### ARE YOU READY? PAGE 451

1. E
2. F
3. B
4. D
5. A
6. $\frac{16}{20} = \frac{4(4)}{4(5)} = \frac{4}{5}$
7. $\frac{14}{21} = \frac{7(2)}{7(3)} = \frac{2}{3}$
8. $\frac{33}{121} = \frac{11(3)}{11(11)} = \frac{3}{11}$
9. $\frac{56}{80} = \frac{8(7)}{8(10)} = \frac{7}{10}$
10. 18 to 24
    6(3) to 6(4)
    3 to 4
11. 34 to 18
    2(17) to 2(9)
    17 to 9
12. Total # of CDs is:
    36 + 18 + 34 + 24 = 112
    36 to 112
    4(9) to 4(28)
    9 to 28
13. 112 to 24
    8(14) to 8(3)
    14 to 3
14. yes; pentagon
15. yes; hexagon
16. no
17. yes; octagon
18. $P = 2\ell + 2w$
    $= 2(8.3) + 2(4.2)$
    $= 25$ ft
19. $P = 6s$
    $= 6(30) = 180$ cm
20. $P = 4s$
    $= 4(11.4) = 45.6$ m
21. $P = 5s$
    $= 5(3.9) = 19.5$ in.

### 7-1 RATIO AND PROPORTION, PAGES 454–459

#### CHECK IT OUT! PAGES 454–456

1. slope $= \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$
   $= \frac{5 - 3}{6 - (-2)}$
   $= \frac{2}{8} = \frac{1}{4}$
2. Let ∠ measures be $x$, $6x$, and $13x$. Then $x + 6x + 13x = 180$. After like terms are combined, $20x = 180$. So $x = 9$. The ∠ measures are $x = 9°$, $6x = 6(9) = 54°$, and $13x = 13(9) = 117°$.

3a. $\frac{3}{8} = \frac{x}{56}$
$3(56) = x(8)$
$168 = 8x$
$x = 21$

b. $\frac{2y}{9} = \frac{8}{4y}$
$2y(4y) = 9(8)$
$8y^2 = 72$
$y^2 = 9$
$y = \pm 3$

c. $\frac{d}{3} = \frac{6}{2}$
$d(2) = 3(6)$
$2d = 18$
$d = 9$

d. $\frac{x + 3}{4} = \frac{9}{x + 3}$
$(x + 3)(x + 3) = 4(9)$
$x^2 + 6x + 9 = 36$
$x^2 + 6x - 27 = 0$
$(x - 3)(x + 9) = 0$
$x = 3$ or $-9$

4. $16s = 20t$
   $\frac{t}{s} = \frac{16}{20}$
   $\frac{t}{s} = \frac{4}{5} = 4{:}5$
5. **1 Understand the Problem**
   Answer will be height of new tower.
   **2 Make a Plan**
   Let $y$ be height of new tower. Write a proportion that compares the ratios of model height to actual height.
   $\frac{\text{height of 1st tower}}{\text{height of 1st model}} = \frac{\text{height of new tower}}{\text{height of new model}}$
   $\frac{1328}{8} = \frac{y}{9.2}$
   **3 Solve**
   $\frac{1328}{8} = \frac{y}{9.2}$
   $1328(9.2) = 8(y)$
   $12{,}217.6 = 8y$
   $y = 1527.2$ m
   **4 Look Back**
   Check answer in original problem. Ratio of actual height to model height is 1328 : 8, or 166 : 1. Ratio of actual height to model height for new tower is 1527.2 : 9.2 In simplest form, this ratio is also 166 : 1. So ratios are equal, and answer is correct.

#### THINK AND DISCUSS, PAGE 457

1. No; ratio 6 : 7 is < 1, but ratio 7 : 6 is > 1.
2. She can see if cross products are =. Since 3(28) = 7(12), ratios do form a proportion. Therefore ratios are = and fractions are equivalent.
3.

| Definition: A proportion is an eqn. stating that 2 ratios are =. | Properties: If $\frac{a}{b} = \frac{c}{d}$, then $ad = bc$, $\frac{b}{a} = \frac{d}{c}$, and, $\frac{a}{c} = \frac{b}{d}$ |
|---|---|
| **Proportion** | |
| Example: Possible answer: $\frac{1}{3} = \frac{4}{12}$ is a proportion. | Nonexample: Possible answer: $\frac{1}{3} = \frac{4}{13}$ is not a proportion. |

#### EXERCISES, PAGES 457–459

***GUIDED PRACTICE, PAGE 457***

1. means: 3 and 2; extremes: 1 and 6
2. $sv$; $tu$
3. slope $= \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$
   $= \frac{4 - 3}{1 - (-1)} = \frac{1}{2}$
4. slope $= \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$
   $= \frac{2 - (-2)}{2 - (-2)}$
   $= \frac{4}{4} = \frac{1}{1}$

5. $\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{-1 - 1}{2 - (-1)}$
$= \frac{-2}{3} = -\frac{2}{3}$

6. Let side lengths be $2x$, $4x$, $5x$, and $7x$. Then $2x + 4x + 5x + 7x = 36$. After like terms are combined, $18x = 36$. So $x = 2$. The shortest side measures $2x = 2(2) = 4$ m.

7. Let ∠ measures be $5x$, $12x$, and $19x$. Then $5x + 12x + 19x = 180$. After like terms are combined, $36x = 180$. So $x = 5$. The largest ∠ measures $19x = 19(5) = 95°$.

8. $\frac{x}{2} = \frac{40}{16}$
$x(16) = 2(40)$
$16x = 80$
$x = 5$

9. $\frac{7}{y} = \frac{21}{27}$
$7(27) = y(21)$
$189 = 21y$
$y = 9$

10. $\frac{6}{58} = \frac{t}{29}$
$6(29) = 58(t)$
$174 = 58t$
$t = 3$

11. $\frac{y}{3} = \frac{27}{y}$
$y(y) = 3(27)$
$y^2 = 81$
$y = \pm 9$

12. $\frac{16}{x-1} = \frac{x-1}{4}$
$16(4) = (x-1)(x-1)$
$64 = x^2 - 2x + 1$
$0 = x^2 - 2x - 63$
$0 = (x-9)(x+7)$
$x = 9$ or $-7$

13. $\frac{x^2}{18} = \frac{x}{6}$
$x^2(6) = 18(x)$
$6x^2 - 18x = 0$
$6x(x-3) = 0$
$x = 0$ or $3$

14. $2a = 8b$
$\frac{a}{b} = \frac{8}{2}$
$\frac{a}{b} = \frac{4}{1} = 4{:}1$

15. $6x = 27y$
$\frac{6}{27} = \frac{y}{x}$
$\frac{y}{x} = \frac{2}{9} = 2{:}9$

16. **1 Understand the Problem**
Answer will be height of Arkansas State Capitol.
**2 Make a Plan**
Let $x$ be height of Arkansas State Capitol. Write a proportion that compares the ratios of height to width.
$$\frac{\text{height of U.S. Capitol}}{\text{width of U.S. Capitol}} = \frac{\text{height of Arkansas Capitol}}{\text{width of Arkansas Capitol}}$$
$$\frac{288}{752} = \frac{x}{564}$$
**3 Solve**
$\frac{288}{752} = \frac{x}{564}$
$288(564) = 752(x)$
$162{,}432 = 752x$
$x = 216$ ft
**4 Look Back**
Check answer in original problem. Ratio of height to width for U.S. Capitol is 288 : 752, or 18 : 47. Ratio of height to width for Arkansas State Capitol is 216 : 564 In simplest form, this ratio is also 18 : 47. So ratios are equal, and answer is correct.

***PRACTICE AND PROBLEM SOLVING, PAGES 458–459***

17. $\text{slope} = \frac{4-1}{1-0} = \frac{3}{1}$

18. $\text{slope} = \frac{-4+1}{3-0} = -\frac{1}{1}$

19. $\text{slope} = \frac{0+3}{3-1} = \frac{3}{2}$

20. Let side lengths be $4x$ and $4x$, and let base length be $7x$.
$4x + 4x + 7x = 52.5$
$15x = 52.5$
$x = 3.5$
length of base $= 7(3.5) = 24.5$ cm

21. Let ∠ measures be $2x$, $3x$, $2x$, and $3x$. By Quad. ∠ Sum Thm., sum of ∠ measures is 360°.
$2x + 3x + 2x + 3x = 360$
$10x = 360$
$x = 36$
∠ measures are $2(36) = 72°$, $3(36) = 108°$, 72°, and 108°.

22. $\frac{6}{8} = \frac{9}{y}$
$6y = 8(9) = 72$
$y = 12$

23. $\frac{x}{14} = \frac{50}{35}$
$35x = 14(50) = 700$
$x = 20$

24. $\frac{z}{12} = \frac{3}{8}$
$8z = 12(3) = 36$
$z = 4.5$

25. $\frac{2m+2}{3} = \frac{12}{2m+2}$
$(2m+2)^2 = 3(12)$
$4m^2 + 8m + 4 = 36$
$4m^2 + 8m - 32 = 0$
$m^2 + 2m - 8 = 0$
$(m-2)(m+4) = 0$
$m = 2$ or $-4$

26. $\frac{5y}{16} = \frac{125}{y}$
$5y^2 = 16(125)$
$5y^2 = 2000$
$y^2 = 400$
$y = \pm 20$

27. $\frac{x+2}{12} = \frac{5}{x-2}$
$(x+2)(x-2) = 12(5)$
$x^2 - 4 = 60$
$x^2 = 64$
$x = \pm 8$

28. $5y = 25x$
$\frac{5}{25} = \frac{x}{y}$
$\frac{x}{y} = \frac{1}{5}$

29. $35b = 21c$
$\frac{b}{c} = \frac{21}{35} = \frac{3}{5}$
Ratio is 3 : 5.

30. Let $x$ represent height of actual windmill.
$$\frac{\text{height of windmill}}{\text{width of windmill}} = \frac{\text{height of model}}{\text{width of model}}$$
$\frac{x}{20} = \frac{1.2}{0.8}$
$0.8x = 20(1.2) = 24$
$x = 30$ m

31. $\frac{a}{b} = \frac{5}{7}$
$7a = 5b$

32. $\frac{a}{b} = \frac{5}{7}$
$7a = 5b$
$7 = \frac{5b}{a}$
$\frac{7}{5} = \frac{b}{a}$

33. $\frac{a}{b} = \frac{5}{7}$
$7a = 5b$
$\frac{7a}{5} = b$
$\frac{a}{5} = \frac{b}{7}$

34. Cowboys lost
$16 - 10 = 6$ games.
wins : losses $= 10:6$
$= \frac{10}{2}:\frac{6}{2}$
$= 5:3$

35. slope $= \frac{5+4}{21+6}$
$= \frac{9}{27} = \frac{1}{3}$

36. slope $= \frac{1+5}{6-16}$
$= \frac{6}{-10} = -\frac{3}{5}$

37. slope $= \frac{5.5+2}{4-6.5}$
$= \frac{7.5}{-2.5} = -3$

38. slope $= \frac{0-1}{-2+6} = -\frac{1}{4}$

39a. $\frac{1.25 \text{ in.}}{15 \text{ in.}} = \frac{x \text{ in.}}{9600 \text{ in.}}$

b. $1.25(9600) = 15x$
$12{,}000 = 15x$
$x = 800$ in.
$= 66$ ft 8 in.

40. Quad. is a rect. because opp. sides are ≅ and diags. are ≅.

41. Areas are $6^2 = 36$ cm$^2$ and $9^2 = 81$ cm$^2$.
$\frac{36}{81} = \frac{4}{9}$

42. $\frac{5}{3.5} = \frac{20}{w}$
$5w = 3.5(20) = 70$
$w = 14$ in.

43. A ratio is a comparison of 2 numbers by div.
A proportion is an eqn. stating that 2 ratios are =.

***TEST PREP, PAGE 459***

44. B
$x + 4x + 5x = 18$
$10x = 18$
$x = 1.8$ in.
$4x = 4(1.8) = 7.2$ in.,
$5x = 5(1.8) = 9$ in.

45. H
$\frac{3}{5} = \frac{x}{y}$
$3y = 5x$
$y = \frac{5x}{3}$
$\frac{y}{5} = \frac{x}{3}$

46. A
$\frac{5}{2} = \frac{1.25}{v}$
$5v = 2(1.25) = 2.5$
$v = \frac{1}{2}$

47. First, cross multiply:
$36x = 15(72) = 1080$
Then divide both sides by 36:
$\frac{36x}{36} = \frac{1080}{36}$
Finally, simplify:
$x = 30$
You must assum that $x \neq 0$.

***CHALLENGE AND EXTEND, PAGE 459***

48. Perimeters are $2(3) + 2(5) = 16$ and $2x + 2(4) = 2x + 8$.
$\frac{4}{7} = \frac{16}{2x+8}$
$4(2x + 8) = 7(16)$
$8x + 32 = 112$
$8x = 80$
$x = 10$

49. Given $\frac{a}{b} = \frac{c}{d}$, add 1 to both sides of eqn:
$\frac{a}{b} + \frac{b}{b} = \frac{c}{d} + \frac{d}{d}$
Adding fractions on both sides of eqn. gives
$\frac{a+b}{b} = \frac{c+d}{d}$.

50. Possible proportions are $\frac{1}{2} = \frac{3}{6}, \frac{1}{3} = \frac{2}{6}, \frac{2}{1} = \frac{6}{3}, \frac{2}{6} = \frac{1}{3}, \frac{3}{1} = \frac{6}{2}, \frac{3}{6} = \frac{1}{2}, \frac{6}{2} = \frac{3}{1}$, and $\frac{6}{3} = \frac{2}{1}$.
There are 8 possible proportions. Total number of outcomes = 4! = 24.
Probability $= \frac{8}{24} = \frac{1}{3}$

51. $\frac{x^2 + 9x + 18}{x^2 - 36} = \frac{(x+6)(x+3)}{(x+6)(x-6)}$
$= \frac{x+3}{x-6}$, where $x \neq \pm 6$

***SPIRAL REVIEW, PAGE 459***

52. $y - 6(0) = -3$
$y = -3$

53. $(3) - 6x = -3$
$-6x = -6$
$x = 1$

54. $y - 6(-4) = -3$
$y + 24 = -3$
$y = -27$

55. Think: Use Same-Side Ext. ∠s Thm. to find $y$, then use Vert. ∠s Thm.
$3y + 2y + 20 = 180$
$5y = 160$
$y = 32$
$m\angle ABD = 3y$
$= 3(32) = 96°$

56. Think: Use Vert. ∠s Thm.
$m\angle CDB = 2y + 20$
$= 2(32) + 20$
$= 84°$

57. $9^2 \stackrel{?}{=} 5^2 + 8^2$
$81 \stackrel{?}{=} 25 + 64$
$81 < 89$
△ is acute.

58. $20^2 \stackrel{?}{=} 8^2 + 15^2$
$400 \stackrel{?}{=} 64 + 225$
$400 > 289$
△ is obtuse.

59. $25^2 \stackrel{?}{=} 7^2 + 24^2$
$625 \stackrel{?}{=} 49 + 576$
$625 = 625$
△ is a right triangle.

## TECHNOLOGY LAB: EXPLORE THE GOLDEN RATIO, PAGES 460–461

### ACTIVITY 1

1. Check students' work. The equal ratios have the approximate value of 1.62.
2. The ratios have the same value as the ratios in Step 1.

## TRY THIS, PAGE 461

1. If side length of square is 2 units, then $MB = 1$ unit and $BC = 2$ units. $\overline{MC}$ is hyp. of rt. $\triangle$ formed by $\overline{MB}$ and $\overline{BC}$. By Pyth. Thm.,
$$MC = \sqrt{5} \text{ units}$$
$$AE = \sqrt{5} + 1 \text{ units}$$
$$\frac{AE}{EF} = \frac{\sqrt{5}+1}{2} \approx 1.618$$

2. $$BE = \sqrt{5} - 1 \text{ units}$$
$$\frac{BE}{EF} = \frac{\sqrt{5}-1}{2} \approx 0.618$$
The sign of the numerator in this fraction is different from that of the fraction in **Try This** Problem 1.

3. Quotients have values that approach 1.618.

4. There are $1 + 1 = 2$ rabbits.

5. There are $8 + 13 = 21$ petals on the daisy.

6. No; $\frac{5.4}{4} \approx 1.4$

7. Yes; $\frac{4.5}{2.8} \approx 1.6$

## 7-2 RATIOS IN SIMILAR POLYGONS, PAGES 462–467

### CHECK IT OUT! PAGES 462–464

1. $\angle C \cong \angle H$. By Rt. $\angle \cong$ Thm., $\angle B \cong \angle G$. By 3rd $\angle$s Thm., $\angle A \cong \angle J$.
$$\frac{AB}{JG} = \frac{10}{5} = 2, \frac{BC}{GH} = \frac{6}{3} = 2, \frac{AC}{JH} = \frac{11.6}{5.8} = 2$$

2. **Step 1** Identify pairs of $\cong$ $\angle$s.
$\angle L \cong \angle P$ (Given)
$\angle M \cong \angle N$ (Rt. $\angle \cong$ Thm.)
$\angle J \cong \angle S$ (3rd $\angle$s Thm.)
**Step 2** Compare corr. sides.
$$\frac{JL}{SP} = \frac{75}{30} = \frac{5}{2}, \frac{LM}{PN} = \frac{60}{24} = \frac{5}{2}, \frac{JM}{SN} = \frac{45}{18} = \frac{5}{2}$$
yes; similarity ratio is $\frac{5}{2}$, and $\triangle LMJ \sim \triangle PNS$.

