Solving and Applying Proportions

DIAGNOSING READINESS page 180

1. $\frac{2}{3} \cdot \frac{3}{5} = \frac{2}{5}$ **2.** $4\frac{1}{2} \cdot \frac{1}{8} = \frac{9}{2} \cdot \frac{1}{8} = \frac{9 \cdot 1}{2 \cdot 8} = \frac{9}{16}$
3. $2\frac{2}{5} \div \frac{3}{4} = \frac{12}{5} \cdot \frac{4}{3} = \frac{4}{5} \cdot \frac{4}{1} = \frac{4 \cdot 4}{5 \cdot 1} = \frac{16}{5} = 3\frac{1}{5}$
4. $8 \div \frac{8}{3} = 8 \cdot \frac{3}{8} = 3$ **5.** $0.75 = 75\%$
6. $\frac{5}{8} = 0.625 = 62.5\%$ **7.** $12.5 = 1250\%$ **8.** $0.002 = 0.2\%$
9. $\frac{105}{150} = 0.7 = 70\%$ **10.** $n - 22$ **11.** $p + 40$ **12.** $20m$
13. $z + 17$ **14.** $3(2 - n) = 6 - 3n$ **15.** $0.4(t + 5) = 0.4t + 2$ **16.** $-8(x - 1) = -8x + 8$ **17.** $25(a + 8) = 25a + 200$ **18.** $-2.5(4 - c) = -10 + 2.5c$
19. $-(b + 12) = -b - 12$

20.
$$\frac{t}{3} = 8$$
$$3\left(\frac{t}{3}\right) = 3(8)$$
$$t = 24$$
Check: $\frac{24}{8} = 3$ ✓

21.
$$\frac{2}{5}w = -4$$
$$\frac{5}{2}\left(\frac{2}{5}w\right) = \frac{5}{2}(-4)$$
$$w = -10$$
Check: $\frac{2}{5}(-10) = -4$ ✓

22.
$$7x = \frac{42}{5}$$
$$\frac{1}{7}(7x) = \frac{1}{7}\left(\frac{42}{5}\right)$$
$$x = \frac{6}{5} = 1\frac{1}{5}$$
Check: $7\left(\frac{6}{5}\right) = \frac{42}{5}$ ✓

23.
$$\frac{4}{9}y = \frac{13}{3}$$
$$\frac{9}{4}\left(\frac{4}{9}y\right) = \frac{9}{4}\left(\frac{13}{3}\right)$$
$$y = \frac{39}{4} = 9\frac{3}{4}$$
Check: $\frac{4}{9}\left(\frac{39}{4}\right) = \frac{39}{9} = \frac{13}{3}$ ✓

24.
$$-2k = \frac{5}{2}$$
$$\frac{-2k}{-2} = \frac{1}{-2}\left(\frac{5}{2}\right)$$
$$k = -\frac{5}{4} = -1\frac{1}{4}$$
Check: $-2\left(-\frac{5}{4}\right) = \frac{5}{2}$ ✓

25.
$$20y = -2$$
$$\frac{20y}{20} = \frac{-2}{20}$$
$$y = -\frac{1}{10}$$
Check: $20\left(-\frac{1}{10}\right) = -2$ ✓

26.
$$\frac{w}{2} = \frac{1}{3}$$
$$2\left(\frac{w}{2}\right) = 2\left(\frac{1}{3}\right)$$
$$w = \frac{2}{3}$$
Check: $\frac{1}{2}\left(\frac{2}{3}\right) = \frac{1}{3}$ ✓

27.
$$\frac{11}{3}x = 5$$
$$\frac{3}{11}\left(\frac{11}{3}x\right) = \frac{3}{11}(5)$$
$$x = \frac{15}{11} = 1\frac{4}{11}$$
Check: $\frac{11}{3}\left(\frac{15}{11}\right) = \frac{15}{3} = 5$ ✓

4-1 Ratio and Proportion pages 182–188

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

1. $\frac{7}{12}$ **2.** $\frac{4}{7}$ **3.** $\frac{3}{4}$ **4.** 4 **5.** $\frac{3}{4}$ **6.** $\frac{1}{2}$

Check Understanding **1a.** $\frac{\$1.20}{32 \text{ oz}} = \$0.0375/\text{oz} = 3.75¢/\text{oz}$; $\frac{\$1.60}{64 \text{ oz}} = \$0.025/\text{oz} = 2.5¢/\text{oz}$ **1b.** 64-oz
2. $\frac{0.15 \text{ mi}}{1 \text{ h}} \cdot \frac{5280 \text{ ft}}{1 \text{ mi}} \cdot \frac{1 \text{ h}}{60 \text{ min}} = 13.2 \text{ ft/min}$

3a.
$$\frac{x}{8} = \frac{5}{6}$$
$$8\left(\frac{x}{8}\right) = 8\left(\frac{5}{6}\right)$$
$$x = \frac{20}{3} = 6\frac{2}{3}$$

3b.
$$\frac{y}{12} = \frac{4}{7}$$
$$12\left(\frac{y}{12}\right) = 12\left(\frac{4}{7}\right)$$
$$y = \frac{48}{7} = 6\frac{6}{7}$$

3c.
$$\frac{18}{50} = \frac{m}{15}$$
$$15\left(\frac{18}{50}\right) = 15\left(\frac{m}{15}\right)$$
$$5.4 = m$$

4a.
$$\frac{x}{4} = \frac{25}{12}$$
$$12x = 4 \cdot 25$$
$$\frac{12x}{12} = \frac{4 \cdot 25}{12}$$
$$x = \frac{4 \cdot 25}{12} = \frac{25}{3} = 8\frac{1}{3}$$

4b.
$$\frac{24}{5} = \frac{y}{7}$$
$$7 \cdot 24 = 5y$$
$$\frac{168}{5} = \frac{5y}{5}$$
$$33.6 = y$$

4c.
$$\frac{54}{d} = \frac{72}{64}$$
$$64 \cdot 54 = 72d$$
$$\frac{64 \cdot 54}{72} = \frac{72d}{72}$$
$$48 = d$$

5a.
$$\frac{2}{35} = \frac{x}{60}$$

5b.
$$60\left(\frac{2}{35}\right) = 60\left(\frac{x}{60}\right)$$
$$3\frac{3}{7} = x$$
You would walk about 3.4 mi.

6a. $\frac{x+2}{14} = \frac{x}{10}$

$10(x+2) = 14x$

$10x + 20 = 14x$

$20 = 4x$

$5 = x$

6b. $\frac{y-15}{y+4} = \frac{35}{7}$

$7(y-15) = 35(y+4)$

$7y - 105 = 35y + 140$

$-105 = 28y + 140$

$-245 = 28y$

$\frac{-245}{28} = \frac{28y}{28}$

$-8.75 = y$

6c. $\frac{3}{w+6} = \frac{5}{w-4}$

$3(w-4) = 5(w+6)$

$3w - 12 = 5w + 30$

$-12 = 2w + 30$

$-42 = 2w$

$\frac{-42}{2} = \frac{2w}{2}$

$-21 = w$

6d. $\frac{d-7}{4} = \frac{2d+1}{3}$

$3(d-7) = 4(2d+1)$

$3d - 21 = 8d + 4$

$-21 = 5d + 4$

$-25 = 5d$

$\frac{-25}{5} = \frac{5d}{5}$

$-5 = d$

Exercises **1.** $\frac{\$57}{6\text{ h}} = \$9.50/\text{h}$ **2.** $\frac{\$2}{5\text{ lb}} = \$.40/\text{lb}$

3. $\frac{524\text{ cars}}{4\text{ weeks}} = 131\text{ cars/week}$ **4.** $\frac{600\text{ calories}}{1.5\text{ h}} = 400\text{ cal/h}$

5. $\frac{\$2.40}{10\text{ oz}} = \$.24/\text{oz}$ **6.** $\frac{\$1.08}{12\text{ oz}} = \$.09/\text{oz}$

7. Convert quarts to gallons: $\left(x\ \text{qt}\right)\frac{1\text{ gal}}{4\text{ qt}} = \frac{x}{4}\text{ gal}$.

So, conversion factor is a ratio $\frac{\text{second unit}}{\text{first unit}}$. The answer is A.

8. A **9.** B **10.** A **11.** $\left(8\text{ h}\right)\frac{60\text{ min}}{1\text{ h}} = 480\text{ min}$

12. $\left(120\text{ cm}\right)\frac{1\text{ m}}{100\text{ cm}} = 1.20\text{ m}$ **13.** $\left(3\text{ h}\right)\frac{60\text{ min}}{1\text{ h}}\frac{60\text{ s}}{1\text{ min}} = 10{,}800\text{ s}$

14. $\frac{5}{6} = \frac{c}{9}$

$9\left(\frac{5}{6}\right) = 9\left(\frac{c}{9}\right)$

$7.5 = c$

15. $\frac{3}{8} = \frac{x}{30}$

$30\left(\frac{3}{8}\right) = 30\left(\frac{x}{30}\right)$

$11.25 = x$

16. $\frac{2}{8} = \frac{n}{20}$

$20\left(\frac{2}{8}\right) = 20\left(\frac{n}{20}\right)$

$5 = n$

17. $\frac{7}{5} = \frac{k}{18}$

$18\left(\frac{7}{5}\right) = 18\left(\frac{k}{18}\right)$

$25.2 = k$

18. $\frac{3}{4} = \frac{x}{10}$

$10\left(\frac{3}{4}\right) = 10\left(\frac{x}{10}\right)$

$7.5 = x$

19. $\frac{4}{6} = \frac{m}{9}$

$9\left(\frac{4}{6}\right) = 9\left(\frac{m}{9}\right)$

$6 = m$

20. $\frac{8}{d} = \frac{-12}{30}$

$8 \cdot 30 = -12d$

$d = \frac{240}{-12} = -20$

21. $\frac{5}{9} = \frac{8}{w}$

$5w = 8 \cdot 9$

$w = \frac{72}{5} = 14.4$

22. $\frac{2}{14} = \frac{m}{63}$

$63\left(\frac{2}{14}\right) = 63\left(\frac{m}{63}\right)$

$m = 9$

23. $\frac{-8}{11} = \frac{12}{v}$

$-8v = 11 \cdot 12$

$v = \frac{132}{-8} = -16.5$

24. $\frac{4}{9} = \frac{b}{15}$

$15\left(\frac{4}{9}\right) = 15\left(\frac{b}{15}\right)$

$b = 6\frac{2}{3}$

25. $\frac{3}{k} = \frac{-20}{35}$

$3(35) = -20k$

$k = \frac{105}{-20} = -5.25$

26. $\frac{q}{42} = \frac{15}{7}$

$42\left(\frac{q}{42}\right) = 42\left(\frac{15}{7}\right)$

$q = 90$

27. $\frac{6}{8} = \frac{21}{x}$

$6x = 8 \cdot 21$

$x = \frac{8(21)}{6} = 28$

28. $\frac{7}{n} = \frac{35}{88}$

$7 \cdot 88 = 35n$

$n = \frac{7(88)}{35} = \frac{88}{5}$

$n = 17.6$

29. $\frac{20}{18} = \frac{75}{w}$

$20w = 18(75)$

$w = \frac{18(75)}{20} = 67.5$

30. $\frac{200}{12} = \frac{x}{42}$

$x = \frac{200(42)}{12} = 700$

The canary's heart beats 700 times.

31. $\frac{66}{1.25} = \frac{x}{2}$

$x = \frac{2 \cdot 66}{1.25} = 105.6$

You would cover 105.6 km in 2 h.

32. $\frac{x+3}{4} = \frac{7}{8}$

$8(x+3) = 4 \cdot 7$

$8x + 24 = 28$

$8x = 4$

$x = 0.5$

33. $\frac{a-6}{5} = \frac{7}{12}$

$12(a-6) = 5 \cdot 7$

$12a - 72 = 35$

$12a = 107$

$a = \frac{107}{12} = 8\frac{11}{12}$

34. $\frac{8}{9} = \frac{w-2}{6}$

$6 \cdot 8 = 9(w-2)$

$48 = 9w - 18$

$66 = 9w$

$w = \frac{66}{9} = 7\frac{1}{3}$

35. $\frac{1}{c+5} = \frac{2}{3}$

$3 = 2(c+5)$

$3 = 2c + 10$

$-7 = 2c$

$c = -3\frac{1}{2}$

36. $\frac{8}{b+10} = \frac{4}{2b-7}$

$8(2b-7) = 4(b+10)$

$16b - 56 = 4b + 40$

$12b - 56 = 40$

$12b = 96$

$b = 8$

37. $\frac{k+5}{10} = \frac{k-12}{9}$

$9(k+5) = 10(k-12)$

$9k + 45 = 10k - 120$

$45 = k - 120$

$165 = k$

38. $\frac{\$2}{\text{lb}} \frac{1\text{ lb}}{16\text{ oz}} = 12.5¢/\text{oz}$ **39.** $\frac{\$3}{1\text{ lb}} \frac{1\text{ lb}}{16\text{ oz}} = 18.75¢/\text{oz}$

40. $\frac{4¢}{\text{day}} \frac{365\text{ days}}{1\text{ yr}} = \$14.60/\text{yr}$ **41.** $\frac{5¢}{\text{day}} \frac{365\text{ days}}{\text{yr}} = \$18.25/\text{yr}$

42. $\frac{5\text{ cm}}{\text{min}} \frac{1\text{ m}}{100\text{ cm}} \frac{60\text{ min}}{1\text{ hr}} \frac{24\text{ hr}}{1\text{ day}} \frac{7\text{ days}}{1\text{ week}} = 504\text{ m/week}$

43. $\frac{1\text{ qt}}{1\text{ min}} \frac{1\text{ gal}}{4\text{ qt}} \frac{60\text{ min}}{1\text{ hr}} \frac{24\text{ hr}}{1\text{ day}} \frac{7\text{ days}}{1\text{ week}} = 2520\text{ gal/week}$

44. $\frac{1\text{ mi}}{3\text{ min}} \frac{60\text{ min}}{1\text{ h}} = 20\text{ mi/h}$ **45.** $\frac{1\text{ mi}}{4\text{ min}} \frac{60\text{ min}}{1\text{ hr}} = 15\text{ mi/h}$

46. $\frac{1\text{ mi}}{300\text{ sec}} \frac{60\text{ sec}}{1\text{ min}} \frac{60\text{ min}}{1\text{ h}} = 12\text{ mi/h}$

47. $\frac{10{,}560\text{ ft}}{2\text{ h}} \frac{1\text{ mi}}{5280\text{ ft}} = 1\text{ mi/h}$ **48.** $\frac{21{,}120\text{ ft}}{4\text{ h}} \frac{1\text{ mi}}{5280\text{ ft}} = 1\text{ mi/h}$

49. $\frac{270\text{ ft}}{10.8\text{ min}} \frac{1\text{ mi}}{5280\text{ ft}} \frac{60\text{ min}}{1\text{ h}} \approx 0.28\text{ mi/h}$

50. $\frac{21}{5} = \frac{x}{12}$

$12(21) = 5x$

$x = \frac{12(21)}{5} = 50.4$

It will take 50.4 min.

