2	2
3	4.5
4	8

40b.



41a. $a = 5 - 1 = 4$; $C(5) = 0.27 + 0.11(5 - 1) = 0.71$

41b. $0.27 + 0.11(a - 1) = 1.50$

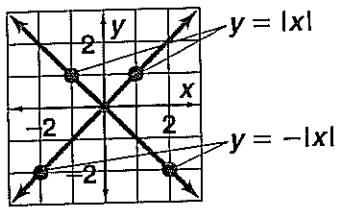
$0.11(a - 1) = 1.23$

$a - 1 = \frac{1.23}{0.11} = 11.18$

$a = 12.18$

For \$1.50, one can talk for a total of about 12 min.

42a.



42b. The individual graphs are V-shaped; they are not straight lines. Reflection is about the x-axis.

42c. To reflect about the x-axis, one changes y to $-y$. The equation becomes

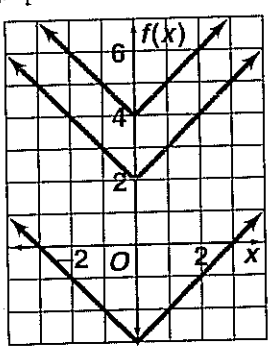
$$-y = |x| + 1$$

or

$$y = -|x| - 1.$$

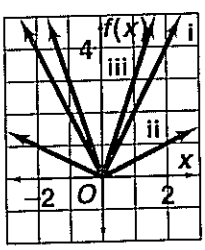
43. With an equation in x^2 one should check three points to be sure of identification. $f(-1) = \frac{1}{2}(-1)^2 + (-1) = -\frac{1}{2}$; $f(0) = 0$; $f(1) = \frac{1}{2} \cdot 1^2 + 1 = 1\frac{1}{2}$; the graph is B.

44a.



44b. It changes the y intercept. That is, it moves the graph up or down but does not change its slope.

45a.



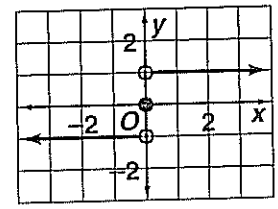
45b. It makes the graph wider or narrower; it changes its slope.

46a. The values of s are 1, 1 (as for any positive x), and -1, -1 (as for any negative x). This function is also called a step function; it's like a single step and not a whole flight of stairs.

46b. range = $\{-1, 0, 1\}$

46c.

x	y
−4	−1
−2	−1
0	0
2	1
4	1

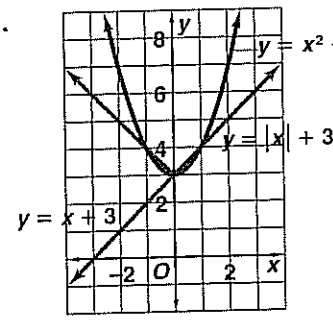


46d. No; $s(3 + 5) = s(8) = 1$; $s(3) + s(5) = 1 + 1 = 2$.

47. Time = 3 hours. $68 + 40(3) = 188$; the answer is C.

48. $f(0) = -2$; $f(1) = -1\frac{1}{2}$; the answer is F. **49.** From the table, $f(0) = 1$, so it can't be A or D; B: $f(2) = 5$✓; C: $f(2) = -1$; the answer is B. **50.** $f(-2) = 10 - 4(-2) = 18$; $f(2) = 10 - 4 \cdot 2 = 2$; the answer is I.

51.

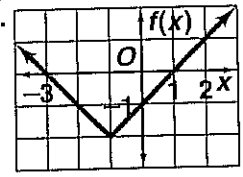


The graphs of all equations go through the point $(0, 3)$. $y = x + 3$ and $y = x^2 + 3$ share a point at $(1, 4)$. Both sides of the graphs $y = x^2 + 3$ and $y = |x| + 3$ go upward (they will hold water), but $y = |x| + 3$ has straight sides whereas $y = x^2 + 3$ has curved lines. **52a.** Tables may vary.

Sample:

x	$f(x)$
−4	1
−2	−1
−1	−2
0	−1
2	1

52b.



53. $f(-2) = 3(-2) + 1 = -5$; $f(0) = 3(0) + 1 = 1$; $f(3.5) = 3(3.5) + 1 = 11.5$; range = $\{-5, 1, 11.5\}$

54. $g(-2) = 3(-2) - 5 = -11$; $g(0) = -5$; $g(3.5) = 5.5$; range = $\{-11, -5, 5.5\}$ **55.** $f(-2) = -3(-2) + 4 = 10$; $f(0) = 4$; $f(3.5) = -3(3.5) + 4 = -6.5$; range = $\{-6.5, 4, 10\}$. When there is a minus sign in front of the variable, reverse the sequence so that the elements of the range are an increasing ordered set. **56.** $|-2| - 5 = -3$; $|0| - 5 = -5$; $|3.5| - 5 = -1.5$; range = $\{-5, -3, -1.5\}$ **57.** $12 - (-2) = 14$; $12 - 0 = 12$; $12 - 3.5 = 8.5$; range = $\{8.5, 12, 14\}$

58. $5(-2 - 2) = -20$; $5(0 - 2) = -10$; $5(3.5 - 2) = 7.5$; range = $\{-20, -10, 7.5\}$ **59.** $6(-2) + 1 = -11$; $6(0) + 1 = 1$; $6 \cdot 3.5 + 1 = 22$; range = $\{-11, 1, 22\}$ **60.** $0.5(-2) - 8 = -9$; $0.5 \cdot 0 - 8 = -8$; $0.5(3.5) - 8 = -6.25$; range = $\{-9, -8, -6.25\}$ **61.** $-11(-2) + 9 = 31$; $-11(0) + 9 = 9$; $-11(3.5) + 9 = -29.5$; range = $\{-29.5, 9, 31\}$

62.

$$|x| + 7 = 11$$

$$|x| = 4$$

$$x = 4 \quad \text{or} \quad x = -4$$

63. $9 = 10 + |b|$

$-1 = |b|$

This is impossible; there is no solution.

64. $5|t| = 18$

$|t| = \frac{18}{5} = 3.6$

$t = 3.6$ or $t = -3.6$

65. $-2|k| = -14$

$|k| = \frac{-14}{-2} = 7$

$k = 7$ or $k = -7$

66. $20 = 4|c| - 8$

$28 = 4|c|$

$7 = |c|$

$c = 7$ or $c = -7$

67. $3 = |z - 1|$

$z - 1 = 3$ or $z - 1 = -3$

$z = 4$ or $z = -2$

68. $|r + 11| = 4$

$r + 11 = 4$ or $r + 11 = -4$

$r = -7$ or $r = -15$

69. $|m - 0.5| = 1$

$m - 0.5 = 1$ or $m - 0.5 = -1$

$m = 1.5$ or $m = -0.5$

70. $3|w + 4| = 9$

$|w + 4| = 3$

$w + 4 = 3$ or $w + 4 = -3$

$w = -1$ or $w = -7$

71. $(3 \text{ cm})\left(\frac{16 \text{ km}}{1 \text{ cm}}\right) = 48 \text{ km}$ **72.** $(2.5 \text{ cm})\left(\frac{16 \text{ km}}{1 \text{ cm}}\right) = 40 \text{ km}$ **73.** $(6.3 \text{ cm})\left(\frac{16 \text{ km}}{1 \text{ cm}}\right) = 100.8 \text{ km}$

74. $(8.5 \text{ cm})\left(\frac{16 \text{ km}}{1 \text{ cm}}\right) = 136 \text{ km}$ **75.** $(10.2 \text{ cm})\left(\frac{16 \text{ km}}{1 \text{ cm}}\right) = 163.2 \text{ km}$

76a. $\frac{\text{model}}{\text{original}} = \frac{7}{8} = \frac{x}{29}$

$7 \cdot 29 = 8x$

$\frac{7 \cdot 29}{8} = x$

$25.375 = x$

76b. $\frac{7}{8} = \frac{x}{35.833}$

$x = 35.833\left(\frac{7}{8}\right)$

$x = 31.354$

76c. $\frac{7}{8} = \frac{x}{18.5}$

$x = 18.5\left(\frac{7}{8}\right)$

$x = 16.1875$

TECHNOLOGY *page 253*

1. $y(-5) = 3(-5) + 6 = -15 + 6 = -9$; $3 \cdot 0 + 6 = 6$; $3 \cdot 3 + 6 = 15$; $3 \cdot 7 + 6 = 27$; range $= \{-9, 6, 15, 27\}$

2. $0.4(-2.1) - 5.1 = -5.94$; $1.2(1.35) - 5.1 = -4.56$; $0.4(5.7) - 5.1 = -2.82$; range $= \{-5.94, -4.56, -2.82\}$

3. at $x = 0$, $y = 3$; at $y = 0$,

$0 = -2x + 3$

$-3 = -2x$

$1.5 = x$ ($= y$-intercept)

4. at $x = 0$, $y = -1$; at $y = 0$,

$0 = -0.25x - 1$

$1 = -0.25x$

$-4 = x$

5. at $x = 0$, $y = 2.16$; at $y = 0$,

$0 = 1.2x + 2.16$

$-2.16 = 1.2x$

$x = \frac{-2.16}{1.2} = -1.8$

6. Graph crosses the axes at $y = 6$ and $x = \frac{-6}{-0.2} = 30$. Minimum ranges would be $x = -2$ to 32 and $y = -2$ to 8; a more generous range would be Xmin $= -10$, Xmax $= 35$, Ymin $= -10$, Ymax $= 10$.