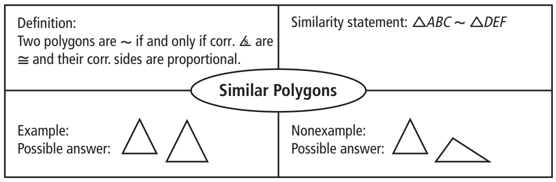
3. Let $x$ be length of the model boxcar in inches. Rect. model of boxcar is $\sim$ to rect. boxcar, so corr. lengths are proportional.
$$\frac{\text{length of boxcar}}{\text{length of model}} = \frac{\text{width of boxcar}}{\text{width of model}}$$
$$\frac{36.25}{x} = \frac{9}{1.25}$$
$$36.25(1.25) = 9x$$
$$45.3125 = 9x$$
$$x = \frac{45.3125}{9} \approx 5 \text{ in.}$$

### THINK AND DISCUSS, PAGE 464

1. $\cong$ symbol is formed.

2. Sides of rect. *EFGH* are 9 times as long as corr. sides of rect. *ABCD*.

3. Possible answers: reg. polygons of same type; Ⓢ

4. 


### EXERCISES, PAGES 465–467

***GUIDED PRACTICE, PAGE 465***

1. Possible answer: students' desks

2. $\angle M \cong \angle U$ and $\angle N \cong \angle V$. By 3rd $\angle$s Thm., $\angle P \cong \angle W$.
$$\frac{MN}{UV} = \frac{4}{8} = \frac{1}{2}, \frac{MP}{UW} = \frac{3}{6} = \frac{1}{2}, \frac{NP}{VW} = \frac{2}{4} = \frac{1}{2}$$

3. $\angle A \cong \angle H$ and $\angle C \cong \angle K$. By def. of $\cong$ $\angle$s, and taking vertices clockwise in both figures, $\angle B \cong \angle J$ and $\angle D \cong \angle L$.
$$\frac{AB}{HJ} = \frac{8}{12} = \frac{2}{3}, \frac{BC}{JK} = \frac{4}{6} = \frac{2}{3}, \frac{CD}{KL} = \frac{4}{6} = \frac{2}{3},$$
$$\frac{DA}{LH} = \frac{8}{12} = \frac{2}{3}$$

4. **Step 1** Identify pairs of $\cong$ $\angle$s. Think: All $\angle$s of a rect. are rt. $\angle$s and are $\cong$.
$\angle A \cong \angle E$, $\angle B \cong \angle F$, $\angle C \cong \angle G$, and $\angle D \cong \angle H$.
**Step 2** Compare corr. sides.
$$\frac{AB}{EF} = \frac{135}{90} = \frac{3}{2}, \frac{AD}{EH} = \frac{45}{30} = \frac{3}{2}$$
Yes; since opp. sides of a rect. are $\cong$, corr. sides are proportional. Similarity ratio is $\frac{3}{2}$, and $ABCD \sim EFGH$.

5. **Step 1** Identify pairs of $\cong$ $\angle$s.
$\angle M \cong \angle W$, $\angle P \cong \angle U$ (Given)
$\angle R \cong \angle X$ (3rd $\angle$s Thm.)
**Step 2** Compare corr. sides.
$$\frac{RM}{XW} = \frac{8}{12} = \frac{2}{3}, \frac{MP}{WU} = \frac{10}{15} = \frac{2}{3}, \frac{RP}{XU} = \frac{4}{6} = \frac{2}{3}$$
yes; similarity ratio is $\frac{2}{3}$, and $\triangle RMP \sim \triangle XWU$.

6. Let $x$ be height of reproduction in feet. Reproduction is $\sim$ to original, so corr. lengths are proportional.
$$\frac{\text{height of reproduction}}{\text{height of original}} = \frac{\text{width of reproduction}}{\text{width of original}}$$
$$\frac{x}{73} = \frac{24}{58}$$
$$58x = 73(24) = 1752$$
$$x = \frac{1752}{58} \approx 30 \text{ ft}$$

***PRACTICE AND PROBLEM SOLVING, PAGES 465–466***

7. $\angle K \cong \angle T$, $\angle L \cong \angle U$ (Given)
$\angle J \cong \angle S$, $\angle M \cong \angle V$ (Rt. $\angle \cong$ Thm.)
$$\frac{JK}{ST} = \frac{20}{24} = \frac{5}{6}, \frac{KL}{TU} = \frac{14}{16.8} = \frac{5}{6}, \frac{LM}{UV} = \frac{30}{36} = \frac{5}{6},$$
$$\frac{JM}{SV} = \frac{10}{12} = \frac{5}{6}$$

8. $\angle A \cong \angle X$, $\angle C \cong \angle Z$ (Given)
$\angle B \cong \angle Y$ (3rd $\angle$s Thm.)
$$\frac{AB}{XY} = \frac{8}{4} = 2, \frac{BC}{YZ} = \frac{6}{3} = 2, \frac{CA}{ZX} = \frac{12}{6} = 2$$

9. **Step 1** Identify pairs of ≅ ∡.
m∠R = 90 − 53 = 37°
∠R ≅ ∠U (Def. of ≅ ∡)
∠S ≅ ∠Z (Rt. ∠ ≅ Thm.)
∠Q ≅ ∠X (3rd ∡ Thm.)
**Step 2** Compare corr. sides.
$\frac{QR}{XU} = \frac{35}{40} = \frac{7}{8}, \frac{QS}{XZ} = \frac{21}{24} = \frac{7}{8}, \frac{RS}{UZ} = \frac{28}{32} = \frac{7}{8}$
yes; similarity ratio = $\frac{7}{8}$; $\triangle RSQ \sim \triangle UZX$

10. **Step 1** Identify pairs of ≅ ∡.
∠A ≅ ∠M, ∠B ≅ ∠J, ∠C ≅ ∠K, ∠D ≅ ∠L
(Rt. ∠ ≅ Thm.)
**Step 2** Compare corr. sides.
$\frac{AB}{MJ} = \frac{18}{24} = \frac{3}{4}, \frac{AD}{ML} = \frac{AD}{JK} = \frac{36}{54} = \frac{2}{3}$
no; the rectangles are not similar

11. $\frac{\text{model length}}{\text{car length}} = \frac{1}{56}$
$\frac{3}{\ell} = \frac{1}{56}$
$3(56) = \ell$
$\ell = 168$ in. = 14 ft

12. Let $x$, $y$ be side lengths of squares $ABCD$ and $PQRS$. Areas are $x^2$ and $y^2$, so
$\frac{x^2}{y^2} = \frac{4}{36} = \frac{1}{9}$
$\frac{x}{y} = \sqrt{\frac{1}{9}} = \frac{1}{3}$
~ ratio of $ABCD$ to $PQRS = \frac{x}{y} = \frac{1}{3}$
~ ratio of $PQRS$ to $ABCD = \frac{y}{x} = \frac{3}{1}$

13. sometimes (iff acute ∡ are ≅)

14. always (all (rt.) ∡ are ≅, all side-length ratios are =)

15. never (in trap., 1 pair sides are ∦, so opp. pairs of ∡ cannot be ≅; but in ▱, they are ≅)

16. always (by CPCTC, all corr. ∡ are ≅, and since corr. sides ≅, ~ ratio = 1)

17. sometimes (similar polygons are ≅ iff ~ ratio = 1)

18. By def. of reg. polygons, corr. int. ∡ are ≅, and side lengths are ≅ and thus proportional. So any 2 reg. polygons with same number of sides are ~.

19. $\frac{EF}{AB} = \frac{FG}{BC}$
$\frac{x+3}{4} = \frac{2x-4}{3}$
$3(x+3) = 4(2x-4)$
$3x + 9 = 8x - 16$
$25 = 5x$
$x = 5$

20. $\frac{MP}{XZ} = \frac{NP}{YZ}$
$\frac{x+5}{30} = \frac{4x-10}{75}$
$75(x+5) = 30(4x-10)$
$5(x+5) = 2(4x-10)$
$5x + 25 = 8x - 20$
$45 = 3x$
$x = 15$

21. Possible answer:
$\frac{\text{Statue of Liberty's nose}}{\text{Statue of Liberty's hand}} \approx \frac{\text{your nose}}{\text{your hand}}$
$\frac{x \text{ ft}}{16.4 \text{ ft}} \approx \frac{2 \text{ in.}}{7 \text{ in.}}$
$7x \approx 2(16.4) = 32.8$
$x \approx 4.7$
Estimated length of Statue of Liberty's nose is 4.7 ft (or between 4.5 ft and 5 ft).

22. If 2 polygons are ~, then their corr. ∡ are ≅ and their corr. sides are proportional. If corr. ∡ of 2 polygons are ≅ and their corr. sides are proportional, then polygons are ~.

23. ▱*JKLM* ~ ▱*NOPQ* → ∠O ≅ ∠K → m∠O = 75°
*NOPQ* a ▱ → ∠Q ≅ ∠O → m∠Q = 75°
∠O and ∠Q are 75° ∡.

24. $\frac{\text{width on blueprint}}{\text{actual width}} = \frac{\text{length on blueprint}}{\text{actual length}}$
$\frac{w}{14} = \frac{3.5}{18}$
$18w = 14(3.5) = 49$
$w = \frac{49}{18} \approx 2.7$ in.

25. Polygons must be ≅. Since polygons are ~, their corr. ∡ must be ≅. Since ~ ratio is 1, corr. sides must have same length.

26a. $\frac{\text{height of tree on backdrop}}{\text{height of tree on flat}} = \frac{1}{10}$
$\frac{0.9}{h} = \frac{1}{10}$
$0.9(10) = h$
$h = 9$ ft

b. $\frac{\text{height of tree on flat}}{\text{height of actual tree}} = \frac{1}{2}$
$\frac{9}{H} = \frac{1}{2}$
$9(2) = H$
$H = 18$ ft

c. ~ ratio = $\frac{\text{height of tree on backdrop}}{\text{height of actual tree}}$
$= \frac{0.9}{18} = \frac{1}{20}$

***TEST PREP, PAGE 467***

27. C
$\frac{y}{14.4} = \frac{8.4}{4.8}$
$4.8y = 14.4(8.4)$
$= 120.96$
$y = 25.2$

28. F
$\frac{5}{2} = \frac{GL}{PS}$
$\frac{5}{2} = \frac{20}{PS}$
$5PS = 20(2) = 40$
$PS = 8$

29. Ratios of sides are not the same: $\frac{12}{3.5} = \frac{24}{7}$, $\frac{10}{2.5} = 4$, $\frac{6}{1.5} = 4$

***CHALLENGE AND EXTEND, PAGE 467***

30. $\frac{\text{model length}}{\text{building length}} = \frac{1}{500}$
$\frac{\ell}{200} = \frac{1}{500}$
$500\ell = 200$
$\ell = 0.4$ ft = 4.8 in.
$\frac{\text{model width}}{\text{building width}} = \frac{1}{500}$
$\frac{w}{140} = \frac{1}{500}$
$500w = 140$
$w = 0.28$ ft = 3.36 in.

**31.** Since $\overline{QR} \parallel \overline{ST}$, $\angle PQR \cong \angle PST$ and $\angle PRQ \cong \angle PTS$ by Alt. Int. ∠s Thm. $\angle P \cong \angle P$ by Reflex. Prop. of ≅. Thus corr. ∠s of $\triangle PQR$ and $\triangle PST$ are ≅. Since $PS = 6$ and $PT = 8$, $\frac{PQ}{PS} = \frac{PR}{PT} = \frac{QR}{ST} = \frac{1}{2}$. Therefore $\triangle PQR \sim \triangle PST$ by def. of ∼ polygons.

**32a.** By HL, $\triangle ABD \cong \triangle CBD$, so $\angle A \cong \angle C$, and $m\angle A = m\angle C = 45°$. So $\triangle ABC$ is a 45°-45°-90° △.
$AC = AB\sqrt{2} = 1\sqrt{2} = \sqrt{2}$
$m\angle CBD = 90 - \angle C = 45°$, so $\triangle CDB$ is also *a* 45°-45°-90° △. So
$BC = 1 = DC\sqrt{2} = DB\sqrt{2}$
$\sqrt{2} = 2DC = 2DB$
$DC = DB = \frac{\sqrt{2}}{2}$

**b.** From part a., corr. ∠s *of* $\triangle ABC$ *and* $\triangle CDB$.
$\frac{AB}{BD} = \frac{BC}{DC} = \frac{AC}{BC} = \sqrt{2}$. By def. of ∼,
$\triangle ABC \sim \triangle CDB$.

**33a.** rect. *ABCD* ∼ rect. *BCFE*

**b.** $\frac{\ell}{1} = \frac{1}{\ell - 1}$

**c.** $\ell(\ell - 1) = 1$
$\ell^2 - \ell = 1$
$\ell^2 - \ell - 1 = 0$
$\ell = \frac{1 \pm \sqrt{1^2 - 4(1)(-1)}}{2}$
$= \frac{1 \pm \sqrt{5}}{2}$
Think: $\ell > 0$, so take positive sq. root.
$\ell = \frac{1 + \sqrt{5}}{2}$

**d.** $\ell \approx 1.6$

***SPIRAL REVIEW, PAGE 467***

**34.** # of orders = # of permutations of 4 things
= 4! = 24

**35.** Think: Kite → diags. are ⊥. So $\angle QTR$ is a rt. ∠.
$m\angle QTR = 90°$

**36.** Think: $\triangle PST \cong \triangle RST$. By CPCTC,
$\angle PST \cong \angle RST$
$m\angle PST = m\angle RST = 20°$

**37.** Think: $\triangle PST$ is a rt. △. So $\angle PST$ and $\angle TPS$ are comp.
$m\angle TPS = 90 - m\angle PST$
$= 90 - 20 = 70°$

**38.** $\frac{x}{4} = \frac{y}{10}$
$10x = 4y$

**39.** $\frac{x}{4} = \frac{y}{10}$
$10x = 4y$
$\frac{10x}{y} = 4$
$\frac{10}{y} = \frac{4}{x}$

**40.** $\frac{x}{4} = \frac{y}{10}$
$x = \frac{4y}{10}$
$\frac{x}{y} = \frac{4}{10}$ or $\frac{2}{5}$

## TECHNOLOGY LAB: PREDICT TRIANGLE SIMILARITY RELATIONSHIPS, PAGES 468–469

### ACTIVITY 1, PAGE 468

**3.** The ratios of cor. side lengths are =.

### TRY THIS, PAGE 468

**1.** △ Sum Thm.

**2.** Yes; in ∼ △s, corr. sides are proportional.

### ACTIVITY 2, PAGE 468

**3.** corr. ∠s are ≅.

### TRY THIS, PAGE 469

**3.** Yes; if 2 △s have their corr. sides in same ratio, then they are ∼.

**4.** They are similar in that both allow you to conclude that corr. ∠s are ≅. They are different in that the conjecture suggests that △s with corr. sides in same ratio have same shape, but SSS ≅ Thm. allows you to conclude that the △s have both same shape and same size.

### ACTIVITY 3, PAGE 469

**3.** The ratio of the corr. sides of $\triangle ABC$ and $\triangle DEF$ are proportional.

**4.** The corr. ∠s of the △s are ≅.

### TRY THIS, PAGE 469

**5.** Yes; corr. sides are proportional and corr. ∠s are ≅.

**6.** If △s have 2 pairs of corr. sides in same proportion and included ∠s are ≅, then △s are ∼. This is related to the SAS ≅ Thm.

## 7-3 TRIANGLE SIMILARITY: AA, SSS, AND SAS, PAGES 470–477

### CHECK IT OUT! PAGES 470–473

**1.** By △ Sum Thm., $m\angle C = 47°$, so $\angle C \cong \angle F$. $\angle B \cong \angle E$ by Rt. ∠ ≅ Thm. Therefore $\triangle ABC \sim \triangle DEF$ by AA ∼.

**2.** $\angle TXU \cong \angle VXW$ by Vert. ∠s Thm.
$\frac{TX}{VX} = \frac{12}{16} = \frac{3}{4}$, $\frac{XU}{XW} = \frac{15}{20} = \frac{3}{4}$
Therefore $\triangle TXU \sim \triangle VXW$ by SAS ∼.