51. $\frac{0.35}{1} = \frac{x}{30}$

$0.35(30) = x$

$10.5 = x$

It grows about 10.5 mm.

52. $\frac{168\text{ mi}}{1\text{ h}} \frac{5280\text{ ft}}{1\text{ mi}} \frac{1\text{ h}}{3600\text{ sec}} = 246.4\text{ ft/s}$

53. $\frac{m+12}{9m} = \frac{5}{9}$

$9(m+12) = 5 \cdot 9m$

$9m + 108 = 45m$

$108 = 36m$

$\frac{108}{36} = \frac{36m}{36}$

$m = 3$

54. $\frac{p}{20} = \frac{p-4}{5}$

$5p = 20(p-4)$

$5p = 20p - 80$

$0 = 15p - 80$

$80 = 15p$

$p = \frac{80}{15} = 5\frac{1}{3}$

55. $\frac{n+12}{4} = \frac{n}{16}$

$16(n+12) = 4n$

$16n + 12 \cdot 16 = 4n$

$12n + 12 \cdot 16 = 0$

$12n = -12 \cdot 16$

$n = -16$

56. $\frac{29}{24} = \frac{b+24}{b}$

$29 \cdot b = 24(b+24)$

$29b = 24b + 24 \cdot 24$

$5b = 576$

$\frac{5b}{5} = \frac{576}{5}$

$b = 115.2$

57. $\frac{w}{15} = \frac{w-9}{12}$

$12w = 15(w-9)$

$12w = 15w - 135$

$-3w = -135$

$w = 45$

58. $\frac{9}{3t-6} = \frac{6}{0.2t+4}$

$9(0.2t+4) = 6(3t-6)$

$1.8t + 36 = 18t - 36$

$36 = 16.2t - 36$

$72 = 16.2t$

$t = 4.\overline{4}$

59. $\frac{n+2}{25} = \frac{n-4}{35}$

$35(n+2) = 25(n-4)$

$35n + 70 = 25n - 100$

$10n + 70 = -100$

$10n = -170$

$n = -17$

60. $\frac{q-11}{q+13} = \frac{2}{3}$

$3(q-11) = 2(q+13)$

$3q - 33 = 2q + 26$

$q - 33 = 26$

$q = 59$

61. $\frac{18+d}{14-d} = \frac{3}{7}$

$7(18+d) = 3(14-d)$

$126 + 7d = 42 - 3d$

$126 + 10d = 42$

$10d = -84$

$d = -8.4$

62. $31 \cdot \frac{1250}{60} \approx 646$; about 646 students

63. $36 \cdot \frac{1250}{60} = 750$; about 750 students

64. $48 \cdot \frac{1250}{60} = 1000$; about 1000 students **65.** Start with an equation equating two fractions. Multiply the numerator of each side by the denominator of the other side. Set these products equal to each other and solve.

Example:

$$\frac{7}{5} = \frac{x}{15} \text{ Multiply through by } 5 \cdot 15.$$
$$15(7) = 5(x)$$
$$x = \frac{15 \cdot 7}{5} = 3 \cdot 7 = 21$$

66. $\frac{\$1.79}{1 \text{ gal}} \frac{1 \text{ gal}}{34 \text{ mi}} \approx \$0.05 \text{ mi}$

67. Mongolia: $\frac{2{,}651{,}000 \text{ people}}{604{,}000 \text{ mi}^2} \approx 4 \text{ people/mi}^2$

Bangladesh: $\frac{129{,}194{,}000 \text{ people}}{52{,}000 \text{ mi}^2} \approx 2485 \text{ people/mi}^2$

United States: $\frac{275{,}562{,}000 \text{ people}}{3{,}536{,}000 \text{ mi}^2} \approx 78 \text{ people/mi}^2$

68. Check students' work. Sample: (3 mi/h) $\frac{22 \text{ ft/sec}}{15 \text{ mi/h}} = 4.4 \text{ ft/s}$

69a.
$$\frac{x-1}{x} = \frac{6}{7}$$
$$7(x-1) = 6x$$
$$7x - 7 = 6x$$
$$x - 7 = 0$$
$$x = 7;$$
$$\frac{x-2}{x} = \frac{6}{7}$$
$$7(x-2) = 6x$$
$$7x - 14 = 6x$$
$$x - 14 = 0$$
$$x = 14$$

69b. The next multiple of 7 is 21.

69c. Check: $\frac{21-3}{21} = \frac{18}{21} = \frac{6}{7}$ ✓

69d.
$$\frac{x-a}{x} = \frac{6}{7}$$
$$7(x-a) = 6x$$
$$7x - 7a = 6x$$
$$x - 7a = 0$$
$$x = 7a$$

70.
$$\frac{b}{t} = \frac{7}{4}$$
$$4b = 7t$$
$$t = \frac{4}{7}b$$
$$b + t = 88$$
$$b + \frac{4}{7}b = 88$$
$$\frac{11}{7}b = 88$$
$$b = \frac{7}{11}88 = \$56$$
$$t = 88 - 56 = \$32$$

Bonnie should receive \$56, and Tim \$32.

71.
$$\frac{v}{120} = \frac{2}{5}$$
$$v = 120\left(\frac{2}{5}\right) = 48$$

The secondary voltage is 48 V.

72. Start by multiplying the first equation through by 24 and the second equation by 9.

$$\frac{12}{3} = x$$
or $$x = 4$$
and $$\frac{x}{4} = \frac{y}{9}$$
$$9x = 4y$$
$$y = \frac{9}{4}x$$
$$y = \frac{9}{4}(4) = 9$$

73.
$$\frac{x^2-3}{5x+2} = \frac{x}{5}$$
$$5(x^2-3) = x(5x+2)$$
$$5x^2 - 15 = 5x^2 + 2x$$
$$-15 = 2x$$
$$x = -7.5$$

74.
$$\frac{w^3+7}{w} = \frac{9w^2+7}{9}$$
$$9(w^3+7) = w(9w^2+7)$$
$$9w^3 + 7 \cdot 9 = 9w^3 + 7w$$
$$7 \cdot 9 = 7w$$
$$w = 9$$

75.
$$\frac{m^2-8}{3m} = \frac{4m+1}{12}$$
$$12(m^2-8) = 3m(4m+1)$$
$$12m^2 - 96 = 12m^2 + 3m$$
$$-96 = 3m$$
$$m = -32$$

76a. Time = $120 + 23 + \frac{14}{60} \approx 143.23$ min. Pace = $\frac{143.23 \text{ min}}{26.2 \text{ mi}} \approx 5.47$ min/mi. **76b.** Time = $120 + 20 + \frac{43}{60} \approx 140.72$ min. Pace = $\frac{140.73 \text{ min}}{26.2 \text{ mi}} \approx 5.37$ min/mi.

77. $\frac{3}{4} = 0.75$, and $\frac{32}{42} \approx 0.76$; the answer is D.

78. $\frac{\$2.50}{28 \text{ oz}} \approx \$0.089/\text{oz}$; the answer is G. **79.** $\frac{\$24}{6 \text{ h}} = \$4/\text{h}$; the answer is C. **80.** $\frac{180 \text{ beats}}{\text{min}} \frac{1 \text{ breath}}{4 \text{ beats}} = 45$ breaths/min; the answer is G.

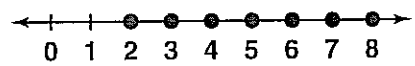
81. [2] 20 in. $\cdot \frac{32 \text{ rings}}{12 \text{ in.}} = 53\frac{1}{3}$ rings; age $\approx$ 53 yr

[1] incorrect proportion solved correctly OR correct proportion solved incorrectly

82. $|r| > 1$

$r > 1$ or $r < -1$

Solution is 2, 3, 4, ...

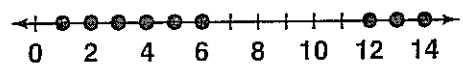


83. $|t-9| > 2$

$t - 9 > 2$ or $t - 9 < -2$

$t > 11$ or $t < 7$

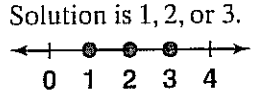
Solution is 12, 13, 14, ...



84. $-7 \le k \le 3$

$-7 \le k$ and $k \le 3$

Solution is 1, 2, or 3.



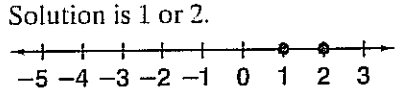
85. $-3 < 2g + 1 < 7$

$-3 < 2g + 1$ and $2g + 1 < 7$

$-4 < 2g$ $\quad$ $2g < 6$

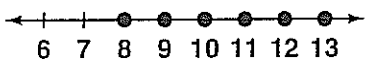
$-2 < g$ and $g < 3$

Solution is 1 or 2.



86. $e > 7$ or $e < -4$

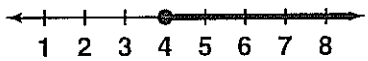
Solution is 8, 9, 10, ...

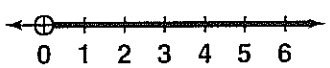


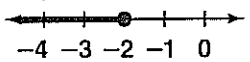
87.
$$|8(b+5)| < 16$$
$$-16 < 8(b+5) < 16$$
$$\frac{-16}{8} < \frac{8(b+5)}{8} < \frac{16}{8}$$
$$-2 < b+5 < 2$$
$$-2-5 < b+5-5 < 2-5$$
$$-7 < b < -3$$

There are no solutions in the set of positive integers.

88. Let t = your height (in.); $t \leq 72$. **89.** Let s = number of students; $s \geq 235$. **90.** Let m = number of miles on full tank; $m \leq 344$. **91.** Let w = dog's weight (lb); $w > 20$.

92.


93.


94.


95.
$$15x = 90$$
$$x = \frac{90}{15} = 6$$

Check: $15 \cdot 6 = 90$ ✓

96.
$$34 = \frac{t}{4}$$
$$4 \cdot 34 = 4\frac{t}{4}$$
$$t = 136$$

Check: $\frac{136}{4} = 34$ ✓

97.
$$-35 = 7h$$
$$\frac{-35}{7} = \frac{7h}{7}$$
$$h = -5$$

Check: $7(-5) = -35$ ✓

98.
$$4.3 - b = 9.8$$
$$-b = 5.5$$
$$b = -5.5$$

Check: $4.3 - (-5.5) = 9.8$ ✓

99.
$$-\frac{3}{5}c = 54$$
$$-\frac{5}{3}\left(-\frac{3}{5}\right)c = -\frac{5}{3}(54)$$
$$c = -90$$

Check: $-\frac{3}{5}(-90) = 54$ ✓

100.
$$v + 7\frac{1}{6} = \frac{2}{3}$$
$$v = \frac{2}{3} - 7\frac{1}{6} = -6\frac{1}{2}$$

4-2 Proportions and Similar Figures *pages 189–196*

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

1. $\frac{6}{7}$ **2.** $\frac{3}{4}$ **3.** $\frac{1}{2}$ **4.** $2\frac{4}{5}$ **5.** $2\frac{4}{15}$ **6.** $6\frac{2}{3}$ **7.** $1\frac{1}{9}$ **8.** 10 **9.** $\frac{3}{5}$

Investigation Answers may vary. Sample: **1.** AB = 8.5 cm, CA = 7.6 cm, CB = 5.6 cm, CD = 3.5 cm, CE = 2.6 cm, DE = 3.9 cm

2. Round all ratios to nearest 0.01: **2a.** $\frac{DE}{AB} = 0.46$ **2b.** $\frac{CE}{CB} = 0.46$ **2c.** $\frac{CD}{CA} = 0.46$ **3a.** true **3b.** true

3c. To nearest 0.1: $\frac{AB}{DE} = \frac{8.5}{3.9} = 2.2$; $\frac{CA}{CD} = 2.2$; true

4. $\frac{CA}{CD}$, $\frac{AB}{DE}$

Check Understanding

1.
$$\frac{LM}{LK} = \frac{GH}{GF}$$

Let $x = LM$.
$$\frac{x}{24} = \frac{20}{32}$$
$$32x = 24 \cdot 20$$
$$\frac{32x}{32} = \frac{24(20)}{32}$$
$$x = 15$$

LM is 15 cm.

2a. $\frac{\text{height of tree}}{\text{shadow of tree}} = \frac{\text{height of boy}}{\text{shadow of boy}}$

Let x = height of tree.
$$\frac{x}{26} = \frac{4.5}{12}$$
$$12x = 4.5(26)$$
$$\frac{12x}{12} = \frac{4.5(26)}{12}$$
$$x = 9.75$$

The tree is 9.75 ft tall.

2b.
$$\frac{x}{56} = \frac{5.4}{7.2}$$
$$7.2x = 56(5.4)$$
$$\frac{7.2x}{7.2} = \frac{56(5.4)}{7.2}$$
$$x = 42$$

The house is 42 ft high.

3a. Grant to Gifford $= 2\frac{3}{8} - \frac{5}{16} = 2\frac{1}{16} = 2.0625$ in. on map. Scale is 1 in.: 10 mi. Actual distance = $(2.0625 \text{ in.})\left(\frac{10 \text{ mi}}{1 \text{ in.}}\right) = 20.625$ mi, or about 21 mi.