5-4 Writing a Function Rule *pages 254–260*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1–6. Tables may vary. Samples are given.

1.

x	$f(x)$
−1	−6
0	−1
1	4
2	9
3	14

2.

x	y
−2	10
−1	7
0	4
1	1
2	−2

3.

t	$g(t)$
−2	−7.4
−1	−7.2
0	−7
1	−6.8
2	−6.6

4.

x	y
−2	−7
−1	−3
0	1
1	5
2	9

5.

x	$f(x)$
−2	8
−1	7
0	6
1	5
2	4

6.

d	$c(d)$
−2	−1.1
−1	−0.1
0	0.9
1	1.9
2	2.9

7. 3 **8.** −2 **9.** 4

Check Understanding 1a. For each x, $f(x)$ is 2 less than x. The function rule appears to be $f(x) = x - 2$. **1b.** Each y is double the corresponding x, so for $x = 1$, 2, 3, and 4 we may say with certainty that $y = 2x$. **1c.** For each x, $f(x)$ is 2 greater than x. The function rule appears to be $f(x) = x + 2$. **2a.** $C(x) = 1.19x$ **2b.** $C(12) = 14.28$; 12 lb of nails cost \$14.28. **3.** Let

p = gross profit, before deductions for overhead and other expenses; n = number of hours worked. $p(n) = 15n - 199$

Exercises **1.** $f(-1) = 4(-1) = -4$; only Table B fits. **2.** $f(-1) = -1 - 4 = -5$; only Table A fits. **3.** $f(-1) = -4 - (-1) = -3$; only Table C fits. **4.** Every $f(x)$ is three times x; $f(x) = 3x$. **5.** Every f is $\frac{1}{2}$ less than x; $f(x) = x - 0.5$. **6.** f increases by $\frac{1}{2}$ when x increases by 1; $f(x) = 0.5x$. **7.** The table is the negative of Problem 4, so $f(x) = -3x$. **8.** Every y is 4 times x; $y = 4x$. **9.** y quadruples every time x doubles; $y = x^2$. **10.** $t(c) = 0.79c$ **11.** $d(n) = 45n$ **12.** $f(h) = \frac{h}{12}$ **13.** $e(n) = 6.37n$ **14.** $A(n) = n^2$ **15.** $V(n) = n^3$ **16.** $A(r) = \pi r^2$ **17a.** $f(x) = 0.19x$ **17b.** $f(8) = 0.19(8) = 1.52$; cost = \$1.52 **18a.** Let x = total weight of letter. $f(x) = 0.34 + 0.21(x - 1)$ **18b.** $f(4) = 0.34 + 0.21(4 - 1) = 0.97$; cost = \$0.97 **19.** $f(x) = 1000x$ **20.** $f(x) = 2.54x$ **21a.** $C(a) = 10a + 1$; this rule is valid only if $a \geq 2$. **21b.** $a = 3$; $C(3) = 10 \cdot 3 + 1 = 31$; the cost = \$31. **21c.** $C(6) = 10 \cdot 6 + 1 = 61$; the total cost of 12 books is \$61. **22a.** $C(b) = 6b$ **22b.** $C(12) = 6 \cdot 12 = 72$; the total cost of 12 books is \$72. **22c.** $\frac{10 \cdot 6 + 1}{12} = 5.08\overline{3}$; the average cost ≈ \$5.08. **22d.** The cost through the club (\$61) is less than from the bookstore (\$72). **23.** A table is very limited; the relation is defined only for the input values specified in the table. The function rule is defined for a very wide range of the input; but for extreme values of the input the function rule might be no longer valid. **24a.** Dependent variable = gallons of water used; independent variable = number of loads. **24b.** $w(n) = 34n$, where w = water used and n = number of loads. **24c.** $w(7) = 34 \cdot 7 = 238$ [238 gal]

24d.
$$442 = 34n$$
$$n = \frac{442}{34}$$
$$n = 13 \text{ loads}$$

25–28. Tables may vary. Samples are given.

25.

x	$f(x)$
−2	−1
0	0
2	1
4	2

26.

x	y
−4	−3
−2	0
0	3

27.

x	y
−1	3
0	2
1	1
2	0
3	−1

28.

x	y
−2	−2
−1	$-\frac{1}{2}$
0	1

29. Answers may vary. Sample: Traveling at a constant speed of 60 mi/h, the distance you travel in x hours is $f(x) = 60x$. If $x = 3$ h, you can travel $60 \cdot 3$, or 180 mi. **30a.** 15% of bill = (0.15) · (bill) = $0.15b$ **30b.** $c(b) = b + 0.15b = 1.15b$ **30c.** 1.15(\$18) = \$20.70

31. $f(x) = x^3$ **32.** From Problem 31; $f(x) = (-x)^3 = -x^3$. **33.** f is 1 less than in Problem 32, so $f(x) = -x^3 - 1$. **34a.** $c(m) = 44 + 0.38m$ **34b.** For $m = 70$ mi, $c(70) = 44 + 0.38(70) = 70.6$; the cost is \$70.60; for $m = 120$ mi, $c(120) = 44 + 0.38(120) = 89.6$; the cost is \$89.60.

34c.
$$44 + 0.38m = 58.44$$
$$0.38m = 58.44 - 44 = 14.44$$
$$m = \frac{14.44}{0.38} = 38$$

The distance = 38 mi.

34d. For n days, $c(n, m) = 44n + 0.38m$. Total distance = $2 \cdot 150 = 300$. $c(2, 300) = 44 \cdot 2 + 0.38 \cdot 300 = 202$. The cost is \$202. **35a.** In the sequence volume = $\left\{\frac{1}{3}, \frac{2}{3}, 1\right\}$ we have brine = {2.31, 4.62, 6.93} so B, the brine concentration (% salt) is proportional to v, the salt volume (cups): $B(v) = 6.93v$. Check: $6.93(0.5) = 3.465$ ✓; $6.93(0.75) = 5.1975$ ✓

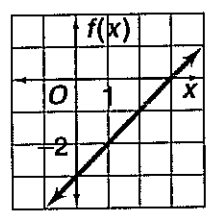
35b. Let w = salt weight (oz). In the sequence w = {3.3, 6.6, 9.9} the weight is proportional to v and B. The coefficient of proportionality is $\frac{B}{w} = \frac{6.93}{9.9} = 0.7$, so $B(w) = 0.7w$. For the listed values of w, the function rule gives {2.31, 3.465, 4.62, 5.1975, 6.93} ✓

36. There is no need for two terms; the answer is A. **37.** Change = amount tendered − cost of dog food; the answer is H. **38.** The table shows successive differences of −5; at $x = 0$, $f = 1$; the only function rule that fits is $f(x) = -5x + 1$; the answer is D. **39. A.** $f(3) = 4 \cdot 3 - 12 = 0$ **B.** $f(0) = 0 + 1 = 1$; B is greater; the answer is B. **40. A.** $f(-3) = (-3)^2 - 4 = 5$ **B.** $f(-2) = -2(-2) + 1 = 5$; A and B are equal; the answer is C. **41.** Be careful here not to mix up the units. $D(w) = 0.1w^2 + 5w$; $D(60) = 0.1(60)^2 + 5 \cdot 60 = 360 + 300 = 660$; the dosage is 660 mg.

42–47. Tables may vary. Samples are given. (Graphs should show x- and y-intercepts as shown below.)