**3.** **Step 1** Prove △s are ∼.
It is given that $\angle RSV \cong \angle T$. By the Reflex. Prop. of ≅, $\angle R \cong \angle R$. Therefore $\triangle RSV \sim \triangle RTU$ by AA ∼.
**Step 2** Find *RT*.
$\frac{RT}{RS} = \frac{TU}{SV}$
$\frac{RT}{10} = \frac{12}{8}$
$8RT = 10(12) = 120$
$RT = 15$

4.

| Statements | Reasons |
|---|---|
| 1. $M$ is mdpt. of $\overline{JK}$, $N$ is mdpt. of $\overline{KL}$, and $P$ is mdpt. of $\overline{JL}$. | 1. Given |
| 2. $MP = \frac{1}{2}KL$, $MN = \frac{1}{2}JL$, $NP = \frac{1}{2}KJ$ | 2. △ Midsegs. Thm. |
| 3. $\frac{MP}{KL} = \frac{MN}{JL} = \frac{NP}{KJ} = \frac{1}{2}$ | 3. Div. Prop. of = |
| 4. $\triangle JKL \sim \triangle NPM$ | 4. SSS ~ *Step 3* |

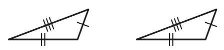
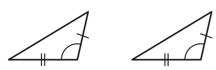
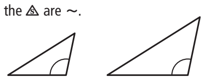
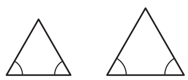
5. $\frac{FG}{AC} = \frac{BF}{AB}$
$\frac{FG}{5x} = \frac{4}{4x}$
$FG(4x) = 4(5x)$
$4FG = 20$
$FG = 5$

## THINK AND DISCUSS, PAGE 473

1. $\angle A \cong \angle D$ or $\angle C \cong \angle F$ 2. $\frac{BA}{ED} = \frac{3}{5}$

3. No; corr. sides need to be proportional but not necessarily ≅ for ⊿ to be ~.

4.

| | Congruence | Similarity |
|---|---|---|
| SSS | If 3 sides of 1 △ are respectively ≅ to 3 sides of another △, then the ⊿ are ≅.  | If 3 sides of 1△ are proportional to the 3 corr. sides of another △, then the ⊿ are ~.  |
| SAS | If 2 sides and the included ∠ of 1 △ are ≅ to 2 sides and the included ∠ of another △, then the ⊿ are ≅.  | If 2 sides of 1△ are proportional to 2 sides of another △ and their included ∠s are ≅, then the ⊿ are ~.  |
| AA | | If 2 ∠s of 1△ are ≅ to 2 ∠s of another △, then the ⊿ are ~.  |

## EXERCISES, PAGES 474–477

### *GUIDED PRACTICE, PAGE 474*

1. By def. of ∠ ≅, $\angle C \cong \angle H$. By △ Sum Thm., $m\angle A = 47°$, so $\angle A \cong \angle F$. Therefore $\triangle ABC \sim \triangle FGH$ by AA ~.

2. $\angle P \cong \angle T$ (given). $\angle QST$ is a rt. ∠ by the Lin. Pair Thm., so $\angle QST \cong \angle RSP$. Therefore $\triangle QST \sim \triangle RSP$ by AA ~.

3. $\frac{DE}{JK} = \frac{8}{16} = \frac{1}{2}, \frac{DF}{JL} = \frac{6}{12} = \frac{1}{2}, \frac{EF}{KL} = \frac{10}{20} = \frac{1}{2}$
Therefore $\triangle DEF \sim \triangle JKL$ by SSS ~.

4. $\angle NMP \cong \angle RMQ$ (given)
$\frac{MN}{MR} = \frac{4}{6} = \frac{2}{3}, \frac{MP}{MQ} = \frac{8}{4+8} = \frac{8}{12} = \frac{2}{3}$
Therefore $\triangle MNP \sim \triangle MRQ$ by SAS ~.

5. **Step 1** Prove ⊿ are ~.
It is given that $\angle C \cong \angle E$. $\angle A \cong \angle A$ by Reflex. Prop. of ≅. Therefore $\triangle AED \cong \triangle ACB$ by AA ~.
**Step 2** Find $AB$.
$\frac{AB}{AD} = \frac{BC}{DE}$
$\frac{AB}{6} = \frac{15}{9}$
$9AB = 15(6) = 90$
$AB = 10$

6. **Step 1** Prove ⊿ are ~.
Since $\overline{UV} \parallel \overline{XY}$, by Alt. Int. ∠s Thm., $\angle U \cong \angle Y$ and $\angle V \cong \angle X$. Therefore $\triangle UVW \sim \triangle YXW$ by AA ~.
**Step 2** Find $WY$.
$\frac{WY}{WU} = \frac{WX}{WV}$
$\frac{WY}{9} = \frac{8.75}{7}$
$7WY = 9(8.75) = 78.75$
$WY = 11.25$

7.

| Statements | Reasons |
|---|---|
| 1. $\overline{MN} \parallel \overline{KL}$ | 1. Given |
| 2. $\angle JMN \cong \angle JKL$, $\angle JNM \cong \angle JLK$ | 2. Corr. ∠s Post. |
| 3. $\triangle JMN \sim \triangle JKL$ | 3. AA ~ *Step 2* |

8.

| Statements | Reasons |
|---|---|
| 1. $SQ = 2QP$, $TR = 2RP$ | 1. Given |
| 2. $SP = SQ + QP$, $TP = TR + RP$ | 2. Seg. Add. Post. |
| 3. $SP = 2QP + QP$, $TP = 2RP + RP$ | 3. Subst. |
| 4. $SP = 3QP$, $TP = 3RP$ | 4. Seg. Add. Post. |
| 5. $\frac{SP}{QP} = 3, \frac{TP}{RP} = 3$ | 5. Div. Prop. of = |
| 6. $\angle P \cong \angle P$ | 6. Reflex. Prop. of ≅ |
| 7. $\triangle PQR \sim \triangle PST$ | 7. SAS ~ *Steps 5, 6* |

9. SAS or SSS ~ Thm.

10. **Step 1** Prove ⊿ are ~.
$\angle S \cong \angle S$ by Reflex. Prop. of ≅
$\frac{SA}{SC} = \frac{733 + 586}{586} \approx 2.25, \frac{SB}{SD} = \frac{800 + 644}{644} \approx 2.24$
Therefore $\triangle SAB \sim \triangle SCD$ by SAS ~.
**Step 2** Find $AB$.
$\frac{AB}{CD} = \frac{SA}{SC}$
$\frac{AB}{533} \approx 2.25$
$AB \approx 2.25(533)$
$\approx 1200$ m or 1.2 km

### *PRACTICE AND PROBLEM SOLVING, PAGES 475–476*

11. $\angle G \cong \angle G$ by Reflex. Prop. of ≅. $\angle GLH \cong \angle K$ by Rt. ∠ ≅ Thm. Therefore $\triangle HLG \sim \triangle JKG$ by AA ~.

12. By Isosc. △ Thm., $\angle B \cong \angle C$ and $\angle E \cong \angle F$. By △ Sum Thm.,
$32 + 2m\angle B = 180$
$2m\angle B = 148°$
$m\angle B = 74°$
By def. of ≅ ∠s, $\angle B \cong \angle E$ and $\angle C \cong \angle F$.
Therefore $\triangle ABC \sim \triangle DEF$ by AA ~.

**13.** $\angle K \cong \angle K$ by Reflex. Prop. of $\cong$
$\frac{KL}{KN} = \frac{6}{4} = \frac{3}{2}, \frac{KM}{KL} = \frac{5+4}{6} = \frac{3}{2}$
Therefore $\triangle KLM \sim \triangle KNL$ by SAS $\sim$.

**14.** $\frac{UV}{XY} = \frac{VW}{YZ} = \frac{WU}{ZX} = \frac{4}{5.5} = \frac{8}{11}$
Therefore $\triangle UVW \sim \triangle XYZ$ by SSS $\sim$.

**15. Step 1** Prove $\triangle$s are $\sim$.
It is given that $\angle ABD \cong \angle C$. $\angle A \cong \angle A$ by Reflex. Prop. of $\cong$. Therefore $\triangle ABD \cong \triangle ACB$ by AA $\sim$.
**Step 2** Find $AB$.
$\frac{AB}{AD} = \frac{AC}{AB}$
$\frac{AB}{4} = \frac{4+12}{AB}$
$AB^2 = 4(16) = 64$
$AB = +\sqrt{64} = 8$

**16. Step 1** Prove $\triangle$s are $\sim$.
Since $\overline{ST} \parallel \overline{VW}$, $\angle PST \cong \angle V$ by Corr. $\angle$s Post. $\angle P \cong \angle P$ by Reflex. Prop. of $\cong$. Therefore $\triangle PST \sim \triangle PVW$ by AA $\sim$.
**Step 2** Find $PS$.
$\frac{PS}{PV} = \frac{ST}{VW}$
$\frac{PS}{PS+6} = \frac{10}{17.5} = \frac{4}{7}$
$7PS = 4(PS + 6)$
$7PS = 4PS + 24$
$3PS = 24$
$PS = 8$

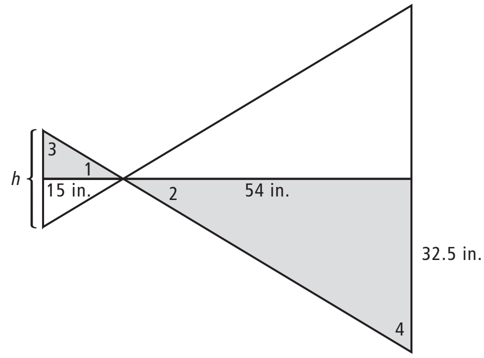
**17.**

| Statements | Reasons |
|---|---|
| 1. $CD = 3AC$, $CE = 3BC$ | 1. Given |
| 2. $\frac{CD}{AC} = 3, \frac{CE}{BC} = 3$ | 2. Div. Prop. of $\cong$ |
| 3. $\angle ACB \cong \angle DCE$ | 3. Vert. $\angle$s Thm. |
| 4. $\triangle ABC \sim \triangle DEC$ | 4. SAS $\sim$ *Steps 2, 3* |

**18.**

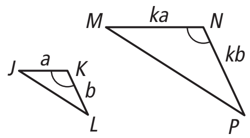
| Statements | Reasons |
|---|---|
| 1. $\frac{PR}{MR} = \frac{QR}{NR}$ | 1. Given |
| 2. $\angle R \cong \angle R$ | 2. Reflex. Prop. of $\cong$ |
| 3. $\triangle PQR \sim \triangle MNR$ | 3. SAS $\sim$ *Steps 1, 2* |
| 4. $\angle 1 \cong \angle 2$ | 4. Def. of $\sim$ $\triangle$s |

**19.**



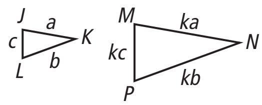

By Vert. $\angle$s Thm., $\angle 1 \cong \angle 2$. Since vert. sides are $\parallel$, $\angle 3 \cong \angle 4$ by Corr. $\angle$s Post., so marked $\triangle$s are $\sim$.
Therefore,
$\frac{h \div 2}{1.25} = \frac{32.5}{54}$
$54\left(\frac{h}{2}\right) = 1.25(32.5)$
$27h = 40.625$
$h \approx 1.5$ in.

**20.**



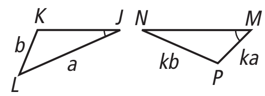

yes; SAS $\sim$

**21.**




yes; SSS $\sim$

**22.**




no

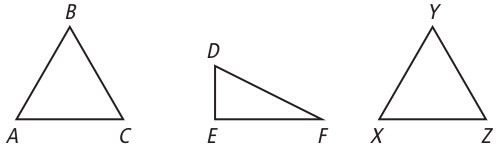
**23.** Think: $\triangle PQR \cong \triangle PST$ by AA $\sim$.
$\frac{PS}{PQ} = \frac{ST}{QR}$
$\frac{x+3}{3} = \frac{x+5}{4}$
$4(x + 3) = 3(x + 5)$
$4x + 12 = 3x + 15$
$x = 3$

**24.** Think: $\triangle EFG \cong \triangle HJG$ by AA $\sim$.
$\frac{EG}{GH} = \frac{FG}{GJ}$
$\frac{2x-2}{15} = \frac{x+9}{20}$
$20(2x - 2) = 15(x + 9)$
$40x - 40 = 15x + 135$
$25x = 175$
$x = 7$

**25a.** Think: Calculate $\frac{\text{slant edge lengths}}{\text{base edge length}}$ for each pyramid.
Pyramid A: $\frac{12}{10} = \frac{6}{5}$; Pyramid B: $\frac{9}{7.2} = \frac{5}{4}$;
Pyramid C: $\frac{9.6}{8} = \frac{6}{5}$
Since slant edges of each pyramid are $\cong$, Pyramids A and C are $\sim$ by SSS $\sim$.
Lengths are =.

**b.** $\frac{\text{base of A}}{\text{base of C}} = \frac{10}{8} = \frac{5}{4}$

**26.** Possible answer: Yes; If corr. $\angle$s are $\cong$ and corr. sides are prop., $\triangle ABC \sim \triangle XYZ$.




**27.** Think: Since all horiz. lines are $\parallel$, 3 $\triangle$s with horiz. bases are $\sim$ by AA $\sim$.

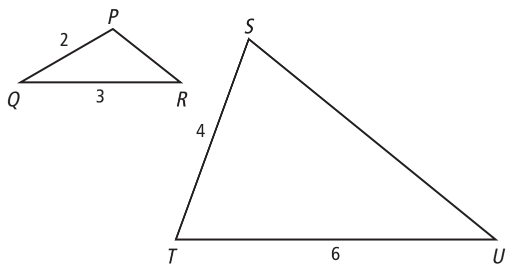
$\frac{JK}{6} = \frac{3}{9}$   $\frac{MN}{6} = \frac{6}{9}$

$9JK = 6(3) = 18$   $9MN = 6(6) = 36$

$JK = 2$ ft   $MN = 4$ ft

**28.** Since $\triangle ABC \sim \triangle DEF$, by def. of $\sim \triangle$s, $\angle A \cong \angle D$ and $\angle B \cong \angle E$. Similarly, since $\triangle DEF \sim \triangle XYZ$, $\angle D \cong \angle X$ and $\angle E \cong \angle Y$. Thus by Trans. Prop. of $\cong$, $\angle A \cong \angle X$ and $\angle B \cong \angle Y$. So $\triangle ABC \sim \triangle XYZ$ by AA $\sim$.

**29.** Possible answer:




**30.** Since $\triangle KNJ$ is isosc. with vertex $\angle N$, $\overline{KN} \cong \overline{JN}$ by def. of an isosc. $\triangle$. $\angle NKJ \cong \angle NJK$ by Isosc. $\triangle$ Thm. It is given that $\angle H \cong \angle L$, so $\triangle GHJ \cong \triangle MLK$ by AA $\sim$.

**31a.** The $\triangle$s are $\sim$ by AA $\sim$ if you assume that camera is $\parallel$ to hurricane $\left(\text{that is, } \overline{YX} \parallel \overline{AB}\right)$.

**b.** $\triangle YWZ \sim \triangle BCZ$ and $\triangle XWZ \sim \triangle ACZ$, also by AA $\sim$.

**c.**

$$\frac{XW}{AC} = \frac{WZ}{ZC} = \frac{50}{150}$$
$$150XW = 50AC$$
$$\frac{YW}{BC} = \frac{WZ}{ZC} = \frac{50}{150}$$
$$150YW = 50BC$$
$$150XW + 150YW = 50AC + 50BC$$
$$150XY = 50AB$$
$$50AB = 150(35) = 5250$$
$$AB = 105 \text{ mi}$$

**32.** Solution B is incorrect. The proportion should be $\frac{8}{10} = \frac{8 + y}{14}$.

**33.** Let measure of vertex $\angle$s be $x°$. Then by Isosc. $\triangle$ Thm., base $\angle$s in each $\triangle$ must measure $\left(\frac{180 - x}{2}\right)^{\circ}$. So $\triangle$s are $\sim$ by AA $\sim$.

***TEST PREP, PAGE 477***

**34.** C

$$\frac{TU}{PQ} = \frac{UV}{QR}$$
$$\frac{TU}{60} = \frac{60 + 20}{40 + 60} = \frac{4}{5}$$
$$5TU = 60(4) = 240$$
$$TU = 48$$

**35.** J

$$\frac{FG}{BC} = \frac{10.5}{42} = \frac{1}{4}$$
$$\frac{GH}{CD} = \frac{14.5}{58} = \frac{1}{4}$$

**36.** C

Rects. $\sim \rightarrow \overline{BC} \sim \overline{FG}$, $\angle C \sim \angle G$, and $\overline{CD} \sim \overline{GH}$, which are conditions for SAS $\sim$.

**37.** 30

$$\frac{x}{12} = \frac{20}{8}$$
$$8x = 12(20) = 240$$
$$x = 30$$

***CHALLENGE AND EXTEND, PAGE 477***

**38.** Assume that $AB < DE$ and choose $X$ on $\overline{DE}$ so that $\overline{AB} \cong \overline{DX}$. Then choose $Y$ on $\overline{DF}$ so that $\overleftrightarrow{XY} \parallel \overline{EF}$. By Corr. $\angle$s Post., $\angle DXY \cong \angle DEF$ and $\angle DYX \cong \angle DFE$. Therefore $\triangle DXY \sim \triangle DEF$ by AA $\sim$. By def. of $\sim \triangle$s, $\frac{DX}{DE} = \frac{XY}{EF} = \frac{DY}{DF}$. By def. of $\cong$, $AB = DX$. So $\frac{AB}{DE} = \frac{XY}{EF}$. It is given that $\frac{AB}{DE} = \frac{BC}{EF}$, so $XY = BC$. $\overline{XY} \cong \overline{BC}$ by def. of $\cong$. Similarly, $\overline{DY} \cong \overline{AC}$, so $\triangle ABC \cong \triangle DXY$ by SSS $\cong$ Thm. It follows that $\triangle ABC \sim \triangle DXY$. Then by Trans. Prop. of $\sim$, $\triangle ABC \sim \triangle DEF$.