3b. $(17.5 \text{ mi})\left(\frac{1 \text{ in}}{5 \text{ mi}}\right) = 3.5$ in.

Exercises 1. $\overline{AB} \cong \overline{PQ}, \overline{BC} \cong \overline{QR}, \overline{CA} \cong \overline{RP}$, $\angle A \cong \angle P, \angle B \cong \angle Q, \angle C \cong \angle R$

2. $\overline{ED} \cong \overline{JH}, \overline{DF} \cong \overline{HK}, \overline{FE} \cong \overline{KJ}, \angle D \cong \angle H$, $\angle E \cong \angle J, \angle F \cong \angle K$

3.
$$\frac{x}{5} = \frac{5}{8}$$
$$8x = 5 \cdot 5$$
$$\frac{8x}{8} = \frac{25}{8}$$
$$x = 3.125; 3.125 \text{ ft}$$

4.
$$\frac{y}{12} = \frac{20}{18}$$
$$18y = 12 \cdot 20$$
$$\frac{18y}{18} = \frac{240}{18}$$
$$y = 13.\overline{3}; 13.\overline{3} \text{ cm}$$

5.
$$\frac{x}{12} = \frac{120}{18}$$
$$18x = 12(120)$$
$$\frac{18x}{18} = \frac{12(120)}{18}$$
$$x = 80; 80 \text{ in.}$$

6.
$$\frac{k}{15} = \frac{56}{21}$$
$$21k = 15(56)$$
$$\frac{21k}{21} = \frac{15(56)}{21}$$
$$k = 40; 40 \text{ m}$$

7. $\frac{x}{24} = \frac{27}{32}$

$32x = 24(27)$

$\frac{32x}{32} = \frac{24(27)}{32}$

$x = 20.25$; 20.25 cm

8. $\frac{k}{6} = \frac{6}{5}$

$5k = 6 \cdot 6$

$\frac{5k}{5} = \frac{36}{5}$

$k = 7.2$; 7.2 ft

9. $\frac{3}{x} = \frac{5}{8}$

$5x = 3(8)$

$\frac{5x}{5} = \frac{24}{5}$

$x = 4.8$; 4.8 ft

10. $\frac{x}{18} = \frac{3}{4.5}$

$4.5x = 3(18)$

$\frac{4.5x}{4.5} = \frac{3(18)}{4.5}$

$x = 12$; 12 in.

11. (5 in.)(17.5 mi/in.) = 87.5 mi

12. (8.3 in.)(17.5 mi/in.) = 145.25 mi

13. (18.6 in.)(17.5 mi/in.) = 325.5 mi

14. (20 in.)(17.5 mi/in.) = 350 mi

15a. L to SP: (1 in.)(16 mi/in.) = 16 mi; L to D: $\left(\frac{13}{8}\text{ in.}\right)$(16 mi/in.) = 26 mi; SP to D: $\left(\frac{9}{8}\text{ in.}\right)$(16 mi/in.) = 18 mi

15b. It's shorter to go via San Paulo than through Lincoln. Distance = $\frac{1}{2}(16) + 18 = 26$; 26 mi. **16.** $\frac{3.5\text{ cm}}{28\text{ km}} = 0.125\ \frac{\text{cm}}{\text{km}} = 1$ cm: 8 km

17. (8 ft)$\left(\frac{1\text{ in.}}{2\text{ ft}}\right)$ by (12 ft)$\left(\frac{1\text{ in.}}{2\text{ ft}}\right)$ = 4 in. by 6 in.

18. (8 ft)$\left(\frac{1\text{ in.}}{3\text{ ft}}\right)$ by (12 ft)$\left(\frac{1\text{ in.}}{3\text{ ft}}\right)$ = $2\frac{2}{3}$ in. by 4 in.

19. (8 ft)$\left(\frac{1\text{ in.}}{4\text{ ft}}\right)$ by (12 ft)$\left(\frac{1\text{ in.}}{4\text{ ft}}\right)$ = 2 in. by 3 in.

20. (8 ft)$\left(\frac{1\text{ in.}}{2.5\text{ ft}}\right)$ by (12 ft)$\left(\frac{1\text{ in.}}{2.5\text{ ft}}\right)$ = 3.2 in. by 4.8 in.

21. $\frac{x}{9} = \frac{15}{4}$

$4x = 9 \cdot 15$

$\frac{4x}{4} = \frac{135}{4}$

$x = 33.75$; 33.75 in.

22. (2.5 in.)$\left(\frac{9\text{ ft}}{1\text{ in.}}\right)$ by (3 in.)$\left(\frac{9\text{ ft}}{1\text{ in.}}\right)$ = 22.5 ft by 27 ft

23a. Robert's proportion is $\frac{\text{short}}{\text{short}} = \frac{\text{short}}{\text{long}}$. His sides do not correspond. One can either rotate or flip one of the figures to line them up. **23b.** $\frac{GH}{PQ} = \frac{HL}{RQ}$

24. 2 in. : 24 ft = 1 in. : 12 ft

25. $\left(\frac{3}{4}\text{ in.}\right)\left(\frac{12\text{ ft}}{1\text{ in.}}\right)$ by (1 in.)$\left(\frac{12\text{ ft}}{1\text{ in.}}\right)$ = 9 ft by 12 ft

26. $\left(\frac{1}{4}\text{ in.}\right)$(12 ft/in.) = 3 ft

27. First, find the area of the two rooms: $\left(\frac{3}{2}\text{ in.}\right)$(12 ft/in.) by $\left(\frac{3}{2}\text{ in.}\right)$(12 ft/in.) = 18 ft by 18 ft = 324 ft^2. Area of dining room = total area − area of kitchen = 324 ft^2 − 108 ft^2 = 216 ft^2.

28. Section is $\left(1\frac{1}{2} - \frac{3}{4}\right)$ by $\left(1\frac{1}{2} - 1\right) = \frac{3}{4}$ in. by $\frac{1}{2}$ in. on drawing, or 9 ft by 6 ft. The table will fit.

29. Let s = shorter side and ℓ = longer side.

$\ell = 2s + 8$

$\frac{\ell}{s} = \frac{12}{5}$

$5\ell = 12s$

$\frac{12s}{12} = \frac{5\ell}{12}$

$s = \frac{5\ell}{12}$

$\ell = 2\frac{5\ell}{12} + 8$

$\ell - \frac{10}{12}\ell = 8$

$\frac{1}{6}\ell = 8$

$\ell = 48$

$s = \frac{5(48)}{14} = 20$

The rectangle has dimensions of 48 cm by 20 cm.

30a. $\frac{w}{3} = \frac{2}{1}$

$w = 6$

The width is 6 m.

30b. $P_{\text{small}} = (2 + 1 + 2 + 1)\text{m} = 6$ m; $P_{\text{large}} = (6 + 3 + 6 + 3)\text{m} = 18$ m **30c.** ratio of sides = $1 : 3 = \frac{1}{3}$; ratio of perimeters = $6 : 18 = 1 : 3 = \frac{1}{3}$; yes, the ratio of perimeters is equal to the ratio of sides.

30d. $6 \cdot 3 = 18$, or 18 m^2; $2 \cdot 1 = 2$, or 2 m^2

30e. $\frac{A_{\text{small}}}{A_{\text{large}}} = \frac{2}{18} = \frac{1}{9}$; the ratio of the areas is the square of the ratio of the corr. sides. **31.** Answers may vary. Sample: doll house to regular house; model car to real car **32a.** Yes, all cubes are similar to each other because they all have the same shape (90° ◬) and their sides are all in proportion.

32b. $\frac{\text{side}_{\text{small}}}{\text{side}_{\text{large}}} = \frac{4}{8} = \frac{1}{2}$

$\frac{\text{volume}_{\text{small}}}{\text{volume}_{\text{large}}} = \frac{(\text{side}_{\text{small}})^3}{(\text{side}_{\text{large}})^3} = \frac{4^3}{8^3} = \left(\frac{4}{8}\right)^3 = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

The volume ratio is the cube of the side ratio.

32c. $\frac{\text{volume}_{\text{large}}}{\text{volume}_{\text{small}}} = \left(\frac{\text{side}_{\text{large}}}{\text{side}_{\text{small}}}\right)^3 = \left(\frac{3}{1}\right)^3 = 9$; their ratio is 9 : 1.

33. $a + b + c = 24$

$a = b + 2$

$\frac{b}{c} = \frac{3}{5}$

$5b = 3c$

$\frac{5b}{3} = \frac{3c}{3}$

$c = \frac{5b}{3}$

$(b + 2) + b + \frac{5b}{3} = 24$

$\frac{11}{3}b + 2 = 24$

$\frac{11}{3}b = 22$

$\frac{3}{11}\left(\frac{11}{3}b\right) = \frac{3}{11}22$

$b = 6$

$a = b + 2 = 6 + 2 = 8$

$c = \frac{5}{3}(6) = 10$

The three sides are 6 cm, 8 cm, and 10 cm.

34. Height: $\frac{11 \text{ in.}}{335 \text{ mi}} \approx 1 \text{ in.} : 30.5 \text{ mi}$; width: $\frac{8.5 \text{ in}}{210 \text{ mi}} =$ 1 in. : 24.7 mi. If we used the latter scale, the height would be $(335 \text{ mi})\left(\frac{1 \text{ in.}}{24.7 \text{ mi}}\right) = 13.6$ in. high, which wouldn't fit on the paper. Choose 1 in. : 30.5 mi.

35.
$$\frac{x}{3640} = 110$$
$$x = 3640 \cdot 110$$
$$x = 400{,}400$$

The moon is about 400,400 km away.

36a.
$$\frac{8}{8 + x} = \frac{5}{7}$$

36b.
$$8 \cdot 7 = 5(8 + x)$$
$$56 = 40 + 5x$$
$$16 = 5x$$
$$x = 3.2; 3.2 \text{ in.}$$

36c. $AB = 8 + x = 8 + 3.2 = 11.2; 11.2$ in.

36d. area $= \frac{1}{2}(AB)(CB) = \frac{1}{2}(11.2)(7) = 39.2; 39.2 \text{ in.}^2$

37. Since BC and XZ are not corr. side lengths, the answer is B. **38.** $(14.5 \text{ cm})\left(\frac{11 \text{ km}}{1 \text{ cm}}\right) = 159.5$ km; the answer is I. **39.** [2] smaller area: $6 \cdot 5 = 30$, or 30 ft^2; larger area: $10 \cdot 12 = 120$, or 120 ft^2;

$$\frac{0.5}{30} = \frac{x}{120}$$
$$0.5(120) = 30x$$
$$60 = 30x$$
$$2 = x$$

Two gallons of paint should cover a 10 ft × 20 ft wall. [1] incorrect calculation for one area and proportion solved correctly OR correct area calculations but proportion set up incorrectly

4. [4] **a.**
$$\frac{77.5}{16} \neq \frac{55}{12}$$
$$77.5(12) \neq 16(55)$$
$$930 \neq 880$$

Since the cross products are not equal, the proportion is not true. So, the postcard is not similar to the painting.

b. $\frac{77.5}{x} = \frac{55}{12}$ OR $\frac{77.5}{16} = \frac{55}{y}$

The postcard should be 12 cm × 16.9 cm OR 11.4 cm × 16 cm. [3] appropriate methods, but with one computational error OR found only one possible postcard size [2] incorrect proportions solved correctly [1] correct answer with no work shown.

41.
$$\frac{x}{2} = \frac{9}{4}$$
$$4x = 2 \cdot 9$$
$$\frac{4x}{4} = \frac{18}{4}$$
$$x = 4.5$$

42.
$$\frac{5}{n} = \frac{3}{10}$$
$$5 \cdot 10 = 3n$$
$$n = \frac{50}{3} = 16\frac{2}{3}$$

43.
$$\frac{-8}{m} = \frac{7}{20}$$
$$-8 \cdot 20 = 7m$$
$$m = \frac{-160}{7} = -22\frac{6}{7}$$

44.
$$\frac{12}{30} = \frac{16}{v}$$
$$\frac{2}{5} = \frac{16}{v}$$
$$2v = 5 \cdot 16 = 80$$
$$v = 40$$

45.
$$5b < -20$$
$$\frac{5b}{5} < \frac{-20}{5}$$
$$b < -4$$

46.
$$\frac{4}{7}x \geq 4$$
$$\frac{7}{4}\left(\frac{4}{7}x\right) \geq \frac{7}{4}(4)$$
$$x \geq 7$$

47.
$$-3m > 12$$
$$\frac{-3m}{-3} < \frac{12}{-3}$$
$$m < -4$$

48.
$$-\frac{2}{3}h < 1$$
$$-\frac{3}{2}\left(-\frac{2}{3}h\right) > -\frac{3}{2}$$
$$h > -\frac{3}{2}$$

CHECKPOINT QUIZ 1 *page 195*

1. $(2 \text{ days})\left(\frac{24 \text{ h}}{1 \text{ day}}\right)\left(\frac{60 \text{ min}}{1 \text{ h}}\right) = 2880$ min **2.** $\frac{\$48}{8 \text{ h}} = \$6/\text{h}$

3.
$$\frac{x}{6} = \frac{7}{4}$$
$$6\frac{x}{6} = 6\frac{7}{4}$$
$$x = 10.5$$

4.
$$\frac{8}{k} = -\frac{12}{30}$$
$$\frac{2}{k} = -\frac{1}{10}$$
$$2 \cdot 10 = -k$$
$$k = -20$$

5.
$$\frac{3}{5} = \frac{y + 1}{9}$$
$$3 \cdot 9 = 5(y + 1)$$
$$27 = 5y + 5$$
$$22 = 5y$$
$$y = 4.4$$

6. $(12 \text{ min})\left(\frac{7 \text{ mi}}{2.5 \text{ mi}}\right) = 33.6$ min

7.
$$\frac{y}{5} = \frac{5}{8}$$
$$5\frac{y}{5} = 5\left(\frac{5}{8}\right)$$
$$y = 3\frac{1}{8}; 3\frac{1}{8} \text{ cm}$$

8.
$$\frac{m}{3} = \frac{6}{4}$$
$$3\frac{m}{3} = 3\left(\frac{6}{4}\right)$$
$$m = 4.5; 4.5 \text{ ft}$$

9.
$$\frac{\text{pole height}}{\text{pole shadow}} = \frac{\text{child height}}{\text{child shadow}}$$

Let x = pole height.

$$\frac{x}{50} = \frac{3.5}{5}$$
$$50\frac{x}{50} = 50\frac{3.5}{5}$$
$$x = 35$$

The pole is 35 ft.