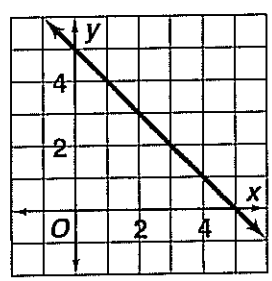
42.

x	$f(x)$
−1	−4
0	−3
1	−2
2	−1
3	0



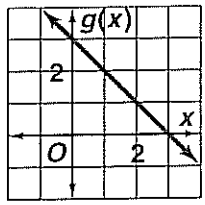
43.

x	y
−1	6
0	5
2	3
4	1
5	0



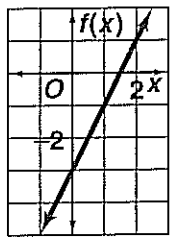
44.

x	$g(x)$
−1	4
0	3
1	2
2	1
3	0



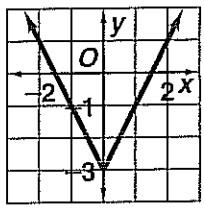
45.

x	$f(x)$
−1	−5
0	−3
1	−1
2	1
3	3



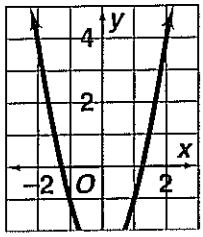
46.

x	y
−2	1
−1	−1
0	−3
1	−1
2	1



47.

x	y
−2	5
−1	−1
0	−3
1	−1
2	5



48. percent of change $= \frac{\text{amount of change}}{\text{original amount}} = \frac{14 - 12}{12} = \frac{2}{12} \approx 0.167 \approx 17\%$; increase **49.** $\frac{100 - 98}{98} = \frac{2}{100} = 0.02 = 2\%$; increase **50.** $\frac{65 - 60}{65} = \frac{5}{65} \approx 0.0769 \approx 8\%$; decrease **51.** $\frac{6 - 1}{6} = \frac{5}{6} \approx 0.833 \approx 83\%$; decrease

52. $\frac{1.8 - 1.4}{1.4} = \frac{0.4}{1.4} \approx 0.2857 \approx 29\%$; increase

53. $\frac{1\frac{1}{2} - \frac{7}{8}}{1\frac{1}{2}} = \frac{\frac{5}{8}}{\frac{12}{8}} = \frac{5}{12} \approx 0.4167 \approx 42\%$; decrease

54a. J (total juice yield in tbsp) = x (juice in tbsp per orange) · n (number of oranges). For big oranges $n = \frac{J}{x} = \frac{16 \text{ tbsp}}{8 \text{ tbsp/orange}} = 2$ oranges; for small oranges $n = \frac{16}{6} = 2\frac{2}{3}$; 3 oranges are needed. **54b.** Max yield = $6 \cdot 3 + 5 \cdot 2 = 28$; juice = 28 tbsp.

READING MATH *page 260*

Tables may vary. Sample:

x	y
−3	2
0	0
3	−2

As x increases, y decreases, so we expect a minus sign in front of a term with x. When $x = 0$, $y = 0$, so no constant term is needed. For every change of x by three units, y changes by 2 units, so the coefficient would be $\frac{2}{3}$. Guess function rule is $y = -\frac{2}{3}x$. Check: when $x = 0$, $y = 0$ ✓; when $x = 3$, $y = -2$ ✓

5-5 Direct Variation *pages 261–267*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies or Presentation Pro CD-ROM.*

1. $q = \frac{m}{n}$ **2.** $r = \frac{d}{t}$ **3.** $y = -\frac{ax}{b}$ **4.** 7.5 **5.** 20 **6.** 5 **7.** 10 **8.** 14.4 **9.** 81

Investigation 1. When s ratio $= \frac{2}{1} = 2$, frame ratio $= \frac{48}{24} = 2$; when s ratio $= \frac{4}{2} = 2$, frame ratio $= \frac{96}{48} = 2$; as the number of seconds doubles, the number of frames doubles.

2. $\frac{\text{number of frames}}{\text{number of seconds}} = \frac{24}{1} = \frac{48}{2} = \frac{72}{3} = \frac{96}{4} = \frac{120}{5} = 24$

3. $f(s) - f(s-1) = 24$ in every case; example: $96 - 72 = 24$ frames **4.** They are all the same: $\frac{f(s)}{s} = 24$; $f(s) - f(s-1) = 24s - 24(s-1) = (24s - 24s) + 24 = 24$ **5a.** $f(0) = 24 \cdot 0 = 0$ **5b.** $(0, 0)$

Check Understanding 1a. $7y = 2x$

$y = \frac{2}{7}x$

Dir. var. form is $y = kx$

Yes, equation can be written in form of a direct variation, with $k = \frac{2}{7}$. Also when $x = 0$, $y = 0$.

1b. $3y + 4x = 8$

$3y = -4x + 8$

$y = -\frac{4}{3}x + \frac{8}{3}$

No, the equation cannot be put into the form $y = kx$. The constant term prevents this. Also, when $x = 0$, $y \neq 0$.

1c. $y - 7.5x = 0$

$y = 7.5x$

which matches $y = kx$

Yes, this is a direct variation, with $k = 7.5$.

2. Points are given in the form (x, y); $x = -3$; $y = -6$.

$y = kx$

$-6 = k(-3)$

$\frac{-6}{-3} = k$

$2 = k$

$y = 2x$

3. If I use x cups of flour (we'll make that the independent variable), what is y, the number of muffins (the dependent variable)? If $x = 1$, then $y = 12$.

$y = kx$

$12 = k(1)$

$12 = k$

$y = 12x$

4a. $\frac{y}{x} = \frac{3.2}{-2} = -1.6; \frac{2.4}{1} = 2.4; \frac{1.6}{4} = 0.4$. No, these ratios are not equal. **4b.** $\frac{y}{x} = \frac{6}{4} = 1.5; \frac{12}{8} = 1.5; \frac{15}{10} = 1.5$; yes, this is a direct variation with $y = kx$.

5. Let x = force applied to handle of windlass to lift 160 lb.

$$\frac{\text{force}_1}{\text{weight}_1} = \frac{\text{force}_2}{\text{weight}_2}$$
$$\frac{0.5}{32} = \frac{x}{160}$$
$$160\frac{0.5}{32} = x$$
$$2.5 = x$$

Force required = 2.5 lb.

Exercises 1, 2, 4. No, these are not direct variations, because $y(0) \neq 0$.

3.
$$-12x = 6y$$
$$-2x = y$$

Compare. $kx = y$

Yes, this is a direct variation; $k = -2$.

5.
$$5x - 6y = 0$$
$$5x = 6y$$
$$\frac{5}{6}x = y$$

Yes, this is a direct variation, with $k = \frac{5}{6}$.

6.
$$-4 + 7x + 4 = 3y$$
$$7x = 3y$$
$$\frac{7}{3}x = y$$

yes; $k = \frac{7}{3}$

7.
$$-x = 10y$$
$$-\frac{1}{10}x = y$$

yes; $k = -\frac{1}{10}$

8.
$$0.7x - 1.4y = 0$$
$$0.7x = 1.4y$$
$$0.5x = y$$

yes; $k = 0.5$

9.
$$\frac{1}{2}x + \frac{1}{3}y = 0$$
$$\frac{y}{3} = -\frac{x}{2}$$
$$y = -\frac{3}{2}x$$

yes; $k = -\frac{3}{2}$

10. $y = kx, 5 = k(1), k = \frac{5}{1}, y = 5x$

11. $y = kx, 1 = k(5), k = \frac{1}{5}, y = \frac{1}{5}x$

12. $y = kx, 10 = k(-8), k = \frac{-10}{8} = -\frac{5}{4}, y = -\frac{5}{4}x$

13. $y = kx, -9 = k(-5), k = \frac{9}{5}, y = \frac{9}{5}x$

14. $y = kx, 3 = k(-2), k = \frac{3}{-2}, y = -\frac{3}{2}x$

15. $y = kx, 1 = k(-6), k = \frac{1}{-6}, y = -\frac{1}{6}x$

16. $y = kx, -4 = k(3), k = \frac{-4}{3}, y = -\frac{4}{3}x$

17. $y = kx, -8 = k(6), k = \frac{-8}{6} = \frac{-4}{3}, y = -\frac{4}{3}x$

18. $y = kx, 8 = k(-6), k = \frac{8}{-6} = \frac{4}{-3}, y = -\frac{4}{3}x$

19. $y = kx, -10 = k(-5), k = \frac{-10}{-5} = 2, y = 2x$

20. $y = kx, -8 = k(12), k = \frac{-8}{12} = \frac{-2}{3}, y = -\frac{2}{3}x$

21. $y = kx, 7 = k(35), k = \frac{7}{35} = \frac{1}{5}, y = \frac{1}{5}x$

22–23. Choices of variables may vary. **22.** Let P = perimeter and ℓ = length of one side. $P(\ell) = 8\ell$

23. Let E = dollar earnings and h = number of hours worked. $E(h) = 7.10k$. **24.** Calculating increments is not helpful here. Calculate ratios: $\frac{y}{x} = \frac{5.4}{3} = 1.8$; $\frac{12.6}{7} = 1.8$; $\frac{21.6}{12} = 1.8$; yes, this is a direct variation; the equation is $y = 1.8x$. **25.** Increments are the same (5) for both x and y; for all entries $y - x = 3$; equation is $y = x + 3$; this is not a direct variation. **26.** $\frac{y}{x} = -1.5$ in each case; yes; the equation is $y = -1.5x$. **27a.** $\frac{\text{weight}}{\text{force}} = \frac{50}{20} = \frac{5}{2}$

27b.
$$\frac{50}{20} = \frac{130}{x}$$
$$50x = 20 \cdot 130$$
$$x = \frac{20 \cdot 130}{50}$$
$$x = 52$$

Force needed = 52 lb.