**39.** Assume that $AB < DE$ and choose $X$ on $\overline{DE}$ so that $\overline{XE} \cong \overline{AB}$. Then choose $Y$ on $\overline{EF}$ so that $\overleftrightarrow{XY} \parallel \overline{DF}$. $\angle EXY \cong \angle EDF$ by Corr. $\angle$s Post., $\angle E \cong \angle E$ by Reflex. Prop. of $\cong$. Therefore $\triangle XEY \sim \triangle DEF$ by AA $\sim$. By def. of $\sim \triangle$s, $\frac{XE}{DE} = \frac{EY}{EF}$. It is given that $\frac{AB}{DE} = \frac{BC}{EF}$. By def. of $\cong$, $XE = AB$, so $\frac{XE}{DF} = \frac{BC}{EF}$. Thus by def. of $\cong$, $BC = EY$ and so $\overline{BC} \cong \overline{EY}$. It is also given that $\angle B \cong \angle E$, so $\triangle ABC \cong \triangle XEY$ by SAS $\cong$ Thm. It follows that $\triangle ABC \sim \triangle XEY$. Then by Trans. Prop. of $\sim$, $\triangle ABC \sim \triangle DEF$.

**40.** Think: Use $\triangle$ Sum Thm. and def. of $\sim$.

$$m\angle X + m\angle Y + m\angle Z = 180$$
$$2x + 5y + 102 - x + 5x + y = 180$$
$$6x + 6y = 78$$
$$x + y = 13$$
$$y = 13 - x$$

Think: Use def. of $\sim$.

$$\angle A \cong \angle X$$
$$m\angle A = m\angle X$$
$$50 = 2x + 5y$$
$$50 = 2x + 5(13 - x)$$
$$50 = 65 - 3x$$
$$3x = 15$$
$$x = 5$$
$$y = 13 - 5 = 8$$
$$m\angle Z = 5(5) + 8 = 33°$$

***SPIRAL REVIEW, PAGE 477***

**41.** $100 = \frac{96 + 99 + 105 + 105 + 94 + 107 + x}{7}$

$$700 = 606 + x$$
$$x = 94$$

**42.** Possible answer: (0, 4), (0, 0), (2, 0)

**43.** Possible answer: (0, $k$), (2$k$, $k$), (2$k$, 0), (0, 0)

**44.** $\frac{2x}{10} = \frac{35}{25}$
$25(2x) = 10(35)$
$50x = 350$
$x = 7$

**45.** $\frac{5y}{450} = \frac{25}{10y}$
$5y(10y) = 450(25)$
$50y^2 = 11{,}250$
$y^2 = 225$
$y = \pm 15$

**46.** $\frac{b-5}{28} = \frac{7}{b-5}$
$(b-5)^2 = 28(7) = 196$
$b - 5 = \pm 14$
$b = 5 \pm 14 = 19$ or $-9$

## 7A MULTI-STEP TEST PREP, PAGE 478

**1.** $\frac{\text{height of model}}{\text{height of real engine}} = \frac{1}{87}$
$\frac{2.5}{x} = \frac{1}{87}$
$2.5(87) = x$
$x = 217.5$ in. $\approx 18$ ft

**2.** $\frac{\text{height of model}}{\text{height of real station}} = \frac{1}{87}$
$\frac{y}{20} = \frac{1}{87}$
$87y = 20$
$y \approx 0.23$ ft $\approx 2\frac{3}{4}$ in.

**3.** $\frac{\text{height of model}}{\text{height of actual restaurant}} = \frac{1}{87}$
$\frac{z}{24} = \frac{1}{87}$
$87z = 24$
$z \approx 0.28$ ft $\approx 3$ in.

**4.** $\frac{\text{base of B}}{\text{base of G}} = \frac{8}{14} = \frac{5}{7}$; $\frac{\text{slant of B}}{\text{slant of G}} = \frac{6}{10} = \frac{3}{5}$; not ~
$\frac{\text{base of G}}{\text{base of H}} = \frac{14}{6} = \frac{7}{3}$; $\frac{\text{slant of G}}{\text{slant of H}} = \frac{10}{4.5} = \frac{20}{9}$; not ~
$\frac{\text{base of B}}{\text{base of H}} = \frac{8}{6} = \frac{4}{3}$; $\frac{\text{slant of B}}{\text{slant of H}} = \frac{6}{4.5} = \frac{4}{3}$; ~
Bank's and hotel's roofs are ~, by SSS ~.

## READY TO GO ON? PAGE 479

**1.** slope $= \frac{-1+2}{4+1} = \frac{1}{5}$

**2.** slope $= \frac{-3-3}{2+1}$
$= \frac{-6}{3} = \frac{-2}{1}$

**3.** slope $= \frac{1-3}{4+4} = \frac{-2}{8}$
$= \frac{-1}{4}$

**4.** slope $= 0$

**5.** $\frac{y}{6} = \frac{12}{9}$
$9y = 6(12) = 72$
$y = 8$

**6.** $\frac{16}{24} = \frac{20}{t}$
$16t = 24(20) = 480$
$t = 30$

**7.** $\frac{x-2}{4} = \frac{9}{x-2}$
$(x-2)^2 = 4(9) = 36$
$x - 2 = \pm 6$
$x = 2 \pm 6$
$= -4$ or $8$

**8.** $\frac{2}{3y} = \frac{y}{24}$
$2(24) = 3y(y)$
$48 = 3y^2$
$16 = y^2$
$y = \pm 4$

**9.** $\frac{\text{length of building}}{\text{length of model}} = \frac{\text{width of building}}{\text{width of model}}$
$\frac{\ell}{1.4} = \frac{240}{0.8}$
$0.8\ell = 1.4(240) = 336$
$\ell = 420$ m

**10.** $\frac{AB}{WX} = \frac{64}{96} = \frac{2}{3}$; $\frac{AD}{WZ} = \frac{30}{50} = \frac{3}{5}$; no

**11.** By def. of comp. ∠s, m∠$M = 23°$ and m∠$K = 67°$; so
*∠J ≅ ∠N, ∠M ≅ ∠P, and ∠R ≅ ∠K*;
$\frac{JM}{NP} = \frac{24}{36} = \frac{2}{3}$; $\frac{MR}{PK} = \frac{26}{39} = \frac{2}{3}$; $\frac{JR}{NK} = \frac{10}{15} = \frac{2}{3}$
yes; $\frac{2}{3}$; △*JMR* ~ △*NPK*

**12.** Think: Assume magnet ~ portrait.
$\frac{\text{length of magnet}}{\text{length of portrait}} = \frac{\text{width of magnet}}{\text{width of portrait}}$
$\frac{\ell}{30} = \frac{3.5}{21}$
$21\ell = 30(3.5) = 105$
$\ell = 5$ cm

**13.**

| Statements | Reasons |
|---|---|
| 1. *ABCD* is a ▱. | 1. Given |
| 2. $\overline{AD} \parallel \overline{BC}$ | 2. Def. of ▱ |
| 3. ∠*EDG* ≅ ∠*FBG* | 3. Alt. Int. ∠s Thm. |
| 4. ∠*EGD* ≅ ∠*FGB* | 4. Vert. ∠s Thm. |
| 5. △*EDG* ~ △*FBG* | 5. AA ~ *Steps 3, 4* |

**14.**

| Statements | Reasons |
|---|---|
| 1. $MQ = \frac{1}{3}MN$, $MR = \frac{1}{3}MP$ | 1. Given |
| 2. $\frac{MQ}{MN} = \frac{1}{3}$, $\frac{MR}{MP} = \frac{1}{3}$ | 2. Div. Prop. of = |
| 3. $\frac{MQ}{MN} = \frac{MR}{MP}$ | 3. Trans. Prop. of = |
| 4. ∠*M* ≅ ∠*M* | 4. Reflex. Prop. of ≅ |
| 5. △*MQR* ~ △*MNP* | 5. SAS ~ *Steps 3, 4* |

**15.** Think: △ *XYZ* ~ △ *VUZ* with ratio of proportion $\frac{5}{2}$, by SAS ~.
$\frac{XY}{UV} = \frac{5}{2}$
$2XY = 5UV$
$2XY = 5(16) = 80$
$XY = 40$ ft

## TECHNOLOGY LAB: INVESTIGATE ANGLE BISECTORS OF A TRIANGLE, PAGE 480

### TRY THIS, PAGE 480

**1.** $\frac{BD}{AB} = \frac{CD}{AC}$ or $\frac{BD}{CD} = \frac{AB}{AC}$.

**2.** $\frac{BD}{CD} = \frac{AB}{AC}$ or $\frac{BD}{AB} = \frac{CD}{AC}$.

### ACTIVITY 2:

**2.** Check students' work.

**3.** $\frac{DI}{DG} = \frac{DE + DF}{\text{perimeter } \triangle DEF}$

4. $\frac{DI}{DG} = \frac{DE + DF}{DE + DF + EF}$; the length of the seg. from the vertex of the bisected ∠ to the incenter divided by the length of the seg. from the vertex to the opp. side is = to the sum of the sides of the bisected ∠ divided by the perimeter of the △.

### TRY THIS, PAGE 480

3. Check students' work.
4. Check students' work.

## 7-4 APPLYING PROPERTIES OF SIMILAR TRIANGLES, PAGES 481–487

### CHECK IT OUT! PAGES 482–483

1. It is given that $\overline{PQ} \parallel \overline{LM}$, so $\frac{PL}{PN} = \frac{QM}{QN}$ by △ Prop. Thm.
$\frac{3}{PN} = \frac{2}{5}$
$15 = 2PN$
$PN = 7.5$

2. $AD = 36 - 20 = 16$ and $BE = 27 - 15 = 12$, so
$\frac{DC}{AD} = \frac{20}{16} = \frac{5}{4}$
$\frac{EC}{BE} = \frac{15}{12} = \frac{5}{4}$
Since $\frac{DC}{AD} = \frac{EC}{BE}$, $\overline{DE} \parallel \overline{AB}$ by Conv. of △ Prop. Thm.

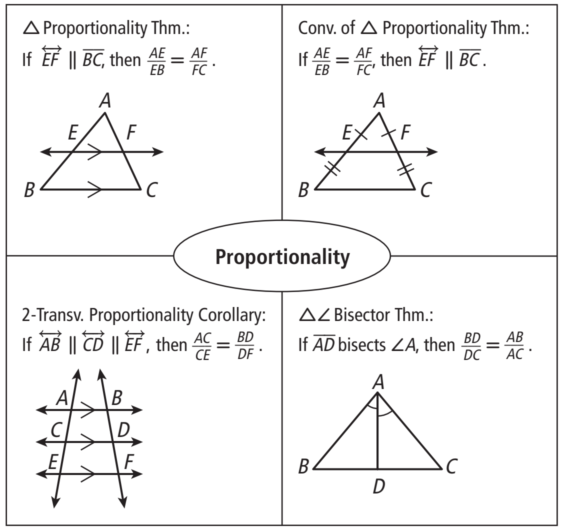
3. $\overline{AK} \parallel \overline{BL} \parallel \overline{CM} \parallel \overline{DN}$
$\frac{KL}{LM} = \frac{AB}{BC}$
$\frac{2.6}{LM} = \frac{2.4}{1.4}$
$2.4(LM) = 2.6(1.4)$
$LM \approx 1.5$ cm
$\frac{KL}{MN} = \frac{AB}{CD}$
$\frac{2.6}{MN} = \frac{2.4}{2.2}$
$2.4(MN) = 2.6(2.2)$
$MN \approx 2.4$ cm

4. $\frac{BD}{CD} = \frac{AB}{BC}$ by △ ∠ Bis. Thm.
$\frac{4.5}{\frac{y}{2}} = \frac{9}{y} = \frac{8}{y-2}$
$9(y - 2) = 8y$
$9y - 18 = 8y$
$y = 18$
$AC = y - 2$
$= 18 - 2 = 16$
$DC = \frac{y}{2} = \frac{18}{2} = 9$

### THINK AND DISCUSS, PAGE 484

1. Possible answer: $\frac{AX}{XB} = \frac{AY}{YC}$; $\frac{AX}{AB} = \frac{XY}{BC}$; $\frac{AY}{AC} = \frac{XY}{BC}$;

2.




### EXERCISES, PAGES 484–487

#### *GUIDED PRACTICE, PAGES 484–485*

1. It is given that $\overline{CD} \parallel \overline{FG}$, so $\frac{CE}{CF} = \frac{DE}{DG}$ by △ Prop. Thm.
$\frac{32}{24} = \frac{40}{DG}$
$32DG = 960$
$DG = 30$

2. It is given that $\overline{QR} \parallel \overline{PN}$, so $\frac{QM}{QP} = \frac{RM}{RN}$ by △ Prop. Thm.
$\frac{8}{5} = \frac{10}{RN}$
$8RN = 50$
$RN = 6.25$

3. $\frac{EC}{AC} = \frac{1.5}{1.5} = 1$; $\frac{ED}{DB} = \frac{1.5}{1.5} = 1$
Since $\frac{EC}{AC} = \frac{ED}{DB}$, $\overline{AB} \parallel \overline{CD}$ by Conv. of △ Prop. Thm.

4. $\frac{VU}{US} = \frac{67.5}{54} = \frac{5}{4}$; $\frac{VT}{TR} = \frac{90}{72} = \frac{5}{4}$
Since $\frac{VU}{US} = \frac{VT}{TR}$, $\overline{TU} \parallel \overline{RS}$ by Conv. of △ Prop. Thm.

5. Let $\ell$ represent length of Broadway between 34th and 35th Streets.
$\frac{\ell}{275} = \frac{250}{240}$
$240\ell = 275(250)$
$\ell \approx 286$ ft

6. $\frac{QR}{RS} = \frac{PQ}{PS}$ by △ ∠ Bis. Thm.
$\frac{x-2}{x+1} = \frac{12}{16}$
$16(x - 2) = 12(x + 1)$
$16x - 32 = 12x + 12$
$4x = 44$
$x = 11$
$QR = 11 - 2 = 9$; $RS = 11 + 1 = 12$

**7.** $\frac{BC}{CD} = \frac{AB}{AD}$ by △ ∠ Bis. Thm.

$\frac{6}{y - 1} = \frac{9}{2y - 4}$

$6(2y - 4) = 9(y - 1)$

$12y - 24 = 9y - 9$

$3y = 15$

$y = 5$

$CD = 5 - 1 = 4$; $AD = 2(5) - 4 = 6$

***PRACTICE AND PROBLEM SOLVING, PAGES 485–486***

**8.** $\frac{GJ}{JL} = \frac{HK}{KL}$

$\frac{6}{4} = \frac{8}{KL}$

$6KL = 32$

$KL = 5\frac{1}{3}$

**9.** $\frac{XY}{YU} = \frac{XZ}{ZV}$

$\frac{30 - 18}{18} = \frac{XZ}{30}$

$12(30) = 18XZ$

$XZ = 20$

**10.** $\frac{EC}{CA} = \frac{12}{4} = 3, \frac{ED}{DB} = \frac{14}{4\frac{2}{3}} = \frac{42}{14} = 3$

So $\overline{AB} \parallel \overline{CD}$ by Conv. of △ Prop. Thm.

**11.** $\frac{PM}{MQ} = \frac{9 - 2.7}{2.7} = 2\frac{1}{3}, \frac{PN}{NR} = \frac{10 - 3}{3} = 2\frac{1}{3}$

So $\overline{MN} \parallel \overline{QR}$ by Conv. of △ Prop. Thm.

**12.** $\frac{LM}{GL} = \frac{HJ}{GH}$

$\frac{LM}{11.3} = \frac{2.6}{10.4}$

$LM = \frac{2.6}{10.4}(11.3)$

$\approx 2.83$ ft

$\frac{MN}{GL} = \frac{JK}{GH}$

$\frac{MN}{11.3} = \frac{2.2}{10.4}$

$MN = \frac{2.2}{10.4}(11.3) \approx 2.39$ ft

**13.** $\frac{BC}{CD} = \frac{AB}{AD}$

$\frac{z - 4}{\frac{z}{2}} = \frac{12}{10}$

$10(z - 4) = \frac{z}{2}(12)$

$10z - 40 = 6z$

$4z = 40$

$z = 10$

$BC = 10 - 4 = 6$; $CD = \frac{10}{2} = 5$

**14.** $\frac{TU}{UV} = \frac{ST}{SV}$

$\frac{2y}{14.4} = \frac{4y - 2}{24}$

$24(2y) = 14.4(4y - 2)$

$48y = 57.6y - 28.8$

$28.8 = 9.6y$

$y = 3$

$ST = 4(3) - 2 = 10$; $TU = 2(3) = 6$

**15.** $\frac{AB}{BD} = \frac{AC}{\mathbf{CE}}$

**16.** $\frac{\mathbf{AD}}{DF} = \frac{AE}{EG}$

**17.** $\frac{DF}{\mathbf{BD}} = \frac{EG}{CE}$

**18.** $\frac{AF}{AB} = \frac{\mathbf{AG}}{AC}$

**19.** $\frac{BD}{CE} = \frac{\mathbf{DF}}{EG}$

**20.** $\frac{AB}{AC} = \frac{BF}{\mathbf{CG}}$

**21.** Let $x$ represent length of 3rd side.

either

$\frac{x}{20} = \frac{12}{16}$

$16x = 240$

$x = 15$ in.

or

$\frac{x}{20} = \frac{16}{12}$

$12x = 320$

$x = \frac{80}{3} = 26\frac{2}{3}$ in.