10. $(5.5 \text{ in.})\left(\frac{20 \text{ mi}}{3 \text{ in.}}\right) = 36\frac{2}{3}$ mi

INVESTIGATION *page 196*

1.
$$\frac{x}{100} = \frac{15}{45}$$
$$100\left(\frac{x}{100}\right) = 100\left(\frac{15}{45}\right)$$
$$x = 33\tfrac{1}{3}$$

15 is $33\frac{1}{3}\%$ of 45.

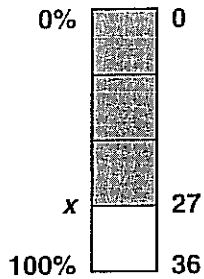
2.
$$\frac{75}{100} = \frac{90}{n}$$
$$75n = 90(100)$$
$$\frac{75n}{75} = \frac{90(100)}{75}$$
$$n = 120$$

90 is 75% of 120.

3.
$$\frac{40}{100} = \frac{n}{85}$$
$$n = 85\left(\frac{40}{100}\right)$$
$$n = 34$$

34 is 40% of 85.

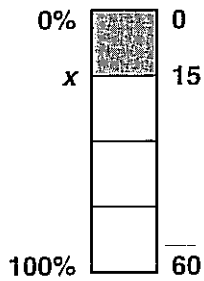
4.



$$\frac{x}{100} = \frac{27}{36}$$
$$36x = 2700$$
$$x = 75$$

27 is 75% of 36.

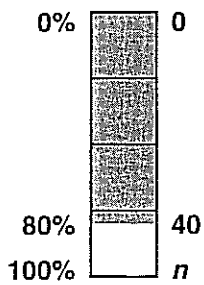
5.



$$\frac{x}{100} = \frac{15}{60}$$
$$60x = 1500$$
$$x = 25$$

15 is 25% of 60.

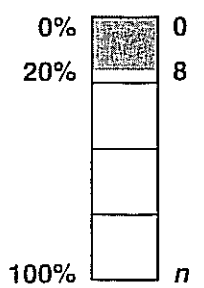
6.



$$\frac{80}{100} = \frac{40}{n}$$
$$80n = 4000$$
$$n = 50$$

40 is 80% of 50.

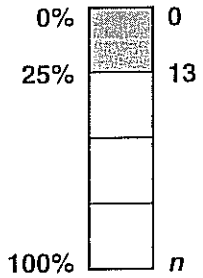
7.



$$\frac{20}{100} = \frac{8}{n}$$
$$20n = 800$$
$$n = 40$$

8 is 20% of 40.

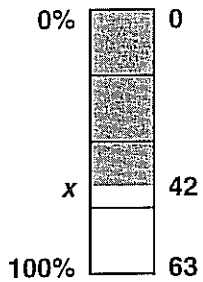
8.



$$\frac{25}{100} = \frac{13}{n}$$
$$25n = 1300$$
$$n = 52$$

13 is 25% of 52.

9.



$$\frac{x}{100} = \frac{42}{63}$$
$$63x = 4200$$
$$x = 66\tfrac{2}{3}$$

42 is $66\frac{2}{3}\%$ of 63.

4-3 Proportions and Percent Equations *pages 197–209*

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

1. 5.4 **2.** 25.84 **3.** $\frac{1}{6}$ **4.** $\frac{1}{54}$ **5.** 0.7, 70% **6.** 0.23, 23%
7. 0.4, 40% **8.** 0.65, 65% **9.** 0.875, 87.5%
10. 0.4375, 43.75% **11.** 0.16, 16% **12.** 0.85, 85%

Check Understanding **1.** $\frac{30}{40} = 0.75 = 75\%$

2. $(30\%) \cdot 40 = 0.30 \cdot 40 = 12$

3.
$$\frac{87.5}{100} = \frac{31.5}{x}$$
$$87.5x = 3150$$
$$x = \frac{3150}{87.5} = 36$$

His school requires 36 h for community service.

4a. 85% of 320 = 0.85 × 320 = 272

4b.
393 = 60% of what?
$$393 = 0.60 \cdot x$$
$$x = \frac{393}{0.60} = 655$$

5a.
$$105 = (125\%)x$$
$$x = \frac{105}{1.25} = 84$$

5b. $\frac{1.6}{320} = 0.005 = 0.5\%$

5c. $\frac{640}{32} = 20 = 2000\%$

5d.
$$3900 = (0.13\%)x$$
$$x = \frac{3900}{0.0013} = 3{,}000{,}000$$

6a. 49% of 280 ≈ 50% of 280 $= \left(\frac{1}{2}\right)(280) = 140$

6b. 65% of 334 ≈ $66.\overline{6}\%$ of 333 $= \frac{2}{3}(333) = 222$

6c. 74.2% of 44 ≈ 75% of 44 $= \left(\frac{3}{4}\right)(44) = 33$

6d. x = 11% of 521 ≈ 10% of 520 $= \left(\frac{1}{10}\right)(520) = 52$

7a. 33% of \$56 ≈ $\frac{1}{3}$ (\$56) ≈ \$19

7b. \$56 − \$19 = \$37

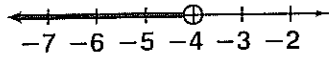
Exercises **1.** $\frac{20}{40} = 0.5 = \frac{50}{100} = 50\%$

2. $\frac{20}{80} = 0.25 = 25\%$ **3.** $\frac{15}{45} = 0.333 = 33\frac{1}{3}\%$
4. $\frac{10}{50} = 0.20 = 20\%$ **5.** $\frac{6}{24} = 0.25 = 25\%$
6. $\frac{18}{90} = 0.20 = 20\%$ **7.** 40% of 20 $= (0.40)20 = 8$
8. $(80\%)(20) = 0.8(20) = 16$ **9.** $0.30(70) = 21$
10. 40% of 70 $= 0.4(70) = 28$ **11.** 8% of 125 $=$ $0.08(125) = 10$ **12.** $0.16(125) = 20$
13. 20 = (40%) of what?
$20 = (40\%) \cdot x$
$x = \frac{20}{0.40} = 50$
14. $20 = (80\%)x$
$x = \frac{20}{0.80} = 25$
15. (15%) of $x = 24$
$(0.15)x = 24$
$x = \frac{24}{0.15} = 160$
16. $(0.20)x = 48$
$x = \frac{48}{0.20} = 240$
17. (60%) of $x = 42$
$0.6x = 42$
$x = \frac{42}{0.6} = 70$
18. $42 = (30\%)x$
$x = \frac{42}{0.30} = 140$
19. 18 hours = 60% of total
$18 = 0.60x$
$x = \frac{18}{0.60} = 30$ h
20. $50 = 0.25x$
$x = \frac{50}{0.25} = 200$
21. $25 = 0.50x$
$x = \frac{25}{0.50} = 50$
22. $96 = x \cdot 150; x = \frac{96}{150} = 0.64 = 64\%$
23. $45 = x \cdot 60; x = \frac{45}{60} = 0.75 = 75\%$
24. $x = 0.05(300) = 15$ **25.** $x = 0.05(200) = 10$
26. $(150\%)(14) = 1.5 \cdot 14 = 21$ **27.** $\frac{28}{14} = 2 = 200\%$
28. $18 = (450\%)x$
$x = \frac{18}{4.50} = 4$
29. $\frac{75}{25} = 3 = 300\%$ **30.** $(0.6\%)70 = (0.006)70 = 0.42$
31. $\frac{2.1}{700} = 0.003 = 0.3\%$ **32.** 51% of 400 $\approx 0.50(400) =$ 200 **33.** 24.8% of 400 $\approx \left(\frac{1}{4}\right)(400) = 100$
34. 67.18% of 33 $\approx \left(\frac{2}{3}\right)(33) = 22$ **35.** 74% of 201 $\approx$ $\left(\frac{3}{4}\right)(200) = 150$ **36.** 9.8% of 680 $\approx \left(\frac{1}{10}\right)(680) = 68$
37. 39% of 80.3 $\approx \frac{4}{10} \cdot 80 = 32$ **38.** Estimate: $0.80 \cdot 1200 = 960$; there will be about 960 students.
39. $3 = (0.75)x$
$x = \frac{3}{0.75} = 4$
40. $x \cdot 75 = 300; x = \frac{300}{75} = 4 = 400\%$
41. $x = 0.002 \cdot 900 = 1.8$
42. $1.8 = 0.02x$
$x = \frac{1.8}{0.02} = 90$

43. $1000x = 988; x = \frac{988}{1000} = 0.988 = 98.8\%$
44. $x = (1.40)(84) = 117.6$ **45.** 50% of 122 $= 61$, so 51.3% is larger. 62 is closer. **46.** $25\%(84) = 21$; value is smaller; 20 is closer. **47.** 10% of 740 $= 74$; 73 is closer.
48. $75\%(240) = 180$. 185 is closer.
49. Jane's tax $= 0.072(13{,}500) = 972$. Julie's tax $=$ $0.05(13{,}500) = 675$. Difference $= 972 - 675 = 297$; \$297.
50. 6% of 545 $= 0.06(545) = 32.70$; \$32.70
51. $214.28 = (0.055)x$
$x = \frac{214.28}{0.055} = 3896$; \$3896
52. 10% of \$8.20 $= 82¢$; 5% of \$8 $= 40¢$; total $= \$1.22 \approx$ \$1.20
53a. $I = 550 \cdot 0.045 \cdot 3 = 74.25$; \$74.25
53b. $67.50 = 900 \cdot r \cdot 2$
$r = \frac{67.50}{900 \cdot 2} = 0.0375 = 3.75\%$
53c. $316.68 = 812 \cdot 0.065 \cdot t$
$t = \frac{316.68}{812 \cdot 0.065} = 6$; 6 yr
54. $I = prt = 340(0.06)3 = 61.20$; \$61.20
55. $p = \frac{I}{rt} = \frac{312.50}{(0.05)(5)} = 1250$; \$1250
56. $r = \frac{I}{pt} = \frac{392}{1400(4)} = 0.07 = 7\%$
57. $t = \frac{I}{pr} = \frac{1540}{(22{,}000)(0.35)} = 2$; 2 yr
58. Answers may vary. Sample: $\frac{8 \text{ h sleeping}}{24 \text{ h in day}} = 33\frac{1}{3}\%$
59a. $n\%$ of $\frac{6}{n} = \left(\frac{n}{100}\right)\left(\frac{6}{n}\right) = \frac{3}{50}$
59b. $2k = (k\%)$ of x
$2k = \left(\frac{k}{100}\right)x$
$\left(\frac{100}{k}\right)2k = \left(\frac{100}{k}\right)\left(\frac{k}{100}\right)x$
$x = 200$
59c. $\frac{3x}{0.75x} = 4 = 400\%$
60. Cost in Canada $= \$C16.99(1.15)\frac{\$US0.66}{\$C1.00} = \$US12.90$; cost in U.S. $= \$US13.99(1.06) = \$US14.83$; yes, it's cheaper in Canada.
61. $(0.62)43{,}931 \approx 27237$ **62.** $27{,}237(0.43) \approx 11712$
63. 170 billion $= (0.40)x$
$x = \frac{170 \text{ billion}}{0.40} = 425$ billion
64. $\$35.00(1 - x) = \$22.75$
$1 - x = \frac{22.75}{35.00} = 0.65$
$x = 0.35 = 35\%$
65. $580(1 + 0.15) = 667$; 667 students
66. $1 - \frac{2}{5} - 0.40 = 0.20 = 20\%$
67. $(1 \text{ in.})\left(\frac{40 \text{ mi}}{3 \text{ in.}}\right) = 13\frac{1}{3}$ mi **68.** $(4.5 \text{ in.})\left(\frac{40 \text{ mi}}{3 \text{ in.}}\right) = 60$ mi
69. $\left(6\frac{3}{4} \text{ in.}\right)\left(\frac{40 \text{ mi}}{3 \text{ in.}}\right) = 90$ mi **70.** $(8 \text{ in.})\left(\frac{40 \text{ mi}}{3 \text{ in.}}\right) = 106\frac{2}{3}$ mi
71. $5b < -20$
$\frac{5b}{5} < \frac{-20}{5}$
$b < -4$
Check: Test $b = -4$ in the equation.
$5b = -20$
$5(-4) = -20$ ✓

Test $b = -5$ in the original inequality.

$$5(-5) < -20 \checkmark$$



72.

$$\tfrac{4}{7}x \geq 4$$

$$\tfrac{7}{4}\left(\tfrac{4}{7}x\right) \geq \tfrac{7}{4}(4)$$

$$x \geq 7$$

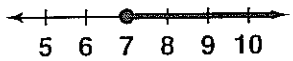
Check: Test $x = 7$ in the equation.

$$\tfrac{4}{7}x = 4$$

$$\tfrac{4}{7}(7) = 4 \checkmark$$

Test $x = 8$ in the original inequality.

$$\tfrac{4}{7}(8) \geq 4 \checkmark$$



73.

$$-\tfrac{2}{3}h < 14$$

$$-\tfrac{3}{2}\left(-\tfrac{2}{3}h\right) > -\tfrac{3}{2}(14)$$

$$h > -21$$

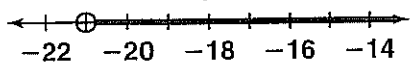
Check: Test $h = -21$ in the equation.

$$-\tfrac{2}{3}h = 14$$

$$-\tfrac{2}{3}(-21) = 14 \checkmark$$

Test $h = -18$ in the original inequality.

$$-\tfrac{2}{3}(-18) < 14 \checkmark$$



74.

$$3.4 < -10.2p$$

$$\frac{3.4}{-10.2} > \frac{-10.2p}{-10.2}$$

$$p < -\tfrac{1}{3}$$

Check: Test $p = -\frac{1}{3}$ in the equation.

$$3.4 = -10.2p$$

$$3.4 = -10.2\left(-\tfrac{1}{3}\right) \checkmark$$

Test $p = -1$ in the original inequality.

$$3.4 < -10.2(-1) \checkmark$$

READING MATH page 203

$I = \$110.25$, $t = 3$ years, $r = 5.25\%$. What is p?

$$I = prt$$

$$110.25 = p \cdot 0.0525 \cdot 3$$

$$110.25 = 0.1575p$$

$$p = 700$$

The principal is \$700.