28.
$$\frac{\text{distance}}{\text{time}} = \frac{3}{10} = \frac{x}{30}$$
$$30\left(\frac{3}{10}\right) = x$$
$$9 = x$$

Check units: $x = (30 \text{ min})\left(\frac{3 \text{ mi}}{10 \text{ min}}\right) = 9 \text{ mi}$

29. $y = kx, \frac{1}{2} = k(3), k = \frac{1}{2 \cdot 3} = \frac{1}{6}, y = \frac{1}{6}x$

30. $y = kx, -5 = k\left(\frac{1}{4}\right), k = (-5)4 = -20, y = -20x$

31. $y = kx, \frac{6}{5} = k\left(\frac{-5}{6}\right), k = \left(\frac{6}{5}\right)\left(\frac{6}{-5}\right) = \frac{36}{-25}, y = -\frac{36}{25}x$

32. $y = kx, 7.2 = k(1.2), k = \frac{7.2}{1.2} = 6, y = 6x$

33. $y = kx, 4.5 = k(0.5), k = \frac{4.5}{0.5} = 9, y = 9x$

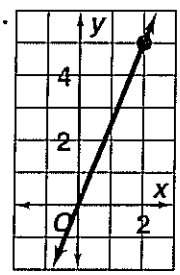
34. $y = kx, \frac{1}{16} = k(-2), k = \frac{1}{16(-2)} = \frac{1}{-32}, y = -\frac{1}{32}x$

35. $y = kx, -1.5 = k(5.2), k = \frac{-15}{52}, y = -\frac{15}{52}x$

36. $y = kx, -\frac{9}{8} = k\left(\frac{-8}{3}\right), k = \left(-\frac{9}{8}\right)\left(\frac{3}{-8}\right) = \frac{27}{64}, y = \frac{27}{64}x$

37a. The ratio $\frac{y}{x}$ is the same for each pair of values (excluding any pair where $x = 0$). **37b.** A straight line through the origin is the graph of a direct variation (provided that the line is not perfectly vertical or perfectly horizontal). **38.** true, provided that the line also passes through (0, 0) **39.** False; when $x = 0$, we must have $y = 0$. **40.** True; if for particular values of x_1 and y_1 we have $y_1 = kx_1$, then $y(3x_1) = k(3x_1) = 3(kx_1) = 3y_1$.

41.



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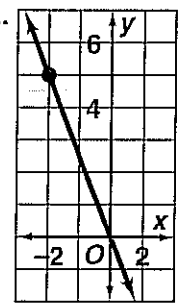

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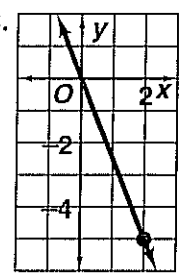

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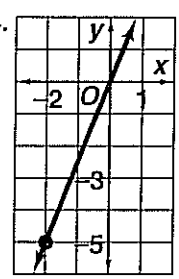


45a. To determine the constant of variation $k = \frac{y}{x}$, we must decide which is y and which is x. Let's choose w = body weight (lb) as the independent variable $[\leftrightarrow x]$ and b = amount of blood (qt) as the dependent variable $[\leftrightarrow y]$; that is, b depends on w via $b = kw$. The constant of variation is $k = \frac{b}{w} = \frac{5}{160} = \frac{1}{32}$. Units of k are qt/lb.

45b. $b = kw$ **45c.** Check students' work. **46a.** $V = IR = 24 \cdot 2 = 48$; voltage is 48 volts.

46b.
$$V = IR$$
$$\frac{V}{I} = R$$
$$R = \frac{18}{24} = 0.75$$

Resistance is 0.75 ohm.

47–52. Set up the ratios so that the variable is upstairs.

47.
$$\frac{4}{3} = \frac{y}{9}$$
$$9\left(\frac{4}{3}\right) = 9\left(\frac{y}{9}\right)$$
$$12 = y$$

48.
$$\frac{2}{-1} = \frac{y}{4}$$
$$4\left(\frac{2}{-1}\right) = y$$
$$-8 = y$$

49.
$$\frac{-5}{3} = \frac{x}{-4.8}$$
$$-4.8\left(\frac{-5}{3}\right) = y$$
$$8 = y$$

50.
$$\frac{y}{1} = \frac{-9}{\frac{3}{2}}$$
$$y = -6$$

51.
$$\frac{2}{5} = \frac{x}{12.5}$$
$$12.5\left(\frac{2}{5}\right) = x$$
$$5 = x$$

52.
$$\frac{-2}{5} = \frac{x}{-5}$$
$$-5\left(\frac{-2}{5}\right) = x$$
$$2 = x$$

53a. (cost c (\$)) = (\$1.83) · (number of gallons, g) or $c = 1.83g$. Yes, this is a direct variation because c is proportional to g and when $g = 0, c = 0$ (no gas, no cost). **53b.** $c = 1.83g$ and $g = \frac{1}{24}m$, so $c = 1.83\left(\frac{m}{24}\right)$, or $c = 0.07625m$.

54. In A, when $x = 0$, $y = 0$; in B, C, D, when $x = 0$, $y \neq 0$. The answer is A.

55. When $x = -8$ **F.** $y = \frac{3}{4}$ **G.** $y = 32$ **H.** $y = 2$ **I.** $y = 32$; the answer is H. (Note: G and I are equivalent.)

56. A. $k = \frac{y}{x} = \frac{-4}{5} = -0.8$ **B.** $y = -0.8x = (-0.8) \cdot (3) = -2.4$; A is greater; the answer is A.

57. A. $y(5) = -0.8 \cdot 5 = -4$ **B.** $y(-5) = (-0.8) \cdot (-5) = 4$; B is greater; the answer is B.

58. A. $y(0) = 0$; A and B are the same; the answer is C.

59.
$$y = kx$$
$$-4 = k(-1)$$
$$4 = k$$
$$y = 4x$$

60. For every entry, $\frac{y}{x} = \frac{3.00}{1} = 3$, etc.; $y = 3x$.

61. For every entry, $\frac{y}{x} = \frac{5}{15} = \frac{1}{3}$, etc.; $y = \frac{1}{3}x$.

62. This is not a direct variation because when $x = 0$, $y \neq 0$. Study the numbers, look for a pattern: notice that $x + y = 12$, or $y = 12 - x$.

63. The rule is not obvious here. Try $\frac{x}{y} = \frac{96}{16} = 6$; try again: $\frac{123}{20.5} = \frac{144}{24} = \frac{171}{28.5} = 6$; ahah! $\frac{x}{y} = 6$ for all, so $y = \frac{1}{6}x$.

64.
$$r + 6 > -12$$
$$r + 6 - 6 > -12 - 6$$
$$r > -18$$

65.
$$5 + c \leq 3.2$$
$$c \leq -1.8$$

66.
$$7m < -21$$
$$m < \frac{-21}{7}$$
$$m < -3$$

67.
$$a - 4.5 \geq 12.1$$
$$a \geq 16.6$$

68.
$$\frac{n}{4} < -20$$
$$4\frac{n}{4} < 4(-20)$$
$$n < -80$$

69.
$$3t \geq 9.12$$
$$t \geq \frac{9.12}{3}$$
$$t \geq 3.04$$

70.
$$\frac{v}{-5} \leq \frac{1}{2}$$
$$-5\left(\frac{v}{-5}\right) \geq -5\left(\frac{1}{2}\right)$$
$$v \geq -\frac{5}{2}$$

71.
$$b + 4\frac{2}{3} > 5\frac{1}{6}$$
$$b > 5\frac{1}{6} - 4\frac{4}{6}$$
$$b > \frac{1}{2}$$

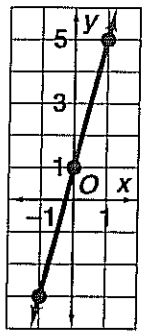
72. Let x = number of ships passing in 2000.
$$700{,}000{,}000 = 45{,}000x$$
$$\frac{700{,}000{,}000}{45{,}000} = x$$
$$15{,}556 = x$$

The number is about 15,600 ships.