**22a.** $\frac{AC}{BD} = \frac{CE}{DF}$

**b.** $\frac{81.6}{80} = \frac{CE}{70}$

$81.6(70) = 80CE$

$CE = 71.4$ cm

**c.** $\frac{AJ}{BK} = \frac{AC}{BD}$

$\frac{AJ}{80 + 70 + 60 + 40} = \frac{81.6}{80}$

$AJ = \frac{81.6}{80}(250) = 255$ cm

**23.**

| Statements | Reasons |
|---|---|
| 1. $\frac{AE}{EB} = \frac{AF}{FC}$ | 1. Given |
| 2. $\angle A \cong \angle A$ | 2. Reflex. Prop. of ≅ |
| 3. $\triangle AEF \sim \triangle ABC$ | 3. SAS ~ *Steps 1, 2* |
| 4. $\angle AEF \cong \angle ABC$ | 4. Def. of ~ △ |
| 5. $\overleftrightarrow{EF} \parallel \overline{BC}$ | 5. Conv. of Corr. ∠s Post. |

**24.**

| Statements | Reasons |
|---|---|
| 1. $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}, \overleftrightarrow{CD} \parallel \overleftrightarrow{EF}$ | 1. Given |
| 2. Draw $\overleftrightarrow{EB}$ intersecting $\overline{CD}$ at $X$. | 2. 2 pts. determine a line |
| 3. $\frac{AC}{CE} = \frac{BX}{XE}$ | 3. △ Prop. Thm. |
| 4. $\frac{BX}{XE} = \frac{BD}{DF}$ | 4. △ Prop. Thm. |
| 5. $\frac{AC}{CE} = \frac{BD}{DF}$ | 5. Trans. Prop. of = |

**25a.** $\frac{PR}{RT} = \frac{QS}{SU}$

$\frac{x}{x + 2} = \frac{\frac{x}{2}}{x - 2} = \frac{x}{x(x - 2)}$

$2x(x - 2) = x(x + 2)$

$2x^2 - 4x = x^2 + 2x$

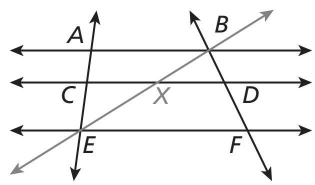
$x^2 - 6x = 0$

$x(x - 6) = 0$

$x = 6$ (*since* $x > 0$)

$PR = 6$; $RT = 6 + 2 = 8$; $QS = \frac{6}{2} = 3$;

$SU = 6 - 2 = 4$




**b.** $\frac{PR}{RT} = \frac{QS}{SU}$ or $\frac{6}{8} = \frac{3}{4}$

**26.** Think: Use △ Prop. Thm. and △ ∠ Bis. Thm.

$\frac{EF}{BE} = \frac{CD}{BC} = \frac{AD}{AB}$

$\frac{EF}{10} = \frac{24}{18} = \frac{4}{3}$

$3EF = 40$

$EF = 13\frac{1}{3}$

**27.** $\dfrac{ST}{TQ} = \dfrac{SR}{RQ} = \dfrac{PN}{NM}$

$\dfrac{ST}{10} = \dfrac{6}{4}$

$4ST = 60$

$ST = 15$

**28.** Total length along Chavez St. is $150 + 200 + 75 = 425$ ft.

$\dfrac{x}{150} = \dfrac{500}{425} = \dfrac{20}{17}$

$17x = 150(20) = 3000$

$x \approx 176$ ft

$\dfrac{y}{200} = \dfrac{500}{425} = \dfrac{20}{17}$

$17y = 4000$

$y \approx 235$ ft

$\dfrac{z}{75} = \dfrac{500}{425} = \dfrac{20}{17}$

$17z = 1500$

$z = 88$ ft

**29.** Draw a seg. on tracing paper whose length is = to the vert. dist. from line 1 to line 6 or no greater than the diag. dist. from line 1 to line 6 of the notebook paper. Place the tracing paper over the notebook paper so that the seg. spans exactly 6 of the lines on the notebook paper. Then mark the spots where the tracing-paper seg. crosses the line on the notebook paper. The method works by the 2-Transv. Proportionality Corollary.

**30.** Think: Use △ Prop. Thm. First find $EX$.

$\dfrac{EX}{AX} = \dfrac{EY}{DY}$

$\dfrac{EX}{17} = \dfrac{16}{18}$

$18EX = 272$

$EX = 15\dfrac{1}{9}$

$AE = AX + XE$

$= 17 + 15\dfrac{1}{9} = 32\dfrac{1}{9}$

$\dfrac{EC}{AE} = \dfrac{DB}{AD}$

$\dfrac{EC}{32^1/_9} = \dfrac{7.5}{15} = \dfrac{1}{2}$

$2EC = 32\dfrac{1}{9}$

$EC = 16\dfrac{1}{18}$

**31.** Possible answer: $\dfrac{BD}{CD} = \dfrac{AB}{AC}$; △ ∠ Bis. Thm.

***TEST PREP, PAGE 487***

**32.** C

$\dfrac{US}{SR} = \dfrac{20}{35} = \dfrac{4}{7}, \dfrac{VT}{TR} = \dfrac{16}{28} = \dfrac{4}{7}$

**33.** J

$\dfrac{AB}{25} = \dfrac{16}{20}$

$20AB = 400$

$AB = 20$

**34.** C

Let $x$ be dist. to 1st St.

$\dfrac{x}{2.4} = \dfrac{2.1}{2.8} = \dfrac{3}{4}$

$4x = 7.2$

$x = 1.8$ mi

$x + 2.4 = 4.2$ mi

**35.** $\dfrac{x}{24} = \dfrac{20}{16} = \dfrac{5}{4}$

$4x = 120$

$x = 30$

$\dfrac{y}{15} = \dfrac{16}{20} = \dfrac{4}{5}$

$5y = 60$

$y = 12$

possible answer: $\dfrac{20}{16} = \dfrac{15}{12}; \dfrac{20}{16} = \dfrac{30}{24}; \dfrac{15}{12} = \dfrac{30}{24};$

$\dfrac{20 + 15}{30} = \dfrac{16 + 12}{24}; \dfrac{20}{15 + 30} = \dfrac{16}{12 + 24};$

$\dfrac{20}{20 + 15 + 30} = \dfrac{16}{16 + 12 + 24}$

***CHALLENGE AND EXTEND, PAGE 487***

**36.** $P = AB + BC + AC$

$29 = AB + 9 + AC$

$20 - AB = AC$

$\dfrac{AB}{AC} = \dfrac{BD}{CD}$

$\dfrac{AB}{20 - AB} = \dfrac{4}{5}$

$5AB = 4(20 - AB)$

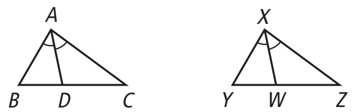
$9AB = 80$

$AB = 8\dfrac{8}{9}$

$AC = 20 - 8\dfrac{8}{9} = 11\dfrac{1}{9}$

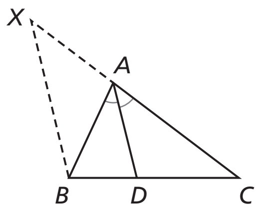
**37. Given:** $\triangle ABC \sim \triangle XYZ$, $\overline{AD}$ bisects $\angle BAC$, and $\overline{XW}$ bisects $\angle YXZ$.

**Prove:** $\dfrac{AD}{XW} = \dfrac{AB}{XY}$



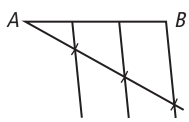

| Statements | Reasons |
|---|---|
| 1. $\triangle ABC \sim \triangle XYZ$ | 1. Given |
| 2. $\angle B \cong \angle Y$ | 2. Def. of ~ polygons |
| 3. $m\angle BAC = m\angle YXZ$ | 3. Def. of ~ polygons |
| 4. $\overline{AD}$ bisects $\angle BAC$ and $\overline{XW}$ bisects $\angle YXZ$. | 4. Given |
| 5. $m\angle BAC = 2m\angle BAD$, $m\angle YXZ = 2m\angle YXW$ | 5. Def. of ∠ bis. |
| 6. $2m\angle BAD = 2m\angle YXW$ | 6. Trans. Prop. of = |
| 7. $m\angle BAD = m\angle YXW$ | 7. Div. Prop. of = |
| 8. $\triangle ABD \sim \triangle XYW$ | 8. AA ~ *Steps 2, 7* |
| 9. $\dfrac{AD}{XW} = \dfrac{AB}{XY}$ | 9. △ Prop. Thm. |

**38.**




| Statements | Reasons |
|---|---|
| 1. $\overline{AD}$ bisects $\angle A$. | 1. Given |
| 2. Draw $\overline{BX} \parallel \overline{AD}$, extending $\overline{AC}$ to $X$. | 2. ∥ Post. |
| 3. $\frac{BD}{DC} = \frac{AX}{AC}$ | 3. △ Prop. Thm. |
| 4. $\angle CAD \cong \angle AXB$ | 4. Corr. ⦣ Post. |
| 5. $\angle CAD \cong \angle DAB$ | 5. Def of ∠ bis. |
| 6. $\angle DAB \cong \angle ABX$ | 6. Alt. Int. ⦣ Thm. |
| 7. $\angle DAB \cong \angle AXB$ | 7. Trans. Prop. of ≅ |
| 8. $\angle ABX \cong \angle AXB$ | 8. Trans. Prop. of ≅ |
| 9. $\overline{AX} \cong \overline{AB}$ | 9. Conv. Isosc. △ Thm. |
| 10. $AX = AB$ | 10. Def. of ≅ segs. |
| 11. $\frac{BD}{DC} = \frac{AB}{AC}$ | 11. Subst. |

**39.** Possible answer: Check students' work.




***SPIRAL REVIEW, PAGE 487***

**40.** $5 = 1 + 4$, $6 = 2 + 4$, … $n$th term is $n + 4$

**41.** $3 = 3(1)$, $6 = 3(2)$, … $n$th term is $3n$

**42.** $1 = 1^2$, $4 = 2^2$, $9 = 3^2$, … $n$th term is $n^2$

**43.** Let $C = (x, y)$.

$3 = \frac{1 + x}{2}$ $\qquad -7 = \frac{4 + y}{2}$

$6 = 1 + x$ $\qquad -14 = 4 + y$

$x = 5$ $\qquad y = -18$

$C = (5, -18)$

**44.** $\angle A \cong \angle A$ (Reflex. Prop. of ≅)

$\frac{AB}{AD} = \frac{8}{12} = \frac{2}{3}, \frac{AC}{AE} = \frac{6}{9} = \frac{2}{3}$

Therefore $\triangle ABC \sim \triangle ADE$ by SAS ~.

**45.** $\angle KLJ \cong \angle NLM$ (Vert. ⦣ Thm.)

$\angle K \cong \angle N$ (△ Sum Thm. → $m\angle N = 68°$)

Therefore $\triangle JKL \sim \triangle MNL$ by AA ~.

## 7-5 USING PROPORTIONAL RELATIONSHIPS, PAGES 488–494

### CHECK IT OUT! PAGES 488–490

**1.** **Step 1** Convert measurements to inches.

$GH = 5$ ft 6 in. $= 5(12)$ in. $+ 6$ in. $= 66$ in.

$JH = 5$ ft $= 5(12)$ in. $= 60$ in.

$NM = 14$ ft 2 in. $= 14(12)$ in. $+ 2$ in. $= 170$ in.

**Step 2** Find ~ ⦣.

Because sun's rays are ∥, $\angle J \cong \angle N$. Therefore $\triangle GHJ \cong \triangle LMN$ by AA ~.

**Step 3** Find $LM$.

$\frac{GH}{LM} = \frac{JH}{NM}$

$\frac{66}{LM} = \frac{60}{170}$

$60LM = 66(170)$

$LM = 187$ in. $= 15$ ft 7 in.

**2.** Use a ruler to measure dist. between City Hall and El Centro College. Dist. is 4.5 cm.

To find actual dist. $y$, write a proportion comparing map dist. to actual dist.

$\frac{4.5}{y} = \frac{1.5}{300}$

$1.5y = 4.5(300)$

$1.5y = 1350$

$y = 900$

Actual dist. is 900 m, or 0.9 km.

**3.** **Step 1** Set up proportions to find length $\ell$ and width $w$ of of scale drawing.

$\frac{\ell}{74} = \frac{1}{20}$ $\qquad \frac{w}{60} = \frac{1}{20}$

$20\ell = 74$ $\qquad 20w = 60$

$\ell = 3.7$ in. $\qquad w = 3$ in.

**Step 2** Use a ruler to draw a rect. with new dimensions. (Check students' work.)

**4.** Similarity ratio of $\triangle ABC$ to $\triangle DEF$ is $\frac{4}{12}$, or $\frac{1}{3}$.

By Proportional Perimeters and Areas Thm., ratio of ⦣' perimeters is also $\frac{1}{3}$, and ratio of ⦣' areas is $\left(\frac{1}{3}\right)^2$, or $\frac{1}{9}$.

Perimeter

$\frac{P}{42} = \frac{1}{3}$

$3P = 42$

$P = 14$ mm

Area

$\frac{A}{96} = \frac{1}{9}$

$9A = 96$

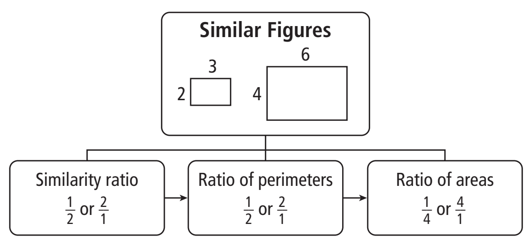
$A = 10\frac{2}{3}$ mm$^2$

Perimeter of $\triangle ABC$ is 14 mm, and area is $10\frac{2}{3}$ mm$^2$.

### THINK AND DISCUSS, PAGE 490

**1.** Set up a proportion: $\frac{5.5}{x} = \frac{1}{25}$. Then solve for $x$ to find actual dist.: $x = 5.5(25) = 137.5$ mi.

**2.**



## EXERCISES, PAGES 491–494

***GUIDED PRACTICE, PAGE 491***

1. indirect measurement
2. **Step 1** Convert measurements to inches.
   5 ft 6 in. = 5(12) in. + 6 in. = 66 in.
   4 ft = 4(12) in. = 48 in.
   40 ft = 40(12) in. = 480 in.
   **Step 2** Find ~ △.
   Since marked ∠ are ≅, △ are ~ by AA ~.
   **Step 3** Find height of dinosaur, *h*.
   $\frac{h}{66} = \frac{480}{48}$
   $\frac{h}{66} = 10$
   $h = 10(66) = 660$ in.
   Height of dinosaur is 660 in., or 55 ft.
3. Use a ruler to measure to-scale length of $\overline{AB}$.
   Length is 0.25 in.
   To find actual length *AB*, write a proportion comparing to-scale length to actual length.
   $\frac{0.25}{AB} = \frac{1}{48}$
   $AB = 0.25(48) = 12$ ft
4. Use a ruler to measure to-scale length of $\overline{CD}$.
   Length is 0.75 in.
   To find actual length *CD*, write a proportion comparing to-scale length to actual length.
   $\frac{0.75}{CD} = \frac{1}{48}$
   $CD = 0.75(48) = 36$ ft
5. Use a ruler to measure to-scale length of $\overline{EF}$.
   Length is 1.25 in.
   To find actual length *EF*, write a proportion comparing to-scale length to actual length.
   $\frac{1.25}{EF} = \frac{1}{48}$
   $EF = 1.25(48) = 60$ ft
6. Use a ruler to measure to-scale length of $\overline{FG}$.
   Length is 0.5 in.
   To find actual length *FG*, write a proportion comparing to-scale length to actual length.
   $\frac{0.5}{FG} = \frac{1}{48}$
   $FG = 0.5(48) = 24$ ft
7. **Step 1** Set up proportions to find length $\ell$ and width *w* of scale drawing.
   $\frac{\ell}{10} = \frac{1}{1}$　　$\frac{w}{4.6} = \frac{1}{1}$
   $\ell = 10$ cm　　$w = 4.6$ cm
   **Step 2** Use a ruler to draw a rect. with new dimensions. (Check students' drawings.)
8. **Step 1** Set up proportions to find length $\ell$ and width *w* of scale drawing.
   $\frac{\ell}{10} = \frac{1}{2}$　　$\frac{w}{4.6} = \frac{1}{2}$
   $2\ell = 10$　　$2w = 4.6$ cm
   $\ell = 5$ cm　　$w = 2.3$ cm
   **Step 2** Use a ruler to draw a rect. with new dimensions. (Check students' drawings.)
9. **Step 1** Set up proportions to find length $\ell$ and width *w* of scale drawing.
   $\frac{b}{10} = \frac{1}{2.3}$　　$\frac{w}{4.6} = \frac{1}{2.3}$
   $2.3b = 10$　　$2.3w = 4.6$ cm
   $b = 4.3$ cm　　$w = 2$ cm
   **Step 2** Use a ruler to draw a rect. with new dimensions. (Check students' drawings.)
10. Similarity ratio of *MNPQ* to *RSTU* is $\frac{4}{6}$, or $\frac{2}{3}$.
    By Proportional Perimeters and Areas Thm., ratio of perimeters is also $\frac{2}{3}$.
    $\frac{14}{P} = \frac{2}{3}$
    $2P = 14(3) = 42$
    $P = 21$
    Perimeter of *RSTU* is 21 cm.
11. Ratio of areas is $\left(\frac{2}{3}\right)^2$, or $\frac{4}{9}$.
    $\frac{12}{A} = \frac{4}{9}$
    $4A = 12(9) = 108$
    $A = 27$
    Area of *RSTU* is 27 $cm^2$.