4-4 Percent of Change pages 204–209

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

1. 4 **2.** 40% **3.** 20 **4.** 30 **5.** 16 **6.** 32

Check Understanding **1a.** percent of change = $\frac{\text{amount of change}}{\text{original amount}} = \frac{13.99 - 12.99}{12.99} = \frac{1.00}{12.99} = 0.077 =$ 7.7% ≈ 8%; an increase of 8%.

1b. percent of change = $\frac{13.99 - 12.99}{13.99} = \frac{1.00}{13.99} =$ 0.071 = 7.1% ≈ 7%; a decrease of 7%.

2. percent of increase = $\frac{2919 - 146}{146} = \frac{2773}{146} \approx 1899\%$

3. Height = 9 cm, that is, perhaps 8.6 or 9.4 cm, but not 8.4 or 9.6 cm. So, height is 9 ± 0.5 cm.

4. minimum area = 11.5 ft × 7.5 ft = 86.25 ft^2; maximum area = 8.5 ft × 12.5 ft = 106.25 ft^2

5a. percent error = $\frac{0.5 \text{ in.}}{168 \text{ in.}} = 0.00298 \approx 0.3\%$

5b. percent error = $\frac{0.05 \text{ in}}{168.0 \text{ in.}} = 0.000298 \approx 0.03\%$

6. Volume as measured = 1 in. × 9 in. × 10 in. = 90 in.^{3}. Maximum volume = 1.5 in. × 9.5 in. × 10.5 in. = 149.625 in.^{3}. Minimum volume = 0.5 in. × 8.5 in. × 9.5 in. = 41.65 in^3. Possible errors are 149.6 in.^{3} − 90 in.^{3} = 59.6 in.^{3} and 90 in.^{3} − 41.65 in.^{3} = 58.35 in.^{3} Percent error = $\frac{59.6}{90} \approx 66\%$.

Exercises **1.** $\frac{\text{amount of change}}{\text{original amount}} = \frac{3 - 2}{2} = \frac{1}{2} = 50\%$ (increase) **2.** $\frac{3 - 2}{3} = \frac{1}{3} = 33.3\%$ (decrease) **3.** $\frac{5 - 4}{4} =$ 0.25 = 25% (increase) **4.** $\frac{5 - 4}{5} = 0.20 = 20\%$ (decrease) **5.** $\frac{12 - 9}{9} = \frac{1}{3} = 33.3\%$ (increase) **6.** $\frac{12 - 9}{12} = \frac{1}{4} = 25\%$ (decrease) **7.** $\frac{15 - 12}{12} = \frac{1}{4} =$ 25% (increase) **8.** $\frac{18 - 15}{15} = \frac{1}{5} = 20\%$ (increase) **9.** $\frac{8.3 - 4.5}{4.5} = \frac{3.8}{4.5} = 84.4\%$ (increase) **10.** $\frac{65 - 38}{38} = \frac{27}{38} =$ 71.1% (increase) **11.** $\frac{12.20 - 4.80}{12.20} = \frac{7.40}{12.20} = 0.607 =$ 60.7% (decrease) **12.** $\frac{143 - 125}{125} = \frac{18}{125} = 0.144 =$ 14.4% (increase) **13.** $\frac{125 - 90}{90} = \frac{35}{90} = 0.39 = 39\%$ **14.** $\frac{5 - 2}{5} = \frac{3}{5} = 0.6 = 60\%$ **15.** Error = one-half of least digit = 0.5 ft **16.** 0.05 cm **17.** 0.005 g **18.** 0.5 in. **19.** minimum area = 3.5 cm × 5.5 cm = 19.25 cm^2; maximum area = 4.5 cm × 6.5 cm = 29.25 cm^2 **20.** min = 6.5 mi × 7.5 mi = 48.75 mi^2; max = 7.5 mi × 8.5 mi = 63.75 mi^2 **21.** min = 5.5 in. × 8.5 in. = 46.75 in.^{2}; max = 6.5 in. × 9.5 in. = 61.75 in.^{2} **22.** min = 11.5 km × 4.5 km = 51.75 km^2; max = 12.5 km × 5.5 km = 68.75 km^2 **23.** min = 17.5 in. × 14.5 in. = 253.75 in.^{2}; max = 18.5 in. × 15.5 in. = 286.75 in.^{2} **24.** min = 22.5 km × 13.5 km = 303.75 km^2; max = 23.5 km × 14.5 km = 340.75 km^2 **25.** $\frac{0.5}{2} = 0.25 = 25\%$ **26.** $\frac{0.05}{0.2} = 0.25 = 25\%$

27. $\frac{0.5}{4} = 0.125 = 12.5\%$ **28.** $\frac{0.05}{0.4} = 0.125 = 12.5\%$

29a. measured volume = 8 cm × 3 cm × 2 cm = 48 cm^3

29b. maximum volume = 8.5 × 3.5 × 2.5 = 74.375; 74.375 cm^3 **29c.** minimum volume = 7.5 × 2.5 × 1.5 = 28.125; 28.125 cm^3 **29d.** Errors = 74.375 − 48 = 26.375 and 48 − 28.125 = 19.875. Greater of these is 26.375 cm^3. **29e.** $\frac{\text{greatest possible error}}{\text{measurement}} = \frac{26.375}{48} = 0.549 \approx 55\%$ **30.** $\frac{\text{amount of change}}{\text{original amount}} = \frac{26 - 20}{26} = \frac{6}{26} = 0.23 = 23\%$ (decrease) **31.** $\frac{4.95 - 3.87}{4.95} = \frac{1.08}{4.95} = 0.218 \approx 22\%$ (decrease) **32.** $\frac{54 - 21}{21} = \frac{33}{21} = 1.57 = 157\%$ (increase)

33. $\frac{5.5 - 2}{2} = \frac{3.5}{2} = 1.75 = 175\%$ (increase)

34. $\frac{25{,}000 - 24{,}000}{24{,}000} = \frac{1000}{24{,}000} = 0.0417 \approx 4\%$ (increase)

35. $\frac{18 - 17.5}{18} = \frac{0.5}{18} = 0.028 \approx 3\%$ (decrease)

36. $\frac{8.99 - 3.99}{8.99} = \frac{5}{8.99} = 0.556 \approx 56\%$ (decrease)

37. $\frac{132 - 120}{132} = \frac{12}{132} = 0.091 \approx 9\%$ (decrease)

38. $\frac{49.95 - 42.69}{42.69} = \frac{7.26}{42.69} = 0.170 = 17\%$ (increase)

39. $\frac{10.75 - 10.54}{10.54} = \frac{0.21}{10.54} = 0.02 = 2\%$ (increase)

40. $\frac{19 - 16}{16} = \frac{3}{16} = 0.1875 \approx 19\%$ **41.** 1 mm

42. \$64 to \$74: $\frac{74 - 64}{64} = \frac{10}{64} = 0.156 \approx 16\%$; \$74 to \$64: $\frac{74 - 64}{74} = \frac{10}{74} = 0.1351 \approx 14\%$; they differ in magnitude because the denominators differ.

43. Increase = (10%)(\$64) = \$6.40; increased price = \$64 + \$6.40 = \$70.40. Decrease = (10%)(\$70.40) = \$7.04; decreased price = \$70.40 − \$7.04 = \$63.36.

44. Answers may vary. Sample: Joan bought shoes for \$10. Sarah bought the same shoes 3 days later for \$7. What was the percent change? 30% decrease

45. minimum = 4.05 cm × 6.05 cm = 24.5 cm^2; maximum = 4.15 cm × 6.15 cm = 25.5 cm^2

46. minimum = 6.95 × 8.35 = 58.0 mi^2; maximum = 7.05 mi × 8.45 mi = 59.6 mi^2

47. minimum = 6.005 in. × 9.015 in. = 54.14 $in.^2$; maximum = 6.015 in. × 9.025 in. = 54.29 in^2

48a. $\frac{\text{amount of change}}{\text{original amount}} = \frac{16 - 8}{8} = \frac{8}{8} = 1 = 100\%$

48b. If $b = 2a$, $\frac{b - a}{a} = \frac{2a - a}{a} = \frac{2 - 1}{1} = \frac{1}{1} = 1 = 100\%$

48c. $\frac{16 - 8}{16} = \frac{8}{16} = 50\%$ **48d.** If $b = 0.5a$, $\frac{b - a}{a} = \frac{a - 0.5a}{a} = \frac{1 - 0.5}{1} = \frac{0.5}{1} = 0.5 = 50\%$. This is a decrease of 50%.

49. measured volume = 12 in. × 15 in. × 17 in. = 3060 $in.^3$; max volume = 12.5 in. × 15.5 in. × 17.5 in. = 3390.6 in^3; min volume = 11.5 in. × 14.5 in. × 16.5 in. = 2751.4 in^3; errors = 330.6 $in.^3$ and 308.6 $in.^3$; percent error = $\frac{330.6}{3060} = 0.108 \approx 11\%$

50. measured volume = 2 m × 11 m × 20 m = 440 m^3; max volume = 2.5 m × 11.5 m × 20.5 m = 589.4 m^3; min volume = 1.5 m × 10.5 m × 19.5 m = 307.1 m^3; errors = 149.4 m^3 and 132.9 m^3; percent error = $\frac{149.4}{440} = 0.34 = 34\%$

51. Answers may vary. Sample: Error in linear dimensions = $\pm \frac{1}{2}$ (least digit in dimensions). Measured area = length × width. Max, min areas = (length + error)(width + error), (length − error)(width − error). Percent error in area = $\frac{\text{maximum area} - \text{measured area}}{\text{measured area}}$.

52. Jorge calculated $\frac{15 - 10}{10} = 50\%$, but should have calculated $\frac{15 - 10}{15} = 33.3\%$

53a. Smaller: Measured volume = $(18 \text{ cm})^3 = 5832 \text{ cm}^3$; maximum volume = $(18.5 \text{ cm})^3 = 6332 \text{ cm}^3$; minimum volume = $(17.5 \text{ cm})^3 = 5359 \text{ cm}^3$; errors = $6332 - 5832 = 500 \text{ cm}^3$, $5832 - 5359 = 473 \text{ cm}^3$; percent error in volume = $\frac{500}{5832} = 0.086 \approx 9\%$.

Larger: Measured volume = $(45 \text{ cm})^3 = 91{,}125 \text{ cm}^3$; maximum volume = $(45.5 \text{ cm})^3 = 94{,}196 \text{ cm}^3$; minimum volume = $(44.5 \text{ cm})^3 = 88{,}121 \text{ cm}^3$; errors = $94{,}196 - 91{,}125 = 3071 \text{ cm}^3$, $91{,}125 - 88{,}121 = 3004 \text{ cm}^3$; percent error in volume = $\frac{3071}{91{,}125} = 0.0337 \approx 3\%$.

53b. The amounts of change in linear dimensions are the same, but for the larger cube the percent errors in dimension and volume are smaller. The percent error in linear dimension was 2.8% for the smaller cube but only 1.1% for the larger cube.

54. The first report refers to the ratio $\frac{148.3}{48.7} = 3.05$; the second report refers to the change: $\frac{148.3 - 48.7}{48.7} = \frac{99.6}{48.7} = 2.045 \approx 205\%$.

55a. Let ratio = $\frac{\text{new side}}{\text{old side}} = r = \frac{1 + 0.1}{1} = 1.1$; $\frac{\text{new area}}{\text{old area}} = \frac{(\text{new side})^2}{(\text{old side})^2} = \left(\frac{\text{new side}}{\text{old side}}\right)^2 = r^2 = (1.1)^2 = 1.21 = 1 + 21\%$.

55b, 55c. Same result: area increases by 21% independent of the length of the sides.

56. $\frac{36 - 32}{32} = \frac{4}{32} = \frac{1}{8} = 0.125 = 12.5\%$; the answer is C.

57. Maximum area = 5.5 in. × 8.5 in. = 46.75 $in.^2$. The answer = I. **58.** Minimum digit in measurement = 0.1 cm. Error = $\frac{1}{2}$ (0.1 cm) = 0.05 cm; A. **59.** Baseball [hardball] side = 1.5(softball side); four-base trip = 4(side); $\frac{\text{hardball trip} - \text{soft trip}}{\text{soft trip}} = \frac{4(\text{hard side}) - 4(\text{soft side})}{4(\text{soft side})} = \frac{(\text{hard side}) - (\text{soft side})}{(\text{soft side})} = 50\%$; $\frac{\text{hard area} - \text{soft area}}{\text{soft area}} = \frac{(\text{hard side})^2 - (\text{soft side})^2}{(\text{soft area})^2} = \frac{[1.5(\text{soft side})]^2 - (\text{soft side})^2}{(\text{soft side})^2} = \frac{1.5^2 - 1}{1} = 2.25 - 1 = 1.25 = 125\%$.

60–65. Equations may vary. Samples:

60. $\frac{5}{67} = 0.0746 \approx \frac{7}{100} = 7\%$ **61.** $\frac{13}{15} = 0.867 \approx 87\%$

62.
$$79 = (44\%) \text{ of what?}$$
$$79 = (0.44) \cdot x$$
$$x = \frac{79}{0.44} = 179.5$$

63. $\frac{96}{32} = 3 = 300\%$

64. 0.2% of 834 = $(0.002) \cdot 834 = 1.668 \approx 1.7$

65. 266% of 14 = $(2.66) \cdot 14 = 37.2$

66.
$$5 - 7n > 4 + 8n$$
$$1 > 15n$$
$$\frac{1}{15} > n$$

67.
$$\begin{aligned} 8(q-9) &\le 12q-4 \\ 8q-72 &\le 12q-4 \\ -68 &\le 4q \\ -17 &\le q \end{aligned}$$

68.
$$\begin{aligned} 4x+17-2x &\ge -15x \\ 2x+17 &\ge -15x \\ 17 &\ge -17x \\ -1 &\le x \end{aligned}$$

INVESTIGATION *page 210*

1. 1, 2, 3, 4, 5, 6 **2.** 6 **3.** 3, 6

4. $\frac{\text{number of outcomes divisible by 3}}{\text{total number of outcomes}} = \frac{2}{6} = \frac{1}{3}$ **5.** 36 **6a.** none **6b.** 0 **7a.** (1, 3), (2, 2), (3, 1) **7b.** $\frac{3}{36} = \frac{1}{12}$ **8a.** (5, 6), (6, 5) **8b.** $\frac{2}{36} = \frac{1}{18}$ **9.** (1, 2) and (2, 1), which have a sum of 3. **10.** No; probabilities of sums 2 and 12 are $\frac{1}{36}$; probability of sum 7 is $\frac{6}{36} = \frac{1}{6}$. **11.** even sum in 18 cases; odd sum in 18 cases; yes, equal probabilities

12.