CHECKPOINT QUIZ 2 *page 267*

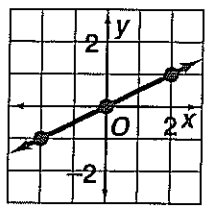
1.

x	y
−1	−3
0	1
1	5



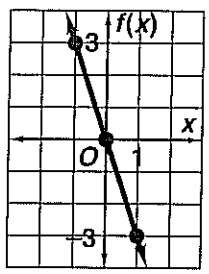
2.

x	y
−2	−1
0	0
2	1



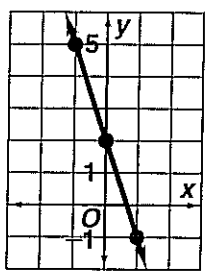
3.

x	$f(x)$
−1	3
0	0
1	−3



4.

x	y
−1	5
0	2
1	−1



5. (\$) = (lb)(\$/lb) or $t(p) = 0.79p$ **6.** (mi) = (h)(mi/h) or $d(n) = 60n$

7. $y = kx, -2 = k(7), k = \frac{-2}{7}, y = \frac{-2}{7}x$

8. $y = kx, -6 = k(-3), k = \frac{-6}{-3} = 2, y = \frac{1}{2}x$

9. $y = kx, -5 = k(-4), k = \frac{5}{4}, y = \frac{5}{4}x$

10a. $\frac{d}{n} = \frac{\text{distance in ft}}{\text{number}} = \frac{56}{8} = 7; d = 7n$

10b. $d(20) = 7 \cdot 20 = 140$; distance = 140 ft

5-6 Describing Number Patterns *pages 268–274*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. 12, 15, 18 **2.** 15, 22, 29 **3.** −2.6, −5.6, −8.6 **4.** 14 **5.** −17 **6.** −1.9

Check Understanding 1a–c. First study each sequence to see if the terms have constant difference or constant ratios. **1a.** Differences are not constant; ratios = $\frac{9}{3} = 3; \frac{27}{9} = 3$; the pattern is "Multiply the previous term by 3" (nth term is 3^n); the next terms are $81 \cdot 3 = 243$; $243 \cdot 3 = 729$. **1b.** All differences = 6; the pattern is "Add 6 to the previous term"; the next terms are $27 + 6 = 33; 33 + 6 = 39$. **1c.** The ratios are all $\frac{-4}{2} = -2$, etc.; the pattern is "Multiply the previous term by −2"; the next terms are $(-16) \cdot (-2) = 32; 32 \cdot (-2) = -64$.
2a. $23 - 11 = 12; 35 - 23 = 12$; the common difference is 12. **2b.** $3 - 8 = -5$, etc.; the common difference is −5.
3a. $A(1) = -5 + (1 - 1)(3) = -5$; $A(6) = -5 + (6 - 1)(3) = -5 + 15 = 10$; $A(12) = -5 + (12 - 1)(3) = -5 + 33 = 28$ **3b.** $A(1) = 6.3 + (1 - 1)(5) = 6.3$; $A(6) = 6.3 + (6 - 1)(5) = 6.3 + 25 = 31.3$; $A(12) = 6.3 + (12 - 1)(5) = 6.3 + 55 = 61.3$

Exercises 1–12. Search for constant differences or constant ratios. **1.** The difference = 2; pattern is "Add 2 to the previous term"; the next terms are 12, 14. **2.** The ratio = $\frac{6}{4} = \frac{13\frac{1}{2}}{9} = \frac{3}{2}$; "Multiply the previous term by $\frac{3}{2}$"; $20\frac{1}{4}, 30\frac{3}{8}$. **3.** The differences are 2, 3, 4; "Add 2 to the first term, 3 to the second term, 4 to the third term, etc."; 18, 24. **4.** The difference = 0.04; "Add 0.04 to the previous term"; 3.16, 3.20. **5.** The constant ratio is $\frac{3.3}{3} = \frac{3.993}{3.63} = 1.1$; "Multiply the previous term by 1.1"; 4.3923, 4.83153. **6.** The differences are constant; "Subtract 2 from the previous term"; −5, −7. **7.** The differences are constant; "Add 1.1 to the previous term"; 5.5, 6.6. **8.** The ratios are constant; "Multiply the previous term by 10"; 10, 100. **9.** Ratios are $\frac{8}{2} = \frac{128}{32} = 4$; "Multiply the previous term by 4"; 512, 2048. **10.** Neither differences nor ratios will work here; "Square successive integers and take reciprocal"; $\frac{1}{25}, \frac{1}{36}$. **11.** Note constant differences; "Subtract 14 from the previous term"; −47, −61. **12.** Observe constant ratios; "Multiply the previous term by 5"; 937.5, 4687.5. **13.** $-2 - (-5) = 3, 1 - (-2) = 3$; the common difference is 3. **14.** $-10 - (-6) = -4$, $-14 - (-10) = -4$; the common difference is −4. **15.** $7 - 18 = -11, -4 - 7 = -11$; the common difference is −11. **16.** $21 - 8 = 13, 34 - 21 = 13$; the common difference is 13. **17.** $\frac{1}{3} - \frac{1}{2} = -\frac{1}{6}, \frac{1}{6} - \frac{1}{3} = -\frac{1}{6}$; the common difference is $-\frac{1}{6}$. **18.** $1.5 - 0.7 = 0.8$, $2.3 - 1.5 = 0.8$; the common difference is 0.8. **19.** $6 - 8 = -2, 4 - 6 = -2$; the common difference is −2. **20.** $22 - 10 = 12, 34 - 22 = 12$; the common difference is 12. **21.** $-4 - (-9) = 5, 1 - (-4) = 5$; the common difference is 5.

22. $2 + (2 - 1)(3) = 5; 2 + 4 \cdot 3 = 14; 2 + 8 \cdot 3 = 26$

23. $-9 + 1 \cdot 6 = -3; -9 + 4 \cdot 6 = 15; -9 + 8 \cdot 6 = 39$

24. $-7 + 1 \cdot 4 = -3; -7 + 4 \cdot 4 = 9; -7 + 8 \cdot 4 = 25$

25. $8 + 1 \cdot 9 = 17; 8 + 4 \cdot 9 = 44; 8 + 8 \cdot 9 = 80$

26. $0.5 + 1 \cdot 3 = 3.5; 0.5 + 4 \cdot 3 = 12.5; 0.5 + 8 \cdot 3 = 24.5$

27. $-5 + 1 \cdot 7 = 2; -5 + 4 \cdot 7 = 23; -5 + 8 \cdot 7 = 51$

28. $9 + 1 \cdot -6 = 3; 9 + 4 \cdot -6 = -15; 9 + 8 \cdot -6 = -39$ **29.** $-2.1 + 1 \cdot -5 = -7.1; -2.1 + 4 \cdot -5 = -22.1; -2.1 + 8 \cdot -5 = -42.1$ **30.** $65 + 1 \cdot -7 = 58; 65 + 4 \cdot -7 = 37; 65 + 8 \cdot -7 = 9$ **31.** $21 + 1 \cdot -4 = 17; 21 + 4 \cdot -4 = 5; 21 + 8 \cdot -4 = -11$ **32.** $-5 + 1 \cdot -3 = -8; -5 + 4 \cdot -3 = -17; -5 + 8 \cdot -3 = -29$ **33.** $0.2 + 1 \cdot -1 = -0.8; 0.2 + 4 \cdot -1 = -3.8; 0.2 + 8 \cdot -1 = -7.8$