***PRACTICE AND PROBLEM SOLVING, PAGES 491–493***

12. 5 ft 2 in. = 62 in.; 7 ft 9 in. = 93 in.; 15.5 ft = 186 in.
    $\frac{h}{62} = \frac{186}{93} = 2$
    $h = 62(2) = 124$ in. $= 10\frac{1}{3}$ ft or 10 ft 4 in.
13. map dist. for $\overline{JK} = 6$ cm
    $\frac{6}{JK} = \frac{1}{9.4}$
    $JK = 6(9.4) \approx 57$ km
14. map dist. for $\overline{NP} = 0.45$ cm
    $\frac{0.45}{NP} = \frac{1}{9.4}$
    $NP = 0.45(9.4) \approx 4$ km
15. **Step 1** Set up proportions to find base *b* and height *h* of scale drawing.
    $\frac{b}{150} = \frac{1.5}{100}$　　$\frac{h}{200} = \frac{1.5}{100}$
    $100b = 225$　　$100h = 300$
    $b = 2.25$ in.　　$h = 3$ in.
    **Step 2** Use a ruler to draw a rt. △ with new dimensions. (Check students' drawings.)
16. **Step 1** Set up proportions to find base *b* and height *h* of scale drawing.
    $\frac{b}{150} = \frac{1}{300}$　　$\frac{h}{200} = \frac{1}{300}$
    $300b = 150$　　$300h = 200$
    $b = 0.5$ in.　　$h \approx 0.67$ in.
    **Step 2** Use a ruler to draw a rt. △ with new dimensions. (Check students' drawings.)
17. **Step 1** Set up proportions to find base *b* and height *h* of scale drawing.
    $\frac{b}{150} = \frac{1}{150}$　　$\frac{h}{200} = \frac{1}{150}$
    $150b = 150$　　$150h = 200$
    $b = 1$ in.　　$h \approx 1.3$ in.
    **Step 2** Use a ruler to draw a rt. △ with new dimensions. (Check students' drawings.)

**18.** scale factor $= \frac{60}{90} = \frac{2}{3}$

$\frac{P}{381} = \frac{2}{3}$

$3P = 762$

$P = 254$ m

**19.** $\frac{A}{1944} = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$

$9A = 7776$

$A = 864$ m$^2$

**20.** scale factor $= \frac{10 \text{ ft}}{0.5 \text{ in.}}$

$= 20$

map dist. $= \frac{30}{16}$ in.

$\frac{x}{\frac{30}{16}} = 20$

$x = \frac{30}{16}(20)$

$\approx 38$ ft

**21.** map dist. $= \frac{10}{8}$ in.

$\frac{x}{\frac{10}{8}} = 20$

$x = \frac{10}{8}(20)$

$= 25$ ft

**22.** map dist. $= \frac{25}{16}$ in.

$\frac{x}{\frac{25}{16}} = 20$

$x = \frac{25}{16}(20)$

$\approx 32$ ft

**23.** map dist. $= \frac{32}{16}$ in.

$\frac{x}{\frac{32}{16}} = 20$

$x = \frac{32}{16}(20)$

$\approx 39$ ft

**24.** By Proportional Perimeters and Areas Thm., $\sim$ ratio = ratio of perimeters $= \frac{8}{9}$.

**25.** By Proportional Perimeters and Areas Thm., ratio of areas $= (\sim \text{ratio})^2$.

$\frac{16}{25} = (\sim \text{ratio})^2$

$\sim \text{ratio} = \sqrt{\frac{16}{25}} = \frac{4}{5}$

**26.** ratio of areas $= (\sim \text{ratio})^2$

ratio of areas $= (\text{ratio of perims.})^2$

$\frac{4}{81} = (\text{ratio of perims.})^2$

ratio of perims. $= \sqrt{\frac{4}{81}} = \frac{2}{9}$

**27.** $\frac{\text{scale width}}{\text{model width}} = \frac{1}{50}$

$\frac{w}{15} = \frac{1}{50}$

$w = \frac{15}{50} = 0.3$ ft

$\frac{\text{scale length}}{\text{model length}} = \frac{1}{50}$

$\frac{\ell}{60} = \frac{1}{50}$

$\ell = \frac{60}{50} = 1.2$ ft

**28a.** hyp. of $\triangle PQR = \sqrt{3^2 + 4^2} = 5$ in.

hyp. of $\triangle WXY = \sqrt{6^2 + 8^2} = 10$ in.

$\frac{\text{perimeter of } \triangle PQR}{\text{perimeter of } \triangle WXY} = \frac{3 + 4 + 5}{6 + 8 + 10}$

$= \frac{12}{24} = \frac{1}{2}$

**b.** $\frac{\text{area of } \triangle PQR}{\text{area of } \triangle WXZ} = \frac{\frac{1}{2}(4)(4)}{\frac{1}{2}(8)(6)}$

$= \frac{6}{24} = \frac{1}{4}$

**c.** The ratio of areas is square of ratio of perimeters.

**29.** Let $\ell_1$ and $w_1$ be dimensions of rect. *ABCD*; let $\ell_2$ and $w_2$ be dimensions of rect. *EFGH*.

$A_1 = \ell_1 w_1$

$135 = \ell_1(9)$

$\ell_1 = 15$ in.

Think: Rects. are $\sim$; let scale factor be $s$.

$\frac{\ell_2}{\ell_1} = \frac{w_2}{w_1} = s$

$\ell_2 = s\ell_1,\ w_2 = sw_1$

$A_2 = \ell_2 w_2$

$= (s\ell_1)(sw_1)$

$= s^2 A_1$

$240 = 135s^2$

$\frac{16}{9} = s^2$

$s = \frac{4}{3}$

$\ell_2 = s\ell_1$

$= \frac{4}{3}(15) = 20$ in.

$w_2 = sw_1$

$= \frac{4}{3}(9) = 12$ in.

**30.** Check students' work.

$\frac{\text{scale length}}{\text{actual length}} = \frac{\ell}{94} = \frac{0.25}{10}$

$10\ell = 23.5$

$\ell = 2.35$ in.

$\frac{\text{scale width}}{\text{actual width}} = \frac{w}{50} = \frac{0.25}{10}$

$10w = 12.5$

$w = 1.25$ in.

**31a.** $\sim$ ratio $= \frac{1 \text{ in.}}{2 \text{ ft}}$

$= \frac{1 \text{ in.}}{24 \text{ in.}} = \frac{1}{24}$

**b.** actual dimensions are $24(2) = 48$ in. and $24(3) = 72$ in.

actual area $= (48)(72) = 3456$ in.$^2$

model area $= (2)(3) = 6$ in.$^2$

$\frac{\text{model area}}{\text{actual area}} = \frac{3456}{6} = \frac{1}{576}$

**c.** actual area $= (4 \text{ ft})(6 \text{ ft}) = 24$ ft$^2$

**32.** In photo, height of person $\approx \frac{1}{2}$ in. and height of statue $\approx 1\frac{5}{8}$ in.

$\frac{\text{actual height of statue}}{\text{height of statue in photo}}$

$= \frac{\text{actual height of person}}{\text{height of statue in person}}$

$\frac{h}{1.625} \approx \frac{5}{0.5}$

$0.5h \approx 8$

$h \approx 16$ ft

**33.** $\frac{\text{map length}}{\text{actual length}} = \text{scale factor}$

$\frac{\ell}{1 \text{ km}} = \frac{1 \text{ cm}}{900{,}000 \text{ cm}} = \frac{1 \text{ cm}}{9 \text{ km}}$

$\ell = \frac{1}{9}$ cm

**34.** By $\triangle$ Midseg. Thm., def. of mdpt., and SSS $\cong$, $\triangle XYZ \cong \triangle ZJX$; so $\triangle$s have same height $h$. Therefore height of $\triangle JKL = h + h = 2h$. Since $KL = 2ZX$,

$$\begin{aligned}\text{area of } \triangle JKL &= \frac{1}{2}(2ZX)(2h)\\ &= 2(ZX)h\\ &= 4\left(\frac{1}{2}(ZX)(h)\right)\\ &= 4(\text{area of } \triangle XYZ)\end{aligned}$$

$$\frac{\text{area of } \triangle JKL}{\text{area of } \triangle XYZ} = \frac{4}{1}$$

**35.** 1 cm : 5 m; Since each cm will represent 5 m, this drawing will be $\frac{1}{5}$ size of the 1 cm : 1 m drawing.

**36.** $\frac{4(x-2)}{4(2x)} = \frac{x-2}{2x} = \frac{4}{9}$

$9(x-2) = 8x$
$9x - 18 = 8x$
$x = 18$
$AB = 18 - 2 = 16$ units
$HE = 2(18) = 36$ units

**37.** With a scale of 1 : 1, drawing is same size as actual object.

**38.** Suppose $x$ and $y$ are whole-number side lengths of smaller square and larger square. Then $2x^2 = y^2$. Thus $x\sqrt{2} = y$. A whole number that is multiplied by $\sqrt{2}$ cannot equal a whole number, since $\sqrt{2}$ is irrational.

***TEST PREP, PAGE 493***

**39.** D

$$\begin{aligned}\text{area of } \triangle RST &= (\text{scale factor})^2(\text{area of } \triangle ABC)\\ &= \left(\frac{15}{10}\right)^2(24) = \frac{9}{4}(24) = 54 \text{ m}^2\end{aligned}$$

**40.** G

$\frac{3.75}{\ell} = \frac{0.25}{1}$
$3.75 = 0.25\ell$
$\ell = 15$ ft

**41.** C. Ratio of perimeters = ~ ratio = $\frac{4}{9}$

**42.** F

$$\begin{aligned}\text{area of } \triangle 2 &= (\sim \text{ratio})^2(\text{area of } \triangle 1)\\ &= \left(\frac{1}{2}\right)^2(16) = 4 \text{ ft}^2\end{aligned}$$

***CHALLENGE AND EXTEND, PAGE 494***

**43a.** $\frac{x}{1.5 \times 10^8 \text{ km}} = \frac{1 \text{ km}}{10^9 \text{ km}} = \frac{10^3 \text{ m}}{10^9 \text{ km}}$

$$\begin{aligned}x &= \frac{10^3 \text{ m}}{10^9 \text{ km}}(1.5 \times 10^8 \text{ km})\\ &= 1.5 \times 10^2 \text{ m or } 150 \text{ m}\end{aligned}$$

**43b.** $\frac{d}{1.28 \times 10^4 \text{ km}} = \frac{10^3 \text{ m}}{10^9 \text{ km}}$

$$\begin{aligned}d &= \frac{10^3 \text{ m}}{10^9 \text{ km}}(1.28 \times 10^4 \text{ km})\\ &= 1.28 \times 10^{-2} \text{ m or } 1.28 \text{ cm}\end{aligned}$$

**44.** It is given that $\triangle ABC \sim \triangle DEF$. Let $\frac{AB}{DE} = x$. Then $AB = DEx$ by Mult. Prop. of =. Similarly, $BC = EFx$ and $AC = DFx$. By Add. Prop. of =, $AB + BC + AC = DEx + EFx + DFx$. Thus $AB + BC + AC = x(DE + EF + DF)$. By Div. Prop. of =, $\frac{AB + BC + AC}{DE + EF + DF} = x$. By subst., $\frac{AB + BC + AC}{DE + EF + DF} = \frac{AB}{DE}$.

**45.** It is given that $\triangle PQR \sim \triangle WXY$. Draw $\perp$s from $Q$ and $X$ to meet $\overline{PR}$ at $S$ and $\overline{WY}$ at $Z$. By def. of ~ polygons, $\frac{PQ}{WX} = \frac{QR}{XY} = \frac{PR}{WY}$, and $\angle P \cong \angle W$. In $\triangle PQS$ and $\triangle WXZ$, $\angle PSQ \cong \angle WZX$. Thus $\triangle PQS \sim \triangle WXZ$ by AA ~. $\frac{PQ}{WZ} = \frac{QS}{XZ} = \frac{PS}{WZ}$ by def. of ~ polygons. $\frac{QR}{XY} = \frac{SP}{ZW}$ by subst. $\frac{\text{Area of } \triangle PQR}{\text{area of } \triangle WXY} = \frac{PR}{WY} \cdot \frac{QS}{XZ} = \frac{PR^2}{WY^2}$.

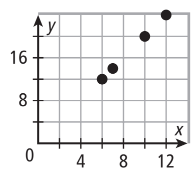
**46a.** $\frac{6}{WX} = \frac{1}{2}$, $WX = 12$; $\frac{7}{XY} = \frac{1}{2}$, $XY = 14$

$\frac{10}{YZ} = \frac{1}{2}$, $YZ = 20$; $\frac{12}{WZ} = \frac{1}{2}$, $WZ = 24$

**b.**

| Quad. *PQRS* | | Quad. *WXYZ* | |
|---|---|---|---|
| **Side** | **Length (m)** | **Side** | **Length (m)** |
| ***PQ*** | 6 | ***WX*** | 12 |
| ***QR*** | 7 | ***XY*** | 14 |
| ***RS*** | 10 | ***YZ*** | 20 |
| ***PS*** | 12 | ***WZ*** | 24 |

**c.**




**d.** $WX = 12 = 2PQ$; similarly $XY = 2QR$, $YZ = 2RS$, and $WZ = 2PS$. So eqn. is $y = 2x$.

***SPIRAL REVIEW, PAGE 494***

**47.** $(x - 3)^2 = 49$
$x - 3 = \pm 7$
$x = 3 \pm 7$
$= 10$ or $-4$

**48.** $(x + 1)^2 - 4 = 0$
$(x + 1)^2 = 4$
$x + 1 = \pm 2$
$x = -1 \pm 2$
$= -3$ or $1$

**49.** $4(x + 2)^2 - 28 = 0$
$4(x + 2)^2 = 28$
$(x + 2)^2 = 7$
$x + 2 = \pm\sqrt{7}$
$x = -2 \pm \sqrt{7}$
$\approx 0.65$ or $-4.65$

**50.** slope of $\overline{AB} = \frac{2}{3}$; slope of $\overline{CD} = \frac{-2}{-3} = \frac{2}{3}$
slope of $\overline{BC}$ = slope of $\overline{AD} = 0$
$\overline{AB} \parallel \overline{CD}$ and $\overline{BC} \parallel \overline{AD}$, so $ABCD$ is a ▱.

**51.** slope of $\overline{JK} = \frac{2}{2} = 1$; slope of $\overline{LM} = \frac{-2}{-2} = 1$

slope of $\overline{KL} = \frac{-3}{3} = -1$; slope of $\overline{JM} = \frac{-3}{3} = -1$

$\overline{JK} \parallel \overline{LM}$ and $\overline{KL} \parallel \overline{JM}$, so *JKLM* is a ▱.

**52.** $58x = 26y$

$y : x = 58 : 26 = 29 : 13$

## 7-6 DILATIONS AND SIMILARITY IN THE COORDINATE PLANE, PAGES 495–500

### CHECK IT OUT! PAGES 495–497

**1. Step 1** Multiply vertices of photo $A(0, 0)$, $B(0, 4)$, $C(3, 4)$, $D(3, 0)$ by $\frac{1}{2}$.

Rect. *ABCD* Rect. *A′B′C′D′*

$A(0, 0) \rightarrow A'\left(\frac{1}{2}(0), \frac{1}{2}(0)\right) \rightarrow A'(0, 0)$

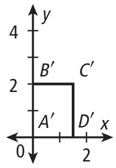
$B(0, 0) \rightarrow B'\left(\frac{1}{2}(0), \frac{1}{2}(4)\right) \rightarrow B'(0, 2)$

$C(0, 0) \rightarrow C'\left(\frac{1}{2}(3), \frac{1}{2}(4)\right) \rightarrow C'(1.5, 2)$

$D(0, 0) \rightarrow D'\left(\frac{1}{2}(3), \frac{1}{2}(0)\right) \rightarrow D'(1.5, 0)$

**Step 2** Plot pts. $A'(0, 0)$, $B'(0, 2)$, $C'(1.5, 2)$, and $D'(1.5, 0)$. Draw the rectangle.

Check student's work




**2.** Since $\triangle MON \sim \triangle POQ$,

$$\frac{PO}{MO} = \frac{OQ}{ON}$$

$$\frac{-15}{-10} = \frac{3}{2} = \frac{-30}{ON}$$

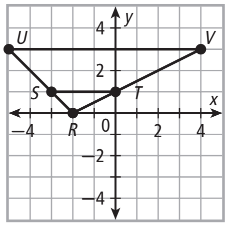
$$3ON = -60$$

$$ON = -20$$

*N* lies on *y*-axis, so its *x*-coord. is 0. Since $ON = -20$, its *y*-coord. must be $-20$. Coords. of *N* are $(0, -20)$.

$(0, -30) \rightarrow \left(\frac{2}{3}(0), \frac{2}{3}(-30)\right) \rightarrow (0, -20)$, so scale factor is $\frac{2}{3}$.

**3. Step 1** Plot pts. and draw △.




**Step 2** Use Dist. Formula to find side lengths.

$RS = \sqrt{(-3 + 2)^2 + (1 - 0)^2} = \sqrt{2}$

$RT = \sqrt{(0 + 2)^2 + (1 - 0)^2} = \sqrt{5}$

$RU = \sqrt{(-5 + 2)^2 + (3 - 0)^2} = \sqrt{18} = 3\sqrt{2}$

$RV = \sqrt{(4 + 2)^2 + (3 - 0)^2} = \sqrt{45} = 3\sqrt{5}$

**Step 3** Find similarity ratio.

$\frac{RS}{RU} = \frac{\sqrt{2}}{3\sqrt{2}} = \frac{1}{3}$ $\frac{RT}{RV} = \frac{\sqrt{5}}{3\sqrt{5}} = \frac{1}{3}$

Since $\frac{RS}{RU} = \frac{RT}{RV}$ and $\angle R \cong \angle R$ by Reflex. Prop. of ≅, $\triangle RST \sim \triangle RUV$ by SAS ~.