(1, 1)	(2, 1)	(3, 1)	(4, 1)
(1, 2)	(2, 2)	(3, 2)	(4, 2)
(1, 3)	(2, 3)	(3, 3)	(4, 3)
(1, 4)	(2, 4)	(3, 4)	(4, 4)

13. 16 **14a.** (1, 3), (2, 2), (3, 1) **14b.** $\frac{3}{16}$ **15.** No; each has the same number of outcomes for a sum of 4, but two cubes have a greater number of total outcomes.

4-5 Applying Ratios to Probability *pages 211–218*

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

1. 32% **2.** 9% **3.** 22.5% **4.** 18%

Check Understanding **1.** $P(\text{Tues or Thurs}) = \frac{\text{number of T days in week}}{\text{total number of days in week}} = \frac{2}{7}$

2. Let N = total number of envelopes. $P(\text{not car}) = \frac{\text{number of envelopes with no car}}{\text{total number of envelopes}} = \frac{N-1}{N} = 1 - \frac{1}{N}$. As N increases, $P(\text{car}) = \frac{1}{N}$ goes down and $P(\text{not car})$ goes up.

3. $P(\text{no defects}) = \frac{2450}{2500} = 0.98 = 98\%$ **4.** $n(\text{work}) = P(\text{work}) \cdot N = 0.996(35{,}400)$, or about 35,260 light bulbs.

Exercises **1.** N = total number of spaces in spinner = 6; n = number of specified spaces. $P(\text{purple}) = \frac{n(\text{purple})}{N} = \frac{3}{6} = \frac{1}{2}$ **2.** $P(\text{green}) = \frac{n(\text{green})}{N} = \frac{2}{6} = \frac{1}{3}$ **3.** $P(5) = \frac{1}{6}$ **4.** $P(\text{even}) = \frac{3}{6} = \frac{1}{2}$ **5.** $P(\text{purple or white}) = \frac{4}{6} = \frac{2}{3}$ **6.** There is no 8, so $P(8) = 0$.

7. $P(>4) = \frac{n(5 \text{ or } 6)}{N} = \frac{2}{6} = \frac{1}{3}$ **8.** $P(\text{even, odd}) = \frac{6}{6} = 1$ **9.** $P(1 \text{ or } 6) = \frac{2}{6} = \frac{1}{3}$ **10.** $P(\text{not white}) = \frac{5}{6}$ **11.** $P(\text{not } 2) = \frac{5}{6}$ **12.** $P(\text{not purple}) = \frac{3}{6} = \frac{1}{2}$ **13.** $P(\text{not } 8) = \frac{6}{6} = 1$ **14.** $P(\text{not picked}) = 1 - P(\text{picked}) = 1 - 20\% = 1 - 0.2 = 0.8 = 80\%$

15. $P(\text{CC}) = \frac{24}{100} = 24\%$ **16.** $P(\text{4-yr}) = \frac{43}{100} = 43\%$ **17.** 15% **18.** $P(\text{not TS}) = \frac{85}{100} = 85\%$ **19.** $P(\text{TS or CC}) = \frac{15+24}{100} = 39\%$ **20.** $P(\text{CC or TS}) = \frac{24+43}{100} = 67\%$ **21a.** $P(\text{oak}) = \frac{27}{67} =$ about 40%. **21b.** $n(\text{oak}) = N \cdot P(\text{oak}) = 500 \cdot 40\% =$ about 200 oak trees. **22a.** $\frac{12}{30} = 0.4 = 40\%$ **22b.** $n(\text{cat or dog}) = N \cdot P(\text{cat or dog}) = 57 \cdot 40\% =$ about 23 families. **23.** $\frac{1}{6}$ **24.** 0 **25.** $\frac{2}{6} = \frac{1}{3}$ **26.** $\frac{5}{6}$

27. Oddness depends on the third digit. There are 5 odd digits and 5 even digits; $P(\text{odd}) = \frac{5}{10} = \frac{1}{2}$.

28. $n < 900$ depends on the first digit. There are no 0's, so there are 9 possibilities; $P(n < 900) = \frac{9}{9}$.

29. Three-digit numbers: The first digit is 1–9; the second and third digits are 0–9. The total number of possibilities $= 9 \times 10 \times 10 = 900$; $P(243 \text{ or } 244) = \frac{2}{900} = \frac{1}{450}$. **30.** $P(n < 100) = 0$ (There aren't any.)

31. Multiples of 30 = 120, 150, . . . , 990. In range 1–999 there are 33 of these, and in range 100–999 there are 30; $P = \frac{30}{900} = \frac{1}{30}$. **32.** Focus on first digit. 1, 2, 3, 4 give value < 500 and 5, 6, 7, 8, 9 give value > 500; $P(n < 500) = \frac{4}{9}$.

33. $\frac{10{,}700}{753{,}000} = 0.0142 \approx 1$ **34.** $\frac{57{,}918}{3{,}536{,}278} = 0.0164 \approx 1.6\%$

35. Answers may vary. Sample: 20 students, 12 girls and 8 boys **35a.** $\frac{1}{20} = 5\%$ **35b.** $P(\text{not boy}) = P(\text{girl}) = \frac{12}{20} = 60\%$ **35c.** $P(\text{not boy}) = 1 - P(\text{boy}) = 1 - \frac{8}{20} = 1 - 40\% = 60\%$ **36a.** $P(10-19) = \frac{39.9 \text{ million}}{275 \text{ million}} = 0.1451 \approx 15\%$ **36b.** $P(40-49) = \frac{41.7 \text{ million}}{275 \text{ million}} = 0.1516 \approx 15\%$

37a. Total $= N = 20$. $P(\text{not ballad}) = 1 - P(\text{ballad}) = 1 - \frac{5}{20} = \frac{3}{4}$ **37b.** $P(\text{rock}) = \frac{8}{20} = \frac{2}{5}$ **37c.** $\frac{3}{20}$

38. Answers may vary. Sample: For theoretical probability, all possible outcomes are equally likely to happen, but experimental probability is based on observed outcomes. **39.** Total area $= 4 \times 4 = 16$. Red area $= 2 \times 2 - 1 \times 1 = 4 - 1 = 3$. $P(\text{red}) = \frac{3}{16}$

40. $P(\text{purple}) = \frac{2 \times 3}{16} = \frac{6}{16} = \frac{3}{8}$

41. $P(\text{yellow or white}) = \frac{4}{16} + \frac{3}{16} = \frac{7}{16}$

42. $P(\text{not purple}) = 1 - P(\text{purple}) = 1 - \frac{3}{8} = \frac{5}{8}$

43. $\text{Odds(green)} = \frac{P(\text{green})}{P(\text{not green})} = \frac{2}{6} = \frac{1}{3}$

44. $\text{Odds(not white)} = \frac{P(\text{not white})}{P(\text{white})} = \frac{5}{3}$

45. Answers may vary. Sample: You can add the numerator and denominator and make the sum the denominator, keeping the numerator the same.

46. $\frac{5}{20} = \frac{1}{4}$ **47.** $\frac{6}{20} = \frac{3}{10}$ **48.** $\frac{6}{20} = \frac{3}{10}$ **49a.** Check students' work. Note "product" = Cube 1 × Cube 2.

49b.

1	2	3	4	5	6
2	4	6	8	10	12
3	6	9	12	15	18
4	8	12	16	20	24
5	10	15	20	25	30
6	12	18	24	30	36

49c. $P(5) = \frac{2}{36} = \frac{1}{18}$; $P(6) = \frac{4}{36} = \frac{1}{9}$; $P(12) = \frac{4}{36} = \frac{1}{9}$; $P(36) = \frac{1}{36}$ **49d.** No, this is unlikely with so few rolls.

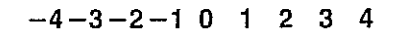
49e. Answers may vary. Sample: In 1000 rolls, expect $n(5) = 1000 \cdot P(5) = \frac{1000}{18} = 56$ times. Scatter $\approx \sqrt{56} \approx 7$. So, if you did the 1000 rolls over and over, you could get numbers for $n(5)$ like 54, 57, 51, 59, etc. There still will be some scatter, but the percent of scattered results goes down as the number of rolls goes up.

50. 2, 3, and 5 are prime. $P(1 \text{ or prime}) = \frac{4}{6} = \frac{2}{3}$; $P(\text{factor of } 6) = P(1 \text{ or } 2 \text{ or } 3 \text{ or } 6) = \frac{4}{6} = \frac{2}{3}$; the answer = A. **51.** $P(\text{fail}) = \frac{8}{150} \approx 5\%$; $n(\text{fail}) = (5\%) \cdot 2855 = 152 \approx 150$; the answer is G. **52.** D **53.** There are $55 + 53 + 64 + 47 + 61 = 280$ beads in a bag. **53a.** $P(\text{theor}) = \frac{1}{5} = 20\%$ **53b.** $P(\text{expt}) = \frac{55}{280} \approx 19.6\%$ **53c.** One would predict, on the average, $\frac{280}{5} = 56$ beads of each color. If the numbers are random, the scatter $\approx \sqrt{56} \approx 7.5$, and the typical range is about from $56 + 7 = 63$ to $56 - 7 = 49$. So, the scatter in the experimental numbers, from 47 to 64, is not unexpected statistically. But the experiment shows that the manufacturer's claim is deceptive. They could easily put in quality controls to provide exactly 56 beads of each color. **54.** $P = \frac{18}{350} \approx 0.051 \approx 5.1\%$. Acceptance limit = $n(\text{defective}) = (4\%)(350) = 14$ staplers. But the statistical fluctuation is $\approx \pm\sqrt{14} \approx \pm 4$, so the acceptable range in a batch of 350 would be from $14 + 4 = 18$ to $14 - 4 = 10$. This batch is just on the edge! Continue production but improve quality control.

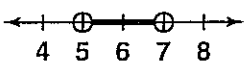
55. $\frac{10 - 8}{8} = \frac{2}{8} - \frac{1}{4} = 0.25 = 25\%$ (increase)

56. $\frac{6 - 4}{4} = \frac{2}{4} = 50\%$ (increase) **57.** $\frac{35 - 25}{25} = \frac{10}{25} = 40\%$ (increase) **58.** $\frac{22 - 11}{22} = \frac{11}{22} = 50\%$ (decrease) **59.** $\frac{16 - 12}{16} = \frac{4}{16} = 25\%$ (decrease) **60.** $\frac{80 - 70}{80} = \frac{10}{80} = 0.125 = 12.5\%$ (decrease)

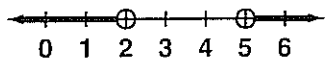
61.
$$-3 \le t \le 4$$
$$-3 \le t \quad \text{and} \quad t \le 4$$



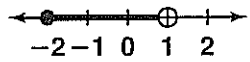
62.
$$8 < b + 3 < 10$$
$$8 < b + 3 \quad \text{and} \quad b + 3 < 10$$
$$8 - 3 < b \quad | \quad b < 10 - 3$$
$$5 < b \quad \text{and} \quad b < 7$$



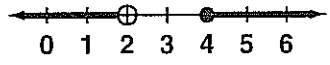
63.
$$7h < 14 \quad \text{or} \quad 4h > 20$$
$$h < 2 \quad \text{or} \quad h > 5$$



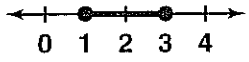
64.
$$5 < 7 - 2w \le 11$$
$$5 < 7 - 2w \quad \text{and} \quad 7 - 2w \le 11$$
$$-2 < -2w \quad | \quad -2w \le 4$$
$$1 > w \quad \text{and} \quad w \ge -2$$
$$-2 \le w < 1$$



65.
$$1 - 3x > -5 \quad \text{or} \quad -x \le -4$$
$$-3x > -6 \quad | \quad x \ge 4$$
$$x < 2 \quad \text{or} \quad x \ge 4$$



66.
$$-2 \le 4k - 6 \le 6$$
$$-2 \le 4k - 6 \quad \text{and} \quad 4k - 6 \le 6$$
$$4 \le 4k \quad | \quad 4k \le 12$$
$$1 \le k \quad \text{and} \quad k \le 3$$
$$1 \le k \le 3$$



67. mean $= \frac{3 + 4 + 5 + 5 + 8 + 12}{6} = \frac{37}{6} \approx 6.17$; median = 5; mode = 5 **68.** mean $= \frac{\text{sum}}{7} = \frac{121}{7} \approx 17.29$; median = 11; mode = 35

69.

3	4 7 9
4	1 9
6	5
7	1

70.

1	2 4 6
2	3 7
4	7
6	8
7	9

CHECKPOINT QUIZ 2 *page 217*

1. 60% of $200 = 0.60 \cdot 200 = 120$ **2.** $\frac{4}{5} = 0.8 = 80\%$

3.
$$18 = (75\%) \cdot x$$
$$x = \frac{18}{0.75} = 24$$

4. 175% of $40 = 1.75(40) = 70$ **5.** $\frac{25 - 20}{20} = \frac{5}{20} = +25\%$ **6.** $\frac{30 - 20}{20} = \frac{+10}{20} = +50\%$ **7.** minimum = 2.5 ft × 4.5 ft = 11.25 ft^2; maximum = 3.5 ft × 5.5 ft = 19.25 ft^2.