34. The difference $= -6; -4, -10$. **35.** The difference $= \frac{1}{4}; 3\frac{1}{4}, 3\frac{1}{2}$. **36.** The differences are $3, 5, 7, \ldots; 26, 37$. **37.** Note $1\frac{1}{3} = \frac{4}{3}$; ratio $= \frac{1}{3}; \frac{4}{27}, \frac{4}{81}$. **38.** The differences are $3, 5, 7, 9, \ldots; 35, 48$. **39.** The difference $= 9; 31, 40$. **40.** The ratio $= \frac{1}{2}; 2.5, 1.25$. **41.** The difference $= \frac{1}{2}; 8, 8\frac{1}{4}$. **42.** The ratio $= -\frac{1}{3}; \frac{4}{27}, -\frac{4}{81}$. **43a.** Answers may vary. Inductive reasoning: Starting with limited data set, using intuition and hunches to arrive at generalization whose scope is far greater than original data set. Deductive reasoning: (a) starting from general principle, using strict logic to derive other general principles; or (b) starting from general principle and input data, predicting output data. **43b.** Answers may vary. Example (1): Induction: working from small table of values by guesswork to general function rule; Deduction: Using function rule and set of values of x to calculate values of y. Example (2): induction: examining short sequence, by leap of imagination, to arrive at pattern rule; deduction: using pattern rule to predict next terms of sequence **44.** The times of the bus are an arithmetic sequence, where $a = 6{:}30$ A.M. $= 390$ min past midnight, and $d = 7$ min. Since $A(14) = 390 + (13)\,7 = 481$ min past midnight $= 8{:}01$ A.M., you will have to wait 8:01 A.M. − 7:56 A.M. $= 5$ min for a bus. **45.** Answers may vary. It would be difficult to propose a sequence with constant ratios. For constant differences,

$$A(8) = a + (8 - 1)d$$
$$-30 = a + 7d$$
$$a = -30 - 7d$$

$d = -4, a = -2$; the sequence is $-2, -6, -10, -14, -18, -22, -26, -30$. **46.** 7 lb 4 oz; 7 lb 9 oz; 7 lb 14 oz; 8 lb 3 oz, 8 lb 8 oz. Last term is weight at age of 5 weeks. **47.** Balance ($) $= 4{,}500; 4{,}350; 4{,}200; 4{,}050; 3{,}900$; at the end of the 4th week the balance is $3,900.

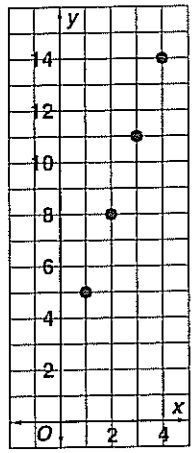
48a. Differences are $2 - 1 = 1; 4 - 2 = 2$; expect the next difference to be 3; expect the next term to be $4 + 3 = 7$.

48b. Ratios are $\frac{2}{1} = 2; \frac{4}{2} = 2$; expect the ratios to continue constant; expect the next term to be $4 \cdot 2 = 8$.

48c. Three terms are not enough to arrive at a unique pattern; with 4 terms, such as 1, 2, 4, 7 or 1, 2, 4, 8, there would be fewer choices for a pattern. **49–52.** For an arithmetic sequence the differences must be constant. **49.** No; the differences $(2.7, 27, \ldots)$ are not constant. **50.** Yes; the differences are all -4. **51.** No; the differences are not constant. **52.** No; the differences are not constant. **53.** Yes; the differences $(=15)$ are equal. **54.** Yes; the differences are constant (-0.8). **55a.** Look at the diagonals. We predict $1, 1, 1, 1, 1; 1, 2, 3, 4, 5; 1, 3, 6, 10$; these give the sixth row as $1, 5, 10, 10, 5, 1$. **55b.** The sums are $1, 2, 4, 8, 16$; extrapolate to the sixth sum $= 32$, which is the sum of $1, 5, 10, 10, 5$, and 1. **56.** $A(2) = 11 + (2 - 1)\left(\frac{1}{3}\right) = 11\frac{1}{3}; 11 + 3\left(\frac{1}{3}\right) = 12; 11 + 7\left(\frac{1}{3}\right) = 13\frac{1}{3}$ **57.** $9 + (2 - 1)(-4.5) = 4.5; 9 + 3(-4.5) = -4.5; 9 + 7(-4.5) = -22.5$ **58.** $-2 + (2 - 2)(-1.6) = -2; -2 + 2(-1.6) = -5.2; -2 + 6(-1.6) = -11.6$ **59.** $\frac{1}{5} + \frac{4}{5} = 1; \frac{1}{5} + 3\left(\frac{4}{5}\right) = 2\frac{3}{5}; \frac{1}{5} + 7\left(\frac{4}{5}\right) = 5\frac{4}{5}$

60a. The sequence is $y = 5, 8, 11, 14$.

60b.



60c. The points lie on a straight line. The function is $y = 5 + (x - 1)(3) = 2 + 3x$. **61a.** Yes; for each key struck only one frequency is produced (ideally). **61b.** As we move 7 white keys to the right, the frequency doubles (octave); that's true no matter where you start. **62a.** $8 + 13 = 21$ **62b.** The sequence is $1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89$. **62c.** Answers may vary. Sample: $3, 3, 6, 9, 15, 24, 39$ **63.** The new term $=$ previous term $+ 6$. **64.** The new term $=$ (previous term) $\cdot$ 1.5. **65.** The new term $=$ previous term $- 2.5$. **66.** The new term $=$ previous term $+ 4$. **67.** The new term $=$ (previous term) $\div 7$. **68.** The new term $=$ previous term $\cdot (-2.5)$. **69.** The difference $= (2x - 4) - (x - 4) = x$; the next term $= 3x + 4 + x = 4x + 4$. **70.** $(7a + 5b + c) - (4a + 3b + c) = 3a + 2b$; the next term $= 7a + 5b + c + 3a + 2b = 10a + 7b + c$. **71a.** The first term $= 10$. **71b.** The common difference is, for example, $-2, -4 = -6$. **71c.** The function rule is (first term) + $(n - 1)$(common difference) or $A(n) = 10 + (n - 1)(-6)$. **72.** The figures are arranged in groups of 3; the colors in each group are red, blue, and purple; the figures in the nth group have $(n + 2)$ sides. **72a.** The next figure is the second member of the third group, so it is blue and has $3 + 2 = 5$ sides:

72b. The 18th figure is the last in the 6th group; the 20th figure is the second in the 7th group; the second figure in a group is blue. **72c.** The 28th figure is the first figure of the 10th group; all figures in the 10th group have $10 + 2 = 12$ sides. **73a.** The first term is -5. **73b.** The common difference is $13 - 7 = 7 - 1 = 6$. **73c.** The rule is (first term) + $(n - 1)$(difference) or $A(n) = -5 + (n - 1)(6)$. **74.** The rule is "Divide previous term by 2"; sequence is $24, 12, 6, 3, 1.5, 0.75, 0.375$; the answer is C. **75.** The common difference is $-11 - (-1) = -10$, etc.; the answer is F. **76.** The difference $= \frac{16}{5} - \frac{11}{5} = \frac{5}{5} = 1$; the answer is A. **77.** $A(7) = -9 + (7 - 1)0.5 = -9 + 3 = -6$; the answer is H. **78.** From comparison with the general formula, the first term $= 0$; the answer is C. **79.** The pattern is "Add 2 to the previous term"; the next term is $x + 2 + 2 = x + 4$; the answer is H. **80.** The common difference is $21 - 24 = 15 - 18 = -3$; the sequence is $24, 21, 18, 15, 12, 9, 6$; the seventh term is 6. **81a.** $f(n) = 26{,}500 + 2880n$ **81b.** $n = 2008 - 2001 = 7$; $26{,}500 + 2880 \cdot 7 = 46{,}660$; salary $= \$46{,}660$ in 2008.

82. $y = kx, -5 = k(4), k = \frac{4}{-5}, y = -\frac{4}{5}x$

83. $y = kx, 12 = k(0.5), k = \frac{12}{0.5} = 24, y = 24x$

84. $y = kx, 14 = k(-1), k = -14, y = -14x$

85. $y = kx, 1.4 = k(10), k = \frac{1.4}{10} = 0.14, y = 0.14x$

86. $y = kx, -3.1 = k(1.1), k = \frac{-3.1}{1.1} = \frac{-31}{11}, y = -\frac{31}{11}x$

87. $y = kx, -3.1 = k(11), k = \frac{-3.1}{11} = -\frac{31}{110}, y = -\frac{31}{110}x$

88. $y = kx, -3 = k(2), k = \frac{-3}{2}, y = -\frac{3}{2}x$

89. $y = kx, \frac{1}{3} = k\left(\frac{1}{2}\right), k = \frac{1}{3} \cdot 2 = \frac{2}{3}, y = \frac{2}{3}x$

90. $f(-2) = -4(-2) = 8; f(1) = -4(1) = -4; f(5) = -4(5) = -20$; range $= \{-20, -4, 8\}$ **91.** $g(-2) = 1 - 4(-2) = 1 + 8 = 9; g(1) = 1 - 4(1) = -3; g(5) = 1 - 4(5) = -19$; range $= \{-19, -3, 9\}$ **92.** $3(-2) + 4 = -6 + 4 = -2; 3(1) + 4 = 7; 3 \cdot 5 + 4 = 19$; range $= \{-2, 7, 19\}$ **93.** $2|-2| = 4; 2|1| = 2; 2|5| = 10$; range $= \{2, 4, 10\}$ *Note*: In these problems the sequence in the range is in order of increasing value, and does not always correspond to the sequence of the domain.