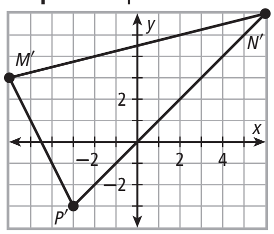
**4. Step 1** Multiply each coord. by 3 to find coords of vertices of $\triangle M'N'P'$.

$M(-2, 1) \rightarrow M'(3(-2), 3(1)) = M'(-6, 3)$

$N(2, 2) \rightarrow N'(3(2), 3(2)) = N'(6, 6)$

$P(-1, -1) \rightarrow P'(3(-1), 3(-1)) = P'(-3, -3)$

**Step 2** Graph $\triangle M'N'P'$.




**Step 3** Use Dist. Formula to find side lengths.

$MN = \sqrt{(2 + 2)^2 + (2 - 1)^2} = \sqrt{17}$

$M'N' = \sqrt{(6 + 6)^2 + (6 - 3)^2} = \sqrt{153} = 3\sqrt{17}$

$NP = \sqrt{(-1 - 2)^2 + (-1 - 2)^2} = \sqrt{18} = 3\sqrt{2}$

$N'P' = \sqrt{(-3 - 6)^2 + (-3 - 6)^2} = \sqrt{162} = 9\sqrt{2}$

$MP = \sqrt{(-1 + 2)^2 + (-1 - 1)^2} = \sqrt{5}$

$M'P' = \sqrt{(-3 + 6)^2 + (-3 - 3)^2} = \sqrt{45} = 3\sqrt{5}$

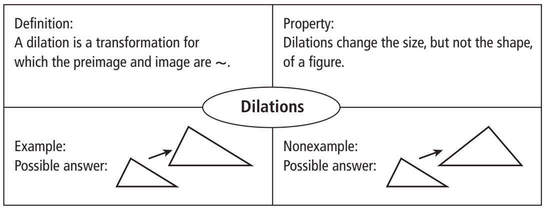
**Step 4** Find similarity ratio.

$\frac{M'N'}{MN} = \frac{3\sqrt{17}}{\sqrt{17}} = 3$, $\frac{N'P'}{NP} = \frac{9\sqrt{2}}{3\sqrt{2}} = 3$, $\frac{M'P'}{MP} = \frac{3\sqrt{5}}{\sqrt{5}} = 3$

Since $\frac{M'N'}{MN} = \frac{N'P'}{NP} = \frac{M'P'}{MP}$, $\triangle M'N'P' \sim \triangle MNP$ by SSS ~.

### THINK AND DISCUSS, PAGE 497

**1.** The scale factor is 4, since each coord. of preimage is multiplied by 4 in order to get coords. of image.

**2.** 


## EXERCISES, PAGES 498–500

***GUIDED PRACTICE, PAGE 498***

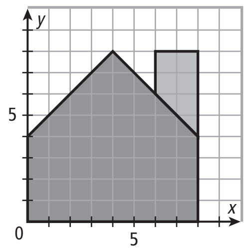
**1.** dilation **2.** scale factor

**3.** **Step 1** Multiply vertices of figure $A(0, 0)$, $B(0, 2)$, $C(2, 4)$, $D(3, 3)$, $E(3, 4)$, $F(4, 4)$, $G(4, 2)$, $H(4, 0)$ by 2.

Fig. $ABCDEFGH$ Fig. $A'B'C'D'E'F'G'H'$

$A(0, 0) \rightarrow A'(2(0), 2(0)) \rightarrow A'(0, 0)$
$B(0, 2) \rightarrow B'(2(0), 2(2)) \rightarrow B'(0, 4)$
$C(2, 4) \rightarrow C'(2(2), 2(4)) \rightarrow C'(4, 8)$
$D(3, 3) \rightarrow D'(2(3), 2(3)) \rightarrow D'(6, 6)$
$E(3, 4) \rightarrow E'(2(3), 2(4)) \rightarrow E'(6, 8)$
$F(4, 4) \rightarrow F'(2(4), 2(4)) \rightarrow F'(8, 8)$
$G(4, 2) \rightarrow G'(2(4), 2(2)) \rightarrow G'(8, 4)$
$H(4, 0) \rightarrow H'(2(4), 2(0)) \rightarrow H'(8, 0)$

**Step 2** Plot pts. $A'$, $B'$, $C'$, $D'$, $E'$, $F'$, $G'$, and $H'$. Draw the figure.




**4.** Since $\triangle AOB \sim \triangle COD$,

$\frac{AO}{CO} = \frac{OB}{OD}$

$\frac{10}{CO} = \frac{6}{15}$

$150 = 6CO$

$CO = 25$

$C$ lies on $x$-axis, so its $y$-coord. is 0. Since $CO = 25$, its $x$-coord. must be 25. Coords. of $C$ are (25, 0).

$(10, 0) \rightarrow \left(\frac{5}{2}(10), \frac{5}{2}(0)\right) \rightarrow (25, 0)$, so scale factor is $\frac{5}{2}$.

**5.** Since $\triangle ROS \sim \triangle POQ$,

$\frac{RO}{PO} = \frac{OS}{OQ}$

$\frac{4}{10} = \frac{OS}{-20}$

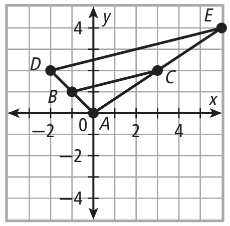
$-80 = 10OS$

$OS = -8$

$S$ lies on $y$-axis, so its $x$-coord. is 0. Since $OS = -8$, its $y$-coord. must be $-8$. Coords. of $S$ are $(0, -8)$.

$(0, -20) \rightarrow \left(\frac{2}{5}(0), \frac{2}{5}(-20)\right) \rightarrow (0, -8)$, so scale factor is $\frac{5}{2}$.

**6.** **Step 1** Plot pts. and draw ▵s.




**Step 2** Use Dist. Formula to find side lengths.

$AB = \sqrt{(-1-0)^2 + (1-0)^2} = \sqrt{2}$

$AC = \sqrt{(3-0)^2 + (2-0)^2} = \sqrt{13}$

$AD = \sqrt{(-2-0)^2 + (2-0)^2} = \sqrt{8} = 2\sqrt{2}$

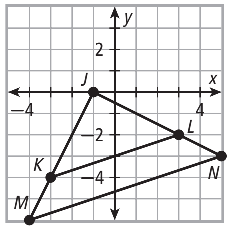
$AE = \sqrt{(6-0)^2 + (4-0)^2} = \sqrt{52} = 2\sqrt{13}$

**Step 3** Find similarity ratio.

$\frac{AB}{AD} = \frac{\sqrt{2}}{2\sqrt{2}} = \frac{1}{2}$ $\frac{AC}{AE} = \frac{\sqrt{13}}{2\sqrt{13}} = \frac{1}{2}$

Since $\frac{AB}{AD} = \frac{AC}{AE}$ and $\angle A \cong \angle A$ by Reflex. Prop. of $\cong$, $\triangle ABC \sim \triangle ADE$ by SAS $\sim$.

**7.** **Step 1** Plot pts. and draw ▵s.




**Step 2** Use Dist. Formula to find side lengths.

$JK = \sqrt{(-3+1)^2 + (-4-0)^2} = \sqrt{20} = 2\sqrt{5}$

$JL = \sqrt{(3+1)^2 + (-2-0)^2} = \sqrt{20} = 2\sqrt{5}$

$JM = \sqrt{(-4+1)^2 + (-6-0)^2} = \sqrt{45} = 3\sqrt{5}$

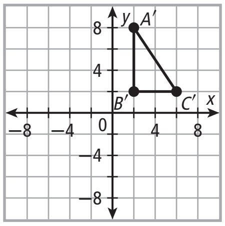
$JN = \sqrt{(5+1)^2 + (-3-0)^2} = \sqrt{45} = 3\sqrt{5}$

**Step 3** Find similarity ratio.

$\frac{JK}{JM} = \frac{2\sqrt{5}}{3\sqrt{5}} = \frac{2}{3}$ $\frac{JL}{JN} = \frac{2\sqrt{5}}{3\sqrt{5}} = \frac{2}{3}$

Since $\frac{JK}{JM} = \frac{JL}{JN}$ and $\angle J \cong \angle J$ by Reflex. Prop. of $\cong$, $\triangle JKL \sim \triangle JMN$ by SAS $\sim$.

**8. Step 1** Multiply each coord. by 2 to find coords of vertices of $\triangle A'B'C'$.
$A(1, 4) \rightarrow A'(2(1), 2(4)) = A'(2, 8)$
$B(1, 1) \rightarrow B'(2(1), 2(1)) = B'(2, 2)$
$C(3, 1) \rightarrow C'(2(3), 2(1)) = C'(6, 2)$
**Step 2** Graph $\triangle A'B'C'$.




**Step 3** Use Dist. Formula to find side lengths.

$AB = \sqrt{(1-1)^2 + (1-4)^2} = 3$

$A'B' = \sqrt{(2-2)^2 + (2-8)^2} = 6$

$BC = \sqrt{(3-1)^2 + (1-1)^2} = 2$

$B'C' = \sqrt{(6-2)^2 + (2-2)^2} = 4$

$AC = \sqrt{(3-1)^2 + (1-4)^2} = \sqrt{13}$

$A'C' = \sqrt{(6-2)^2 + (2-8)^2} = \sqrt{52} = 2\sqrt{13}$

**Step 4** Find similarity ratio.

$\frac{A'B'}{AB} = \frac{6}{3} = 2, \frac{B'C'}{BC} = \frac{4}{2} = 2, \frac{A'C'}{AC} = \frac{2\sqrt{13}}{\sqrt{13}} = 2$

Since $\frac{A'B'}{AB} = \frac{B'C'}{BC} = \frac{A'C'}{AC}$, $\triangle ABC \sim \triangle A'B'C'$ by SSS $\sim$.

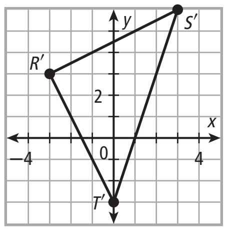
**9. Step 1** Multiply each coord. by $\frac{3}{2}$ to find coords of vertices of $\triangle R'S'T'$.

$R(-2, 2) \rightarrow R'\left(\frac{3}{2}(-2), \frac{3}{2}(2)\right) = R'(-3, 3)$

$S(2, 4) \rightarrow S'\left(\frac{3}{2}(2), \frac{3}{2}(4)\right) = S'(3, 6)$

$T(0, -2) \rightarrow T'\left(\frac{3}{2}(0), \frac{3}{2}(-2)\right) = T'(0, -3)$

**Step 2** Graph $\triangle R'S'T'$.




**Step 3** Use Dist. Formula to find side lengths.

$RS = \sqrt{(2+2)^2 + (4-2)^2} = \sqrt{20} = 2\sqrt{5}$

$R'S' = \sqrt{(3+3)^2 + (6-3)^2} = \sqrt{45} = 3\sqrt{5}$

$ST = \sqrt{(0-2)^2 + (-2-4)^2} = \sqrt{40} = 2\sqrt{10}$

$S'T' = \sqrt{(0-3)^2 + (-3-6)^2} = \sqrt{90} = 3\sqrt{10}$

$RT = \sqrt{(0+2)^2 + (-2-2)^2} = \sqrt{20} = 2\sqrt{5}$

$R'T' = \sqrt{(0+3)^2 + (-3-3)^2} = \sqrt{45} = 3\sqrt{5}$

**Step 4** Find similarity ratio.

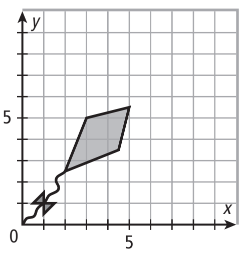
$\frac{R'S'}{RS} = \frac{3\sqrt{5}}{2\sqrt{5}} = \frac{3}{2}, \frac{S'T'}{ST} = \frac{3\sqrt{10}}{2\sqrt{10}} = \frac{3}{2},$

$\frac{R'T'}{RT} = \frac{3\sqrt{5}}{2\sqrt{5}} = \frac{3}{2}$

Since $\frac{R'S'}{RS} = \frac{S'T'}{ST} = \frac{R'T'}{RT}$, $\triangle RST \sim \triangle R'S'T'$ by SSS $\sim$.

***PRACTICE AND PROBLEM SOLVING, PAGE 499***

**10.** Coords. of kite are $A(4, 5)$, $B(9, 7)$, $C(10, 11)$, and $D(6, 10)$.
Coords. of image are $A(2, 2.5)$, $B(4.5, 3.5)$, $C(5, 5.5)$, and $D(3, 5)$.




**11.** $\frac{UO}{XO} = \frac{OV}{OY}$

$\frac{-9}{XO} = \frac{-3}{-8}$

$72 = -3XO$

$XO = -24$

$X$ on $x$-axis $\rightarrow X = (-24, 0)$

$(-9, 0) \rightarrow \left(\frac{8}{3}(-9), \frac{8}{3}(0)\right) = (-24, 0)$, so scale factor is $\frac{8}{3}$.

**12.** $\frac{MO}{KO} = \frac{ON}{OL}$

$\frac{16}{KO} = \frac{-24}{-15}$

$-240 = -24KO$

$KO = 10$

$K$ on $y$-axis $\rightarrow K = (0, 10)$

$(0, 16) \rightarrow \left(\frac{5}{8}(0), \frac{5}{8}(16)\right) = (0, 10)$, so scale factor is $\frac{5}{8}$.

**13.** $DE = \sqrt{2^2 + 4^2} = 2\sqrt{5}$, $DF = \sqrt{4^2 + 4^2} = 4\sqrt{2}$

$DG = \sqrt{3^2 + 6^2} = 3\sqrt{5}$, $DH = \sqrt{6^2 + 6^2} = 6\sqrt{2}$

$\frac{DE}{DG} = \frac{2\sqrt{5}}{3\sqrt{5}} = \frac{2}{3}$, $\frac{DF}{DH} = \frac{4\sqrt{2}}{6\sqrt{2}} = \frac{2}{3}$

$\angle D \cong \angle D$ by Reflex. Prop. of $\cong$. So $\triangle DEF \sim \triangle DGH$ by SAS $\sim$.

**14.** $MN = \sqrt{5^2 + 10^2} = 5\sqrt{5}$, $MP = \sqrt{15^2 + 5^2} = 5\sqrt{10}$

$MQ = \sqrt{10^2 + 20^2} = 10\sqrt{5}$, $MR = \sqrt{30^2 + 10^2} = 10\sqrt{10}$

$\frac{MN}{MQ} = \frac{5\sqrt{5}}{10\sqrt{5}} = \frac{1}{2}$, $\frac{MP}{MR} = \frac{5\sqrt{10}}{10\sqrt{10}} = \frac{1}{2}$

$\angle M \cong \angle M$ by Reflex. Prop. of $\cong$. So $\triangle MNP \sim \triangle MQR$ by SAS $\sim$.

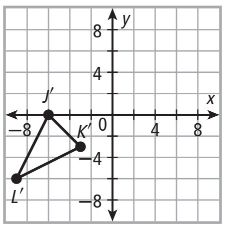
**15. Step 1** Multiply each coord. by 3 to find coords of vertices of $\triangle J'K'L'$.

$J(-2, 0) \rightarrow J'(3(-2), 3(0)) = J'(-6, 0)$

$K(-1, -1) \rightarrow K'(3(-1), 3(-1)) = K'(-3, -3)$

$L(-3, -2) \rightarrow K'(3(-3), 3(-2)) = L'(-9, -6)$

**Step 2** Graph $\triangle J'K'L'$.




**Step 3** Find side lengths.

$JK = \sqrt{1^2 + 1^2} = \sqrt{2}$, $J'K' = \sqrt{3^2 + 3^2} = 3\sqrt{2}$

$KL = \sqrt{2^2 + 1^2} = \sqrt{5}$, $K'L' = \sqrt{6^2 + 3^2} = 3\sqrt{5}$

$JL = \sqrt{1^2 + 2^2} = \sqrt{5}$, $J'L' = \sqrt{3^2 + 6^2} = 3\sqrt{5}$

**Step 4** Verify similarity.

Since $\frac{J'K'}{JK} = \frac{K'L'}{KL} = \frac{J'L'}{JL} = 3$, $\triangle JKL \sim \triangle J'K'L'$ by SSS $\sim$.

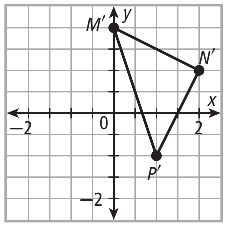
**16. Step 1** Multiply each coord. by $\frac{1}{2}$ to find coords of vertices of $\triangle M'N'P'$.

$M(0, 4) \rightarrow M'\left(\frac{1}{2}(0), \frac{1}{2}(4)\right) = M'(0, 2)$

$N(4, 2) \rightarrow N'\left(\frac{1}{2}(4), \frac{1}{2}(2)\right) = N'(2, 1)$

$P(2, -2) \rightarrow P'\left(\frac{1}{2}(2), \frac{1}{2}(-2)\right) = P'(1, -1)$

**Step 2** Graph $\triangle M'N'P'$.




**Step 3** Find side lengths.

$MN = \sqrt{4^2 + 2^2} = 2\sqrt{5}$, $M'N' = \sqrt{2^2 + 1^2} = \sqrt{5}$

$NP = \sqrt{2^2 + 4^2} = 2\sqrt{5}$, $N'P' = \sqrt{1^2 + 2^2} = \sqrt{5}$

$MP = \sqrt{2^2 + 6^2} = 2\sqrt{10}$, $M'P' = \sqrt{1^2 + 3^2} = \sqrt{10}$

**Step 4** Verify similarity.

Since $\frac{M'N'}{MN} = \frac{N'P'}{NP} = \frac{M'P'}{MP} = \frac{1}{2}$, $\triangle MNP \sim \triangle M'N'P'$ by SSS $\sim$.