8. error $= \frac{0.5}{5} = 10\%$ **9.** $P(\text{Tues or Wed}) = \frac{2}{7}$

10. $\frac{98}{100}(2400) =$ about 2352 bicycles.

TECHNOLOGY *page 218*

1. Answers may vary. Sample: Yes, as long as they are 40% of the data, any 4 numbers will suffice. There's nothing sacred about 1, 2, 3, 4. **2.** probability $= \frac{10}{40} = 25\%$ **3a.** Check students' work. **3b.** no **3c.** The larger

the sample, the less the percent of scatter and the greater the reliability.

4-6 Probability of Compound Events page 219–224

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

1. $\frac{1}{3}$ **2.** $\frac{1}{3}$ **3.** $\frac{1}{6}$ **4.** 0 **5.** $\frac{1}{6}$ **6.** $\frac{1}{4}$ **7.** $1\frac{3}{5}$

Investigation 1. After replacing the first R card there are still 10 cards left. Probability that the second card is an R (given the 100% fact that the first card is an R) = $\frac{2}{10} = \frac{1}{5}$. **2.** Without replacement there are only 9 cards left, and only one R left; $P(\text{R}) = \frac{1}{9}$.

3.

Probability With Replacement

First card	Second Card Matches
$P(\text{R}) = \frac{1}{5}$	$P(\text{R}) = \frac{1}{5}$
$P(\text{A}) = \frac{1}{10}$	$P(\text{A}) = \frac{1}{10}$
$P(\text{N}) = \frac{3}{10}$	$P(\text{N}) = \frac{3}{10}$
$P(\text{D}) = \frac{1}{10}$	$P(\text{D}) = \frac{1}{10}$
$P(\text{O}) = \frac{1}{10}$	$P(\text{O}) = \frac{1}{10}$
$P(\text{M}) = \frac{1}{5}$	$P(\text{M}) = \frac{1}{5}$

Probability Without Replacement

First card	Second Card Matches
$P(\text{R}) = \frac{1}{5}$	$P(\text{R}) = \frac{1}{9}$
$P(\text{A}) = \frac{1}{10}$	$P(\text{A}) = 0$
$P(\text{N}) = \frac{3}{10}$	$P(\text{N}) = \frac{2}{9}$
$P(\text{D}) = \frac{1}{10}$	$P(\text{D}) = 0$
$P(\text{O}) = \frac{1}{10}$	$P(\text{O}) = 0$
$P(\text{M}) = \frac{1}{5}$	$P(\text{M}) = \frac{1}{9}$

Note: The probabilities in the first three columns add up to unity because they all refer to the same set of conditions. In the last column, the probabilities don't add up to 1; they refer to different decks to draw from.

4. Answers may vary. Sample: For the first card the drawings all refer to the same set of 10 cards. For the second card, without replacement the drawings refer to different sets of cards compared to with replacement.

Check Understanding 1. $P(\text{red 5 and blue 1 or 2}) = P(\text{red 5}) \cdot P(\text{blue 1 or 2}) = \frac{1}{6} \cdot \frac{2}{6} = \frac{1}{18}$ **2.** $P(U, I) = P(U) \cdot P(I) = \frac{2}{15} \cdot \frac{2}{15} = \frac{4}{225}$ **3.** $P(U \text{ then } O) = P(U) \cdot P(O \text{ after } U) = \frac{2}{15} \cdot \frac{4}{14} = \frac{4}{105}$

4a. $P(\text{soph then jun}) = P(\text{soph}) \cdot P(\text{jun after soph}) = \frac{4}{13} \cdot \frac{2}{12} = \frac{2}{39}$ **4b.** $P(\text{jun then soph}) = P(\text{jun}) \cdot P(\text{soph after jun}) = \frac{4}{13} \cdot \frac{2}{12} = \frac{2}{39}$ **4c.** Suppose we have N items, with n of type A and m of type B. Probability of selecting one type, then the other without replacement: $P(\text{A then B}) = P(\text{A}) \cdot P(\text{B after A}) = \frac{n}{N} \cdot \frac{m}{N-1}$; $P(\text{B then A}) = P(\text{B}) \cdot P(\text{A after B}) = \frac{m}{N} \cdot \frac{n}{N-1}$. These expressions are equal.

Exercises 1. Each cube has the numbers 1, 2, 3, 4, 5, and 6 on its sides. $P(\text{blue 1 and green 1}) = P(1) \cdot P(1) = \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$ **2.** $P[(\text{blue 1}) \text{ and } (\text{green 1 or 2})] = P(1) \cdot P(1 \text{ or } 2) = \frac{1}{6} \cdot \frac{2}{6} = \frac{1}{18}$

3. $P(\text{blue 1 or 2 and green 1}) = \frac{2}{6} \cdot \frac{1}{6} = \frac{1}{18}$

4. $P(\text{blue 1 or 2 and green 1 or 2}) = P(1 \text{ or } 2) \cdot P(1 \text{ or } 2) = \frac{2}{6} \cdot \frac{2}{6} = \frac{1}{9}$

5. $P(\text{blue even and green even}) = \frac{3}{6} \cdot \frac{3}{6} = \frac{1}{4}$

6. $P(\text{both less than 6}) = \frac{5}{6} \cdot \frac{5}{6} = \frac{25}{36}$

7. $P(\text{both less than 7}) = \frac{6}{6} \cdot \frac{6}{6} = 1$ **8.** 0 (green has no 7)

9. $P(\text{A and A}) = \left(\frac{2}{9}\right)\left(\frac{2}{9}\right) = \frac{4}{81}$ **10.** $P(\text{A and B}) = P(\text{A}) \cdot P(\text{B}) = \left(\frac{2}{9}\right)\left(\frac{3}{9}\right) = \frac{2}{27}$ **11.** $P(\text{B and B}) = \frac{3}{9} \cdot \frac{3}{9} = \frac{1}{9}$

12. $P(\text{C and C}) = \left(\frac{4}{9}\right)\left(\frac{4}{9}\right) = \frac{16}{81}$

13. $P(\text{B and C}) = \frac{3}{9} \cdot \frac{4}{9} = \frac{4}{27}$ **14.** $P(\text{C and B}) = \frac{4}{9} \cdot \frac{3}{9} = \frac{4}{27}$ **15.** $P(\text{vowel then vowel}) = P(\text{vowel}) \cdot P(\text{vowel after vowel}) = \frac{5}{11} \times \frac{4}{10} = \frac{2}{11}$

16. $P(\text{cons then cons}) = \frac{6}{11} \cdot \frac{5}{10} = \frac{3}{11}$ **17.** $P(I \text{ then } I) = \frac{2}{11} \cdot \frac{1}{10} = \frac{1}{55}$ **18.** $P(\text{cons then vowel}) = \frac{6}{11} \cdot \frac{5}{10} = \frac{3}{11}$

19. 0 **20.** 1 **21.** $\frac{4}{7} \cdot \frac{3}{6} = \frac{2}{7}$ **22.** $\frac{5}{11} \cdot \frac{3}{10} = \frac{3}{22}$

23–28. There are three red, two green, and five blue marbles in the bag. **23.** $P(\text{red then blue}) = P(\text{red}) \cdot P(\text{blue after red}) = \frac{3}{10} \cdot \frac{5}{9} = \frac{1}{6}$ **24.** $\frac{5}{10} \cdot \frac{4}{9} = \frac{2}{9}$

25. $\frac{5}{10} \cdot \frac{2}{9} = \frac{1}{9}$ **26.** $P(\text{red then red}) = P(\text{red}) \cdot P(\text{red after red}) = \frac{3}{10} \cdot \frac{2}{9} = \frac{1}{15}$ **27.** 0 (there are no yellow) **28.** $\frac{2}{10} \times \frac{1}{9} = \frac{1}{45}$ **29.** The two tosses don't influence each other and are thus independent. **30.** The first draw changes the conditions of the second (fewer names to pick from) so they are dependent. **31.** They are independent. The conditions of the second draw are the same as if the first draw had never taken place. **32.** With independent events, one event has no effect whatsoever on the conditions and likely outcomes of the others. Dependent: One event changes the conditions and the statistical expectations of the others. **33a.** 58% = 0.58 **33b.** (0.08)(0.07)(0.58) = 0.003248 **34.** Check students' work. **35.** $0.06 \cdot 0.06 = 0.0036$ **36.** $\left(\frac{2}{6}\right)\left(\frac{3}{6}\right) = \frac{1}{6}$

37. $\frac{3}{6} \cdot \frac{1}{5} = \frac{1}{10}$ **38.** $\frac{1}{6} \cdot \frac{3}{6} = \frac{1}{12}$ **39.** $\left(\frac{3}{6}\right)\left(\frac{2}{5}\right) = \frac{1}{5}$

40. $\frac{2}{6} \cdot \frac{1}{5} = \frac{1}{15}$ **41.** $\left(\frac{1}{6}\right)\left(\frac{2}{6}\right) = \frac{1}{18}$ **42a.** $\frac{12}{22} \cdot \frac{11}{21} = \frac{2}{7}$

42b. $\left(\frac{10}{22}\right)\left(\frac{9}{21}\right) = \frac{15}{77}$ **42c.** $\frac{10}{22} \cdot \frac{12}{21} = \frac{20}{77}$ **42d.** $\frac{12}{22} \cdot \frac{10}{21} = \frac{20}{77}$

42e. Sum $= \frac{2}{7} + \frac{15}{77} + \frac{20}{77} + \frac{20}{77} = \frac{22 + 15 + 20 + 20}{77} = \frac{77}{77} = 1$. This is to be expected, because the four cases include all possible combinations. **43a.** $\left(\frac{1}{5}\right)^5 = \frac{1}{3125}$

43b. $\left(\frac{1}{5}\right)^6 = \frac{1}{15{,}625}$ **43c.** $\frac{\left(\frac{1}{5}\right)^5}{\left(\frac{1}{5}\right)^6} = \left(\frac{1}{5}\right)^5 \cdot \left(\frac{5}{1}\right)^6 = 5$

44. The red and yellow cubes each have sides numbered

1, 2, 3, 4, 5, and 6. **44a.** $\left(\frac{1}{6}\right)\left(\frac{1}{6}\right) = \frac{1}{36}$ **44b.** $\frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$ **44c.** There are six pairs of matching numbers, out of a total of 36 equally possible throws; $P = \frac{6}{36} = \frac{1}{6}$. **45a.** The possible numbers are 12, 13, 15, 23, 25, 35, 21, 31, 51, 32, 52, and 53. There are 12 different numbers. **45b.** 10 of these contain a 2 or a 5. The probability of this $= \frac{10}{12} = \frac{5}{6}$. **45c.** The prime numbers are 13, 23, 31, and 53, for which the probability is $\frac{4}{12} = \frac{1}{3}$. **46.** $P = \frac{3}{6} \cdot \frac{3}{6} = \frac{1}{4}$; the answer is C. **47.** $P = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{8}$; the answer is F. **48.** Here there is no replacement. $P = \frac{7}{28} \cdot \frac{6}{27} = \frac{1}{18}$; the answer = B. **49.** $P(2 \text{ green}) = \frac{3}{9} \cdot \frac{2}{8} = \frac{1}{12}$; $P(2 \text{ red}) = \frac{4}{9} \cdot \frac{3}{8} = \frac{1}{6}$; $\frac{P(2 \text{ green})}{P(2 \text{ red})} = \frac{\frac{1}{12}}{\frac{1}{6}} = \frac{1}{2}$ **50.** There are 21 numbers. $P(\text{even}) = \frac{11}{21}$ **51.** Multiples of six are 12, 18, 24, and 30; $P(\text{mult. of } 6) = \frac{4}{21}$. **52.** Primes are 11, 13, 17, 19, 23, and 29; $P(\text{prime}) = \frac{6}{21} = \frac{2}{7}$. **54.** $P(<18) = \frac{8}{21}$

55.
$$|6g| + 7 = 31$$
$$|6g| = 24$$
$$6g = 24 \quad \text{or} \quad 6g = -24$$
$$g = 4 \quad \text{or} \quad g = -4$$

55.
$$|-p + 2| = 0$$
$$-p + 2 = +0 \quad \text{or} \quad -p + 2 = -0$$
$$-p = -2$$
$$p = 2$$

56.
$$|4a| > -3$$
$$4a > -3 \quad \text{or} \quad 4a < -3$$
$$a > -\frac{3}{4} \quad \text{or} \quad a < -\frac{3}{4}$$

All real numbers satisfy this condition.

57.
$$|5 - y| - 2 < -9$$
$$|5 - y| < -7$$

This condition cannot be satisfied for any y.

58.
$$|8w| + 9 < -7$$
$$|8w| < -16$$

No solution; an absolute value cannot be negative.

59.
$$16 < |26 - t| + 7$$
$$9 < |26 - t|$$
$$26 - t > 9 \quad \text{or} \quad 26 - t < -9$$
$$-t > -17 \quad \text{or} \quad -t < -35$$
$$t < 17 \quad \text{or} \quad t > 35$$

EXTENSION *page 225*

1. Poor sample; not all in sample are teenagers. Also, in sample you are more likely to encounter teenagers who get their hair cut frequently than those who get it cut infrequently. **2.** Good sample; it is from the target population. It would be poor only if those who go to the post office have different food preferences from those who don't. **3.** No; the sample is biased toward athletic activities such as biking. **4.** The questions are different in several respects. (1) The word "reckless" would inspire resentment against skateboarders. (2) "Restricted" is less severe than "banned." (3) Skateboarders would be more of a menace in playgrounds with many little children than in public "places" with a more adult presence.

TEST-TAKING STRATEGIES *page 226*

1. $\frac{100}{300} > \frac{99}{300}$ **2.** Results are the same in the range $0 < x < 1$. $\frac{x^4}{x^2} = x^2$, and in that range $x^2 < 1$. So, $x^4 < x^2$. The answer is A. **3.** With two real numbers, we can always evaluate that one is greater than, or equal to, or less than the other.

4.
$$x - 5 = 3x + 7$$
$$-5 = 2x + 7$$
$$-12 = 2x$$
$$x = -6$$

$$4n - 3 = 2(2n + 2) - 7$$
$$4n - 3 = 4n + 4 - 7$$
$$-3 = -3$$

This equation is valid for any value of n. Relationship cannot be determined. The answer is D.