94. $|2(-2)| = 4; |2 \cdot 1| = 2; |2 \cdot 5| = 10$; range $= \{2, 4, 10\}$ **95.** $\frac{3}{4}(-2) - 5 = -6\frac{1}{2}; \frac{3}{4}(1) - 5 = -4\frac{1}{4}; \frac{3}{4}(5) - 5 = -1\frac{1}{4}$; range $= \left\{-6\frac{1}{2}, -4\frac{1}{4}, -1\frac{1}{4}\right\}$

96.

Total	92 counties
EST	77
EDT	5
CDT	10

96a. $\frac{\text{EST}}{\text{Total}} = \frac{77}{92} \approx 0.837 \approx 84\%$

96b. $\frac{\text{CDT}}{\text{Total}} = \frac{10}{92} \approx 0.109 \approx 11\%$

TEST-TAKING STRATEGIES *page 274*

1. The trial-and-error method is very time consuming, even with a clever strategy for making good guesses. Also, using a variable one may obtain an answer in the form of a simple fraction, whereas guessing would usually yield a decimal.

2a. At depth x water pressure is 5 atmospheres.

$$\frac{98}{10.21} = \frac{x}{5}$$
$$5\left(\frac{98}{10.21}\right) = x$$
$$48.0 \approx x$$

The depth is about 48 m.

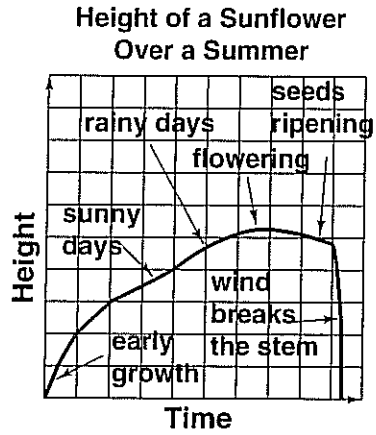
2b.
$$\frac{x}{150} = \frac{10.21}{98}$$
$$x = 150\left(\frac{10.21}{98}\right)$$
$$x \approx 15.6$$

The water pressure is about 15.6 atmospheres.

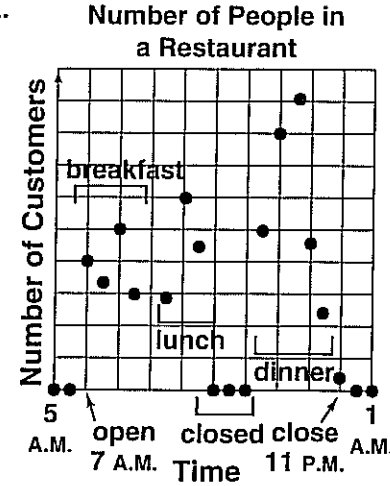
CHAPTER REVIEW *pages 275–277*

1. C **2.** D (drawing general conclusions from limited patterns) **3.** A (y is usually the dependent variable.) **4.** E (only one y for each x) **5.** B (The range is a set of values of y's.) **6.** G **7.** F **8.** Answers may vary. Sample: A computer rental costs \$2.50/h. If you start with a fixed amount of money, the longer you use the computer, the less money you will have left. **9.** Answers may vary. Sample: A residential thermostat senses when the temperature in the room falls below the set level. The heater is turned on until the temperature is 3°F above the set level. The heater is then turned off. The graph shows the air temperature rising while the heater is working, and falling after the heater is turned off. **10.** Answers may vary. Sample: An elevator is at the second floor. Someone gets in, goes to the 11th floor, and gets off. **11–14.** Answers may vary. Samples are given.

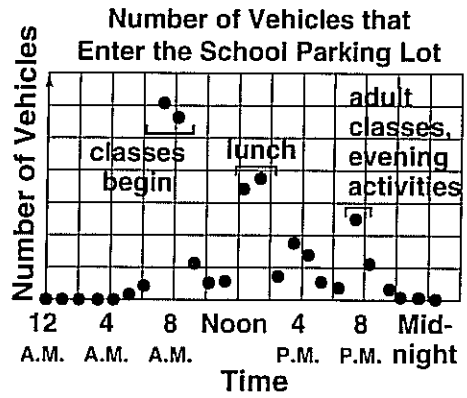
11.



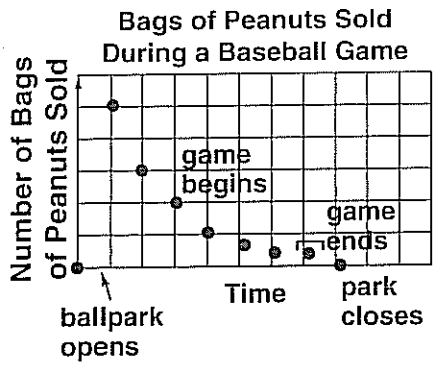
12.



13.



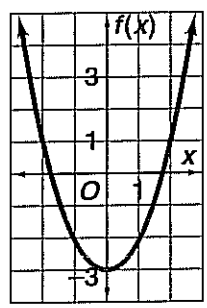
14.



15. $y = 4(-4) - 7 = -16 - 7 = -23$; $y = 4(0) - 7 = -7$; $y = 4(1) - 7 = 4 - 7 = -3$; $y = 4(5) - 7 = 20 - 7 = 13$; range $= \{-23, -7, -3, 13\}$ **16.** $0.5(-4) + 3 = 1$; $0.5(0) + 3 = 3$; $0.5(1) + 3 = 3.5$; $0.5(5) + 3 = 5.5$; range $= \{1, 3, 3.5, 5.5\}$ **17.** $p = (-4)^2 + 1 = 17$; $p = (0)^2 + 1 = 1$; $p = 1^2 + 1 = 2$; $p = 5^2 + 1 = 26$; range $= \{1, 2, 17, 26\}$ (Remember, items in the range are listed in increasing value, not by correspondence with members of the domain.) **18.** $5 - 3(-4) = 17$; $5 - 3(0) = 5$; $5 - 3(1) = 2$; $5 - 3(5) = -10$; range $= \{-10, 2, 5, 17\}$ **19.** No; there are two y's for $x = 1$. **20.** Yes; there are no duplicate x's, so there can't be any duplicate y's. **21.** yes; only one y for each x **22.** no; graph can cross vertical line twice **23.** A relation is a function when each value (x) corresponds to one and only one value (y) of the range. **24–27.** Tables may vary. Samples are given.

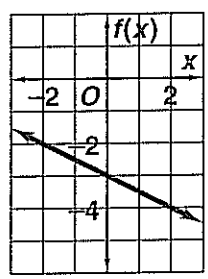
24.

x	$f(x)$
−2	1
0	−3
2	1



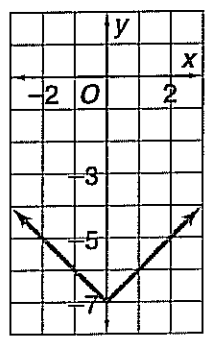
25.

x	$f(x)$
−2	−2
0	−3
2	−4



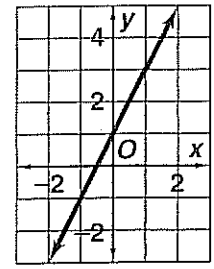
26.

x	y
−2	−5
−1	−6
0	−7
1	−6
2	−5



27.

x	y
−2	−3
−1	−1
0	1
1	3



28. $f(x) = x + 1$ **29.** $f(x) = -x$ **30.** $f(x) = x + 3.5$ **31.** $S(r) = 0.1r$ **32.** Per balloon cost is \$.07 + \$.13 = \$.20; number of balloons $= b$; total cost is $c = 27 + 0.2b$ (in dollars). **33.** yes; $k = -3$ **34.** no; $y(0) \neq 0$ **35.** no; $y(0) \neq 0$ **36.** yes; $k = \frac{2}{5}$ **37.** $y = kx, 1 = k(5)$, $k = \frac{1}{5}, y = \frac{1}{5}x$ **38.** $y = kx, -2 = k(-2), k = \frac{-2}{-2} = 1$, $y = x$ **39.** $y = kx, 2 = k(1), k = \frac{2}{1} = 2, y = 2x$ **40.** $y = kx, 6 = k(-2), k = \frac{6}{-2} = -3, y = -3x$ **41.** yes; $\frac{y}{x}$ = constant; $y = -2x$ **42.** No; $\frac{y}{x}$ is not constant. **43.** yes; $y = \frac{1}{6}x$

44.
$$\frac{\text{water}}{\text{total}} = \frac{54}{75} = \frac{x}{95}$$
$$95\left(\frac{54}{75}\right) = x$$
$$68.4 = x$$

The person contains about 68 kg of water.