**17.** It is not a dilation; it changes shape of transformed figure.

**18.** Solution B is incorrect. Scale factor is ratio of a lin. measure of image to corr. lin. measure of preimage, so scale factor is $\frac{UW}{RT} = \frac{3}{2}$.

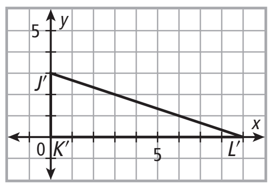
**19.** They are reciprocals. Similarity ratio of $\triangle ABC$ to $\triangle A'B'C'$ is $\frac{AB}{A'B'}$. Scale factor is $\frac{A'B'}{AB}$.

**20a.** Should use origin as vertex of rt. $\angle$; 1 unit reps. 60 cm $\rightarrow$ 3 units rep. 180 cm; so coords. are $J(0, 1)$, $K(0, 0)$, $L(3, 0)$.

**b.** $J \rightarrow J'(3(0), 3(1)) = J'(0, 3)$

$K \rightarrow K'(3(0), 3(0)) = K'(0, 0)$

$L \rightarrow L'(3(3), 3(0)) = L'(9, 0)$




***TEST PREP, PAGE 500***

**21.** A

Check similarity ratio: $\frac{2.4}{4} = \frac{3}{5} = \frac{-6}{-10}$

**22.** H

Perimeter is a lin. measure. So $P' = 2P = 2(60) = 120$.

**23.** A

$AB = 4$, $AC = BC = \sqrt{2^2 + 4^2} = 2\sqrt{5}$

$DE = |3 - 1| = 2$, $DF = EF = \sqrt{1^2 + 2^2} = \sqrt{5}$

$\frac{DE}{AB} = \frac{EF}{BC} = \frac{DF}{AC} = \frac{1}{2}$

**24.** 15

$A \rightarrow A'(3(3), 3(2)) = A'(9, 6)$

$B \rightarrow B'(3(7), 3(5)) = B'(21, 15)$

$A'B' = \sqrt{12^2 + 9^2} = \sqrt{225} = 15$

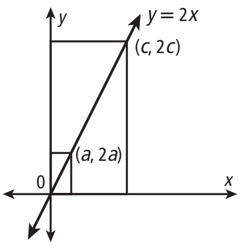
***CHALLENGE AND EXTEND, PAGE 500***

**25.** Possible ~ statements: $\triangle XYZ \sim \triangle MNP$, $\triangle MPN$, $\triangle NMP$, $\triangle NPM$, $\triangle PMN$, or $\triangle PNM$. For each ~ statement, $Z$ could lie either above or below $\overleftrightarrow{XY}$. So there are 2(6) = 12 different △s. They are all different, since $MN$, $NP$, and $MP$ are all ≠.

**26.** scale factor $= \frac{XY}{MP} = \frac{2}{4} = \frac{1}{2}$

From $M$ to $N$ is rise of 2 and run of 1. So from $X$ to $Z$ is *either* rise of 1 and run of $\frac{1}{2}$ *or* rise of −1 and run of $\frac{1}{2}$. Therefore $Z = \left(1 \pm \frac{1}{2}, -2 \pm 1\right) = \left(1\frac{1}{2}, -1\right)$ or $\left(1\frac{1}{2}, -3\right)$.

**27.** All corr. ∠s of rects. are ≅ because they are all rt. ∠s. Suppose 1st rect. has vertex on line $y = 2x$ at $(a, b)$. This pt. is a solution to the eqn., so $b = 2a$, and coords. of vertex are $(a, 2a)$. Similarly, for 2nd rect., coords. of vertex on line $y = 2x$ must be $(c, 2c)$.




1st rect. has dimensions $a$ and $2a$, and 2nd rect. has dimensions $c$ and $2c$. So all ratios of corr. sides $= \frac{c}{a}$. Therefore rects. are ~ by def.

**28.** scale factor $= \frac{DE}{AB} = \frac{6}{3} = 2$

From $A$ to $C$ is rise of 2 and run of 1.

2 positions for $F$ are reflections in horiz. line $\overleftrightarrow{DE}$. So from $D$ to $F$ is rise of ±4 and run of 2. Therefore $F = (1 + 2, -1 \pm 4) = (3, 3)$ or $(3, -5)$.

***SPIRAL REVIEW, PAGE 500***

**29.** Possible answer: $2(50) + 5 + w \geq 250$

$105 + w \geq 250$

**30.** Think: $\triangle DEH \cong \triangle FEH$ by HL. So by CPCTC,

$\overline{HF} \cong \overline{DF}$

$HF = DF = 6.71$

**31.** Think: By Isosc. △ Thm., $\angle EDH \cong \angle EFH$, so by Rt. ∠ ≅ Thm., 3*rd* ∠s Thm, and ASA, $\triangle DFG \cong \triangle FDJ$. So by CPCTC,

$\overline{JF} \cong \overline{GD}$

$JF = GD = 5$

**32.** Think: Use Pyth. Thm.

$CF = \sqrt{CH^2 + HF^2}$

$= \sqrt{2^2 + 6.71^2} \approx 7.00$

**33.** $\frac{RT}{UV} = \frac{RS}{US}$

$\frac{RT}{9} = \frac{6 + 2}{6} = \frac{4}{3}$

$3RT = 36$

$RT = 12$

**34.** $\frac{VT}{VS} = \frac{RU}{US}$

$\frac{x}{x + 3} = \frac{2}{6} = \frac{1}{3}$

$3x = x + 3$

$2x = 3$

$x = 1.5$

$VT = x = 1.5$

**35.** $ST = SV + VT$

$= x + 3 + x$

$= 2x + 3$

$= 2(1.5) + 3 = 6$

## DIRECT VARIATION, PAGE 501

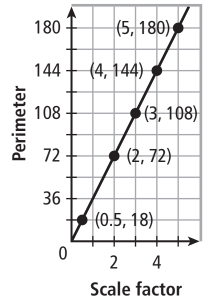
### TRY THIS, PAGE 501

**1. Step 1** Make a table to record data.

| Scale Factor $x$ | Side Length $s = x(6)$ | Perimeter $P = 6s$ |
|---|---|---|
| $\frac{1}{2}$ | 3 | 18 |
| 2 | 12 | 72 |
| 3 | 18 | 108 |
| 4 | 24 | 144 |
| 5 | 30 | 180 |

**Step 2** Graph pts.

Since pts. are collinear and line that contains them includes origin, relationship is a direct variation.




**Step 3** Find eqn. of direct variation.

$y = kx$

$180 = k(5)$

$36 = k$

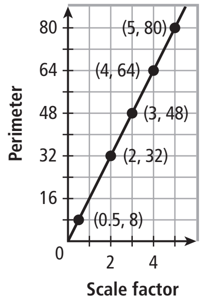
Thus constant of variation is 36.

**2. Step 1** Make a table to record data.

| Scale Factor $x$ | Side Lengths $a = x(3)$ | $b = x(6)$ | $c = x(7)$ | Perimeter $P = a + b + c$ |
|---|---|---|---|---|
| $\frac{1}{2}$ | $1\frac{1}{2}$ | 3 | $3\frac{1}{2}$ | 8 |
| 2 | 6 | 12 | 14 | 32 |
| 3 | 9 | 18 | 21 | 48 |
| 4 | 12 | 24 | 28 | 64 |
| 5 | 15 | 30 | 35 | 80 |

**Step 2** Graph pts.

Since pts. are collinear and line that contains them includes origin, relationship is a direct variation.




**Step 3** Find eqn. of direct variation.

$y = kx$
$80 = k(5)$
$k = 16$

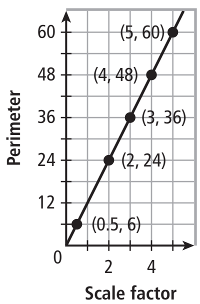
Thus constant of variation is 16.

**3. Step 1** Make a table to record data.

| Scale Factor $x$ | Side Length $s = x(3)$ | Perimeter $P = 4s$ |
|---|---|---|
| $\frac{1}{2}$ | $1\frac{1}{2}$ | 6 |
| 2 | 6 | 24 |
| 3 | 9 | 36 |
| 4 | 12 | 48 |
| 5 | 15 | 60 |

**Step 2** Graph pts.

Since pts. are collinear and line that contains them includes origin, relationship is a direct variation.




**Step 3** Find eqn. of direct variation.

$y = kx$
$60 = k(5)$
$k = 12$

Thus constant of variation is 12.

## MULTI-STEP TEST PREP, PAGE 502

**1.** $\frac{EG}{FH} = \frac{GJ}{HK} = \frac{JC}{KC} = \frac{AE}{BF} = \frac{42.2}{40} = 1.055$

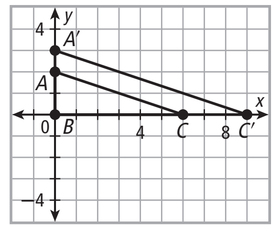
$EG = 1.055FH$
$= 1.055(40) = 42.2$ cm
$GJ = 1.055HK$
$= 1.055(35) \approx 36.9$ cm
$JC = 1.055KC$
$= 1.055(35) \approx 36.9$ cm

**2.** area of $\triangle ABC = \frac{1}{2}(BC)(AB)$
$= \frac{1}{2}(40 + 40 + 35 + 35)(50)$
$= 3750 \text{ cm}^2$

Think: Use Proportional Perimeters and Areas Thm.

area of drawing = (scale factor)$^2$(area of $\triangle ABC$)
$= \left(\frac{1}{25}\right)^2(3750)$
$= \frac{1}{625}(3750) = 6 \text{ cm}^2$

**3.**




## 7B READY TO GO ON?, PAGE 503

**1.** $\frac{ST}{QT} = \frac{RT}{PT}$

$\frac{ST}{ST + 16} = \frac{14}{14 + 12}$
$26ST = 14(ST + 16)$
$26ST = 14ST + 224$
$12ST = 224$
$ST = 18\frac{2}{3}$

**2.** $\frac{AB}{AC} = \frac{BD}{CD}$

$\frac{4y - 1}{5y} = \frac{6}{8}$
$8(4y - 1) = 6(5y)$
$32y - 8 = 30y$
$2y = 8$
$y = 4$
$AB = 4(4) - 1 = 15$
$AC = 5(4) = 20$

**3.** $\frac{FH}{EG} = \frac{HK}{GJ}$

$\frac{FH}{3.6} = \frac{2}{2.4}$
$2.4FH = 7.2$
$FH = 3$ cm

**4.** $\frac{\text{plan length of } \overline{AB}}{AB} = \frac{0.25}{AB} = \frac{1.5}{60}$

$15 = 1.5AB$
$AB = 10$ ft

**5.** $\frac{\text{plan length of } \overline{BC}}{BC} = \frac{0.75}{BC} = \frac{1.5}{60}$

$45 = 1.5BC$
$BC = 30$ ft

**6.** $\frac{\text{plan length of } \overline{CD}}{CD} = \frac{1}{CD} = \frac{1.5}{60}$

$60 = 1.5CD$
$CD = 40$ ft

**7.** $\frac{\text{plan length of } \overline{EF}}{EF} = \frac{0.5}{EF} = \frac{1.5}{60}$

$30 = 1.5EF$

$EF = 20$ ft

**8.** 5 ft 3 in. = 5(12) + 3 in. = 63 in.

5 ft 10 in. = 5(12) + 10 in. = 70 in.

40 ft = 40(12) in. = 480 in.

$\frac{h}{63} = \frac{480}{70}$

$70h = 63(480)$

$h = 432$ in. $= 36$ ft

**9.** By the Dist. Formula:

$AD = \sqrt{1^2 + 2^2} = \sqrt{5}$; $AB = \sqrt{2^2 + 4^2} = 2\sqrt{5}$

$AE = \sqrt{2^2 + 1^2} = \sqrt{5}$; $AC = \sqrt{4^2 + 2^2} = 2\sqrt{5}$

$\angle A \cong \angle A$ by the Reflex. Prop. of $\cong$.

By SAS ~, $\triangle ADE \sim \triangle ABC$.

**10.** By the Dist. Formula:

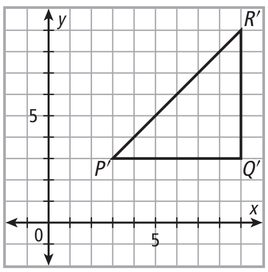
$RS = \sqrt{2^2 + 1^2} = \sqrt{5}$; $RU = \sqrt{4^2 + 2^2} = 2\sqrt{5}$

$RT = |-3 - 0| = 3$; $RV = |6 - 0| = 6$

$\frac{RS}{RU} = \frac{RT}{RV} = \frac{1}{2}$. $\angle SRT \cong \angle URV$ by the Vert. $\angle$s Thm.

By SAS ~, $\triangle RST \sim \triangle RUV$.

**11.**



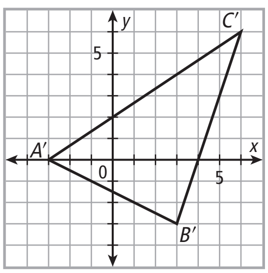

$PQ = QR = 2$; $P'Q' = Q'R' = 6$

$PR = \sqrt{2^2 + 2^2} = 2\sqrt{2}$; $P'R' = \sqrt{6^2 + 6^2} = 6\sqrt{2}$

$\frac{P'Q'}{PQ} = \frac{Q'R'}{QR} = \frac{6}{2} = 3$; $\frac{P'R'}{PR} = \frac{6\sqrt{2}}{2\sqrt{2}} = 3$

By SSS ~, $\triangle P'Q'R' \sim \triangle PQR$.

**12.**




$AB = \sqrt{4^2 + 2^2} = 2\sqrt{5}$; $A'B' = \sqrt{6^2 + 3^2} = 3\sqrt{5}$

$BC = \sqrt{2^2 + 6^2} = 2\sqrt{10}$; $B'C' = \sqrt{3^2 + 9^2} = 3\sqrt{10}$

$AC = \sqrt{6^2 + 4^2} = 2\sqrt{13}$; $A'C' = \sqrt{9^2 + 6^2} = 3\sqrt{13}$

$\frac{A'B'}{AB} = \frac{B'C'}{BC} = \frac{A'B'}{AB} = \frac{3}{2}$

By SSS ~, $\triangle A'B'C' \sim \triangle ABC$.

## STUDY GUIDE: REVIEW, PAGES 504–507

**1.** proportion

**2.** dilation

**3.** means

**4.** ratio

### LESSON 7-1, PAGE 504

**5.** slope of $m = \frac{1}{5}$

**6.** slope of $n = \frac{-3}{6} = -\frac{1}{2}$

**7.** slope of $p = \frac{6}{4} = \frac{3}{2}$

**8.** Let $x$, $y$ be the largest and smallest parts respectively.

$\frac{x + y}{84} = \frac{6 + 3}{3 + 5 + 6}$

$x + y = \frac{84(9)}{14}$

$x + y = 54$

The sum of the smallest and largest parts is 54.

**9.** $\frac{\ell}{w} = \frac{7}{12}$

$\ell = \frac{7}{12}w$

$P = 2\ell + 2w$

$= 2\left(\frac{7}{12}w\right) + 2w$

$6P = 7w + 12w$

$6(95) = 19w$

$w = 30$

$\ell = \frac{7}{12}(30) = 17.5$

Side lengths are 17.5, 30, 17.5, 30.

**10.** $\frac{y}{7} = \frac{9}{3}$

$3y = 63$

$y = 21$

**11.** $\frac{10}{4} = \frac{25}{s}$

$10s = 100$

$s = 10$

**12.** $\frac{x}{4} = \frac{9}{x}$

$x^2 = 36$

$x = \pm 6$

**13.** $\frac{4}{z - 1} = \frac{z - 1}{36}$

$144 = (z - 1)^2$

$z - 1 = \pm 12$

$z = 1 \pm 12$

$= 13$ or $-11$

**14.** $\frac{12}{2x} = \frac{3x}{32}$

$384 = 6x^2$

$x^2 = 64$

$x = \pm 8$

**15.** $\frac{y + 1}{24} = \frac{2}{3(y + 1)}$

$3(y + 1)^2 = 48$

$(y + 1)^2 = 16$

$y + 1 = \pm 4$

$y = -1 \pm 4$

$= 3$ or $-5$

### LESSON 7-2, PAGE 505

**16.** $\frac{JK}{PQ} = \frac{8}{4.8} = \frac{5}{3}$; $\frac{JM}{PS} = \frac{5}{3}$; all $\angle$s are rt $\angle$s, so $\cong$

yes, by def. of ~; ~ ratio $= \frac{5}{3}$; $JKLM \sim PQRS$

**17.** yes, by AA ~; ~ ratio $= \frac{TU}{WX} = \frac{12}{6} = 2$;

$\triangle TUV \sim \triangle WXY$

## LESSON 7-3, PAGE 505

**18.**

| Statements | Reasons |