CHAPTER REVIEW *pages 227–229*

1. rate (This is a ratio. A proportion is an equation equating two ratios.) **2.** cross products **3.** percent of change (This is not a probability.) **4.** greatest possible error **5.** an outcome **6.** Complement of an event **7.** independent (The conditions for drawing the second card are the same as those for the first card.) **8.** sample space **9.** unit rate **10.** percent of increase

11. $\left(\frac{2.5 \text{ mi}}{\text{min}}\right)\left(\frac{60 \text{ min}}{1 \text{ h}}\right) = 150 \text{ mi/h}$

12. $\left(\frac{300 \text{ ft}}{\text{min}}\right)\left(\frac{1 \text{ mi}}{5280 \text{ ft}}\right)\left(\frac{60 \text{ min}}{1 \text{ h}}\right) = 3.41 \text{ mi/h}$

13. $\left(\frac{4 \text{ in.}}{\text{sec}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in.}}\right)\left(\frac{1 \text{ mi}}{5280 \text{ ft}}\right)\left(\frac{60 \text{ sec}}{1 \text{ min}}\right)\left(\frac{60 \text{ min}}{1 \text{ h}}\right) = 0.23 \text{ mi/h}$

14.
$$\frac{14}{12} = \frac{c}{6}$$
$$6\left(\frac{4}{12}\right) = 6\left(\frac{c}{6}\right)$$
$$c = 2$$

15.
$$\frac{t}{5} = \frac{23}{50}$$
$$5\left(\frac{t}{5}\right) = 5\left(\frac{23}{50}\right)$$
$$t = 2.3$$

16.
$$\frac{-9}{m} = \frac{3}{2}$$
$$-18 = 3m$$
$$m = -6$$

17.
$$\frac{x}{8} = \frac{x - 5}{6}$$
$$6x = 8(x - 5)$$
$$6x = 8x - 40$$
$$0 = 2x - 40$$
$$40 = 2x$$
$$x = 20$$

18.
$$\frac{12}{r} = \frac{4}{0.5r - 1}$$
$$12(0.5r - 1) = 4r$$
$$6r - 12 = 4r$$
$$2r - 12 = 0$$
$$2r = 12$$
$$r = 6$$

19. $\frac{d-2}{d+9} = \frac{3}{14}$

$14(d-2) = 3(d+9)$

$14d - 28 = 3d + 27$

$11d - 28 = 27$

$11d = 55$

$d = 5$

20. Let $x = RS$. $\frac{x}{18} = \frac{5}{12}$

$18\left(\frac{x}{18}\right) = 18\left(\frac{5}{12}\right)$

$x = \frac{15}{2} = 7.5$; 7.5 m

21. Let $z = QR$. $\frac{z}{18} = \frac{13}{12}$

$18\left(\frac{z}{18}\right) = 18\left(\frac{13}{12}\right)$

$z = \frac{39}{2} = 19.5$; 19.5 m

22. $\frac{\frac{3}{4}}{\frac{1}{48}} = 48\frac{3}{4} = 36$; 36 ft

23. 15% of 86 $= (0.15) \cdot 86 = 12.9$

24. $1.8 = (72\%)x$

$1.8 = 0.72x$

$x = \frac{1.8}{0.72} = 2.5$

25. $\frac{40}{5} = 8 = 800\%$

26. $(0.04)x = 34$

$x = \frac{34}{0.04} = 850$

27. $\frac{30}{800} = 0.0375 = 3.75\%$ **28.** $I = prt = 2000(0.055)2 = 220$; \$220 **29.** $\frac{85{,}000 - 75{,}000}{75{,}000} = \frac{10{,}000}{75{,}000} = 0.133 \approx 13\%$ (increase) **30.** $\frac{20-15}{20} = \frac{5}{20} = 25\%$ (decrease) **31.** $\frac{60-40}{60} = \frac{20}{60} = 0.333 \approx -33\%$ (decrease) **32.** From 1790 to the present, the population of the United States has increased from 3,929,000 to about 275,000,000, an increase of about +6900%. **33.** measured vol. = 32 in. × 28 in. × 25 in. = 22,400 in.^{3}; max vol. = 32.5 in. × 28.5 in. × 25.5 in. = 23,619 in.^{3}; error = 1219 in.^{3}; percent error $= \frac{1219}{22{,}400} = 0.0544 \approx 5.4\%$ **34.** Maximum number on cube is 6, so $P(\geq 7) = 0$. **35.** $P(\text{not } 5) = P(1, 2, 3, 4, \text{or } 6) = \frac{5}{6}$ **36.** $P(2 \text{ or } 6) = \frac{2}{6} = \frac{1}{3}$ **37.** $P(3) = \frac{1}{6}$ **38a.** The combinations that lead to 3 heads are HHHT, HHTH, HTHH, and THHH. Altogether there are $2^4 = 16$ outcomes. $P(3 \text{ heads}) = \frac{4}{16} = \frac{1}{4}$ **38b.** $P(\text{not 3 heads})$ is the probability that in 4 tosses of the coin, the outcome 3 heads does not occur. Also, $P(\text{not 3 heads}) = P(0, 1, 2, \text{or 4 heads})$.

39. $P(\text{no shower}) = 1 - P(\text{shower}) = 1 - \frac{3}{14} = \frac{11}{14}$

40. The events are dependent because the probabilities of the outcome of the second event are modified by the outcome of the first, and are modified by the fact that the first draw occurred at all regardless of its outcome. $P(6 \text{ then even}) = \left(\frac{1}{10}\right)\left(\frac{4}{9}\right) = \frac{2}{45}$ **41.** The events are independent because the outcomes of the second are unaffected by the first; the conditions for the second draw are identical to those for the first. $P(1 \text{ then odd}) = \left(\frac{1}{10}\right)\left(\frac{5}{10}\right) = \frac{1}{20}$ **42.** Technically, the probabilities of an event are modified by the occurrence of other events on which the first is dependent. Casually, "dependent" means that what you do with your right hand has an influence on what you do with your left. In this context the word "dependence" means "influence," and does not necessarily indicate support or a beneficial relationship. **43.** Independent; one roll does not influence the other. (We presume that there are no little magnets imbedded in the cubes.) **44.** Dependent; the first draw has changed the conditions of the first; there are fewer green socks left and the total number is reduced.

CHAPTER TEST *pages 230–231*

1. $\frac{3}{4} = \frac{c}{20}$

$20\left(\frac{3}{4}\right) = 20\left(\frac{c}{20}\right)$

$c = 15$

2. $\frac{8}{15} = \frac{4}{w}$

$8w = 4 \cdot 15$

$w = \frac{60}{8} = 7.5$

3. $\frac{w}{6} = \frac{6}{15}$

$6\left(\frac{w}{6}\right) = 6\left(\frac{6}{15}\right)$

$w = \frac{12}{5} = 2.4$

4. $\frac{5}{t} = \frac{25}{100}$

$\frac{5}{t} = \frac{1}{4}$

$20 = t$

5. 16% of 250 $= (0.16) \times 250 = 40$

6. $\frac{8}{12.5} = 0.64 = 64\%$

7. 19 = (95%) of what?

$19 = (0.95) \cdot x$

$x = \frac{19}{0.95} = 20$

8. $\frac{3}{4} = \frac{9}{x}$

$3x = 4 \cdot 9$

$\frac{3x}{3} = \frac{36}{3} = 12$

The length is 12 cm.

9. $I = prt$

$r = \frac{I}{pt}$

$r = \frac{60}{500 \cdot 3}$

$r = 0.04 = 4\%$

10. salary = (20 h/wk)(\$6.50/h) = \$130/wk; 6% of salary $= 0.60 \cdot$ \$130/wk = \$7.80/wk

11. $\frac{5 - 4.50}{4.50} = \frac{.50}{4.50} = 0.111 \approx 11\%$ (increase)

12. $\frac{60-45}{60} = \frac{15}{60} = 0.25 = 25\%$ (decrease)

13. $\frac{150-135}{150} = \frac{15}{150} = 0.1 = 10\%$ (decrease)

14. $\frac{24-18}{18} = \frac{6}{18} = 0.333 \approx 33\%$ (increase) **15.** $\frac{36}{60} = \frac{3}{5}$

16. $\frac{34}{170} = \frac{1}{5} = 20\%$ **17.** $\left(\frac{\$0.14}{\text{oz}}\right)\left(\frac{16 \text{ oz}}{1 \text{ lb}}\right) = \$2.24/\text{lb}$

18. $\left(\frac{7 \text{ gal}}{\text{wk}}\right)\left(\frac{4 \text{ qt}}{1 \text{ gal}}\right)\left(\frac{1 \text{ wk}}{7 \text{ days}}\right)\left(\frac{1 \text{ day}}{24 \text{ h}}\right) = \frac{1}{6}$ qt/h

19. $\left(\frac{35 \text{ mi}}{\text{h}}\right)\left(\frac{5280 \text{ ft}}{1 \text{ mi}}\right)\left(\frac{1 \text{ h}}{60 \text{ min}}\right) = 3080$ ft/min

20. $\left(\frac{120 \text{ ft}}{\text{day}}\right)\left(\frac{12 \text{ in.}}{1 \text{ ft}}\right)\left(\frac{1 \text{ day}}{24 \text{ h}}\right)\left(\frac{1 \text{ h}}{60 \text{ min}}\right) = 1$ in./min

21. $(6.5 \text{ in.})\left(\frac{25 \text{ mi}}{1 \text{ in.}}\right) = 162.5$ mi

22. Let x = monument's height.

$$\frac{\text{monument height}}{\text{monument shadow}} = \frac{\text{boy height}}{\text{boy shadow}}$$
$$\frac{x}{20} = \frac{5}{8}$$
$$20\frac{x}{20} = 20\frac{5}{8}$$
$$x = 12.5; 12.5 \text{ ft}$$

23a. $P(\text{not white}) = \frac{9}{14}$ **23b.** $P(\text{red or blue}) = \frac{7}{14} = \frac{1}{2}$

23c. $P(\text{orange}) = 0$ **24.** $\left(\frac{\$4.99}{8}\right)\left(\frac{12}{\text{doz}}\right) = \$7.485/\text{doz.}$

12 carnations for \$6.99 is a better buy. **25.** Answers may vary. Sample: Four cards have one letter each: A, B, C, or D. What is the probability that the first card you select is A and the second is B, if you don't replace the first card before selecting the second card? $\frac{1}{12}$

26a. $\frac{18{,}646 - 1500}{1500} \approx 11.43 = 1143\%$

26b. Compare two numbers in any row, as shown above.

27a. $\left(\frac{8}{16}\right)\left(\frac{8}{16}\right) = \frac{1}{4}$ **27b.** $\left(\frac{8}{16}\right)\left(\frac{8}{15}\right) = \frac{4}{15}$ **27c.** $\left(\frac{8}{16}\right)\left(\frac{8}{16}\right) = \frac{1}{4}$

STANDARDIZED TEST PREP *page 231*

1. A. mean $= \frac{\text{sum}}{\text{number}} = \frac{444}{5} = 88.8$; median = 95; mode = 95 B. mean $= \frac{413}{5} = 82.6$; median = 80; mode = 80 C. mean $= \frac{363}{5} = 72.6$; median = 74; mode = 65 D. mean $= \frac{456}{5} = 91.2$; median = 94; mode = 94. Mean is highest in case B. **2.** $(1 + 10\%) \cdot 100 = 110$; $(1 - 10\%) \cdot 110 = 99$, or \$99; the answer is H.

3. $\left(\frac{10}{30}\right)\left(\frac{9}{29}\right) = \frac{3}{29}$; the answer is B. **4.** The answer is I. In that case one side was inverted but not the other.

5. relative change $= \frac{\text{new value} - \text{old value}}{\text{old value}} = \frac{190{,}000 - 210{,}000}{210{,}000} \approx -0.095 = -9.5\% \approx -10\%$; the answer is B.

6.
$$3n - 5 = 7$$
$$3n = 12$$
$$n = \frac{12}{3} = 4$$

The answer is H.

7. First integer = n. Others are $n + 1$, $n + 2$, and $n + 3$. Their sum is

$$4n + 6 = 190$$
$$4n = 184$$
$$n = 46$$
$$n + 2 = 48$$

The answer is D.

8. $\frac{4 \cdot 3^2}{2 \cdot 6 - 3} = 4$; the answer is G. **9.** B

10.
$$3(x - 4) \le 18 \quad \text{and} \quad 2(x - 1) \ge 6$$
$$3x - 12 \le 18 \quad | \quad 2x - 2 \ge 6$$
$$3x \le 30 \quad | \quad 2x \ge 8$$
$$x \le 10 \quad \text{and} \quad x \ge 4$$

Only 9 is in the range; the answer is F.

11. If (A) $-x - 1 > x + 1$
then $-2x > 2$
and $x < -2$
This might be true or it might be false; the answer is D.

12. $P(\ge 5) = P(5 \text{ or } 6) = \frac{2}{6} = \frac{1}{3}$; $P(\le 2) = P(1 \text{ or } 2) = \frac{2}{6} = \frac{1}{3}$; the answer is C (both equal). **13.** $-|x|$ is always negative; $|-x|$ is always positive; the answer is B.

14. change $= \frac{180 - 225}{225} = \frac{-45}{225} = -0.20 = -20\%$; discount = 20%

15.
$$\tfrac{3}{5}(2m - 3) = -6$$
$$\tfrac{5}{3}\left(\tfrac{3}{5}\right)(2m - 3) = \tfrac{5}{3}(-6)$$
$$2m - 3 = -10$$
$$2m = -7$$
$$m = -\tfrac{7}{2}$$

16.
$$\frac{\text{shown}}{\text{known}} = \frac{3}{5}$$
$$3(\text{shown}) = 5(\text{known})$$
$$\text{known} = \tfrac{5}{3}(\text{shown})$$
$$\text{known} = \tfrac{5}{3}(21) = 35$$

About 35 paintings are known to exist.

17. \$80 + \$20 = \$100; (1 + 20%)(\$80) = 1.2(\$80) = \$96; better to take the \$20 raise; the 20% raise is based on the original figure, not on the final figure.