45.
$$\frac{V}{E} = \frac{106}{120} = \frac{x}{150}$$
$$150\left(\frac{106}{120}\right) = x$$
$$132.5 = x$$

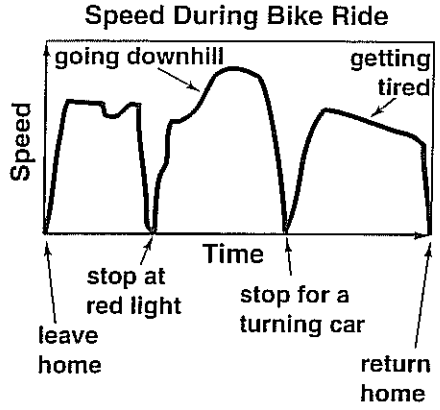
The person would weigh about 132 lb on Venus.

46–48. Using inductive reasoning, we test several possibilities: Is there a constant difference? Is there a constant ratio? **46.** Yes, there is a constant difference, $81 - 90 = -9$; the pattern is "Subtract 9 from the previous term"; 63, 54, 45. **47.** Yes, the constant difference $= +3$; the pattern is "Add 3 to the previous term"; 17, 20, 23. **48.** Again the differences are constant; the pattern is "Add 11 to the previous term"; 56, 67, 78. **49.** The common difference $= 8 - 8\frac{1}{2} = -\frac{1}{2}$; $7, 6\frac{1}{2}, 6$. **50.** $-2; -4, -6, -8$ **51.** 13; 53, 66, 79 **52.** $A(3) = -1 + (3 - 1)2 = -1 + 4 = 3$; $A(8) = -1 + (8 - 1)2 = -1 + 14 = 13$; $A(10) = -1 + (10 - 1)2 = -1 + 18 = 17$ **53.** $4 + (3 - 1)3 = 4 + 6 = 10$; $4 + (8 - 1)3 = 25$; $4 + (10 - 1)3 = 31$ **54.** $1.5 + (n - 1)1.5 = 1.5n$; the terms are $1.5 \cdot 3 = 4.5$; $1.5 \cdot 8 = 12$; $1.5 \cdot 10 = 15$. **55.** $4 + (3 - 1)(-3) = -2$; $4 + (8 - 1)(-3) = -17$; $4 + (10 - 1)(-3) = -23$ **56.** Yes, the differences are constant; 42, 49, 56. **57.** No; the differences are not constant (ratios are constant).

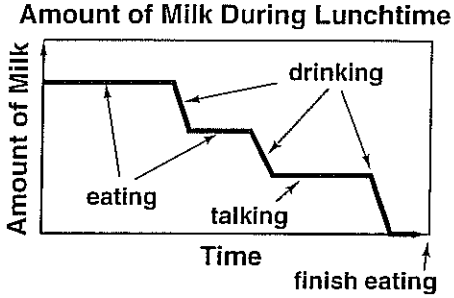
CHAPTER TEST *page 278*

1–2. Answers may vary. Samples are given.

1.



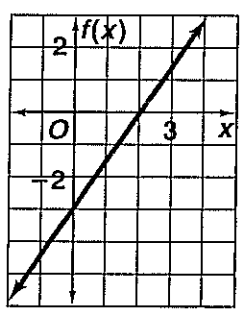
2.



3. Yes, it is a function (even though no simple function rule can be stated); domain = $\{-2, 3, 5, 8\}$; range = $\{5, 6, 12\}$. **4.** No; there are two different y's for $x = 9$. **5.** If any vertical line crosses the graph at two or more places (two y's for one x), the graph does not represent a function. **6.** $r(-3) = 4(-3)^2 + 5 = 36 + 5 = 41$; $4(-1.5)^2 + 5 = 14$; $4(0)^2 + 5 = 5$; $4(1)^2 + 5 = 9$; $4(4)^2 + 5 = 69$; range = $\{5, 9, 14, 41, 69\}$ **7.** $m(-3) = -3(-3) - 2 = 7$; $-3(-1.5) - 2 = 2.5$; $-3(0) - 2 = -2$; $-3(1) - 2 = -5$; $-3(4) - 2 = -14$; range = $\{-14, -5, -2, 2.5, 7\}$

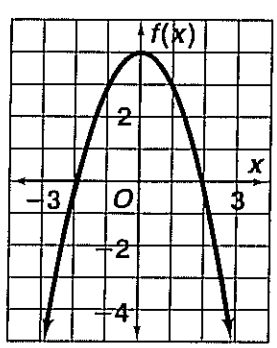
8.

x	$f(x)$
−2	−6
0	−3
2	0
4	3



9.

x	$f(x)$
−2	0
−1	3
0	4
1	3
2	0
3	−5



10–12. Choice of variables may vary. **10.** $c(d) = 0.038d$ **11.** $m(n) = 15n$ **12.** $p(n) = (1.50 - 0.80)n = 0.7n$ **13.** $y = 2x + 1$ **14.** $f(x) = -4.5x$ **15.** Answers may vary. Sample: x = number of cars washed at \$5 each and y = money earned. **16a.** Let t = weight of turkey (lb). Price is $p(t) = 0.59t$. **16b.** $0.59 \cdot 14 = 8.26$; price is \$8.26.

16c.
$$10 = 0.59t$$
$$\frac{10}{0.59} = t$$
$$16.949 = t$$

You can buy a turkey weighing about 16.9 lb.

17. $y = kx, 2 = k(2), k = \frac{2}{2} = 1, y = x$

18. $y = kx, -4 = k(-8), k = \frac{-4}{-8} = \frac{1}{2}, y = \frac{1}{2}x$

19. $y = kx, -1 = k(3), k = \frac{-1}{3}, y = -\frac{1}{3}x$

20. $y = kx, 3 = k(-5), k = \frac{3}{-5}, y = -\frac{3}{5}x$

21. yes, because the graph is a straight line and goes through $(0, 0)$; $y = 3x$ **22.** no, because graph does not pass through the origin

23.
$$10y = 13x$$
$$y = \frac{13}{10}x$$

Compare. $y = kx$, $k = \frac{13}{10}$

24. Compare $f(x) = kx$; $k = 4.5$.

25.
$$x + y = 0$$
$$y = -x$$
$$k = -1$$

26. (5 mL/min)(30 min) = 150 mL **27.** The common difference = $-45 - (-50) = 5$; $-35, -30, -25$.
28. The common difference = $4.7 - 3.7 = 1$; 5.7, 6.7, 7.7.
29. $A(5) = 2 + (5 - 1)(-2.5) = 2 - 10 = -8$
30. $A(5) = -9 + (5 - 1)3 = 3$ **31.** No; the differences are not constant (ratios are constant). **32.** Yes; the common difference = $3.25 - 3 = 0.25$. **33.** Let p = pounds of catfish (lb); let C = cost (\$); $C(p) = 3p$.

STANDARDIZED TEST PREP *page 279*

1. Speed = $\frac{231 \text{ mi}}{5 \text{ h}} = 46.2$ mi/h; the nearest answer is B.
2. 5 h − 3.5 h = 1.5 h; the answer is G. **3.** $\frac{231 \text{ mi}}{3.5 \text{ h}} =$ 66 mi/h; the best answer is B. **4.** Percent of change = $\frac{5 - 3.5}{5} = \frac{1.5}{5} = 0.30 = 30\%$; the answer is H.
5. $\frac{231 \text{ mi}}{150 \text{ mi/h}} = 1.54$ h; the answer is B.
6. $\frac{3.5}{3.5 + 2.75} = 0.56 = \frac{56}{100} = \frac{14}{25}$; the answer is G.
7. Boston–Providence = 231 − 180 = 51 mi; $\frac{51}{231} \approx 0.22 =$ 22% **8.** Yes; Amtrak carries 100,404 riders on the Boston–New York run, and this is 30% of train and air passengers. 30% of the total is 100,404; $0.30x = 100{,}404$; $x = 334{,}680$. If the total stays the same and Amtrak ridership doubles, the percentage will also double. $A = 2(100{,}404) = 200{,}808$. The percent is $\frac{200{,}808}{334{,}680} = 0.60$, or 60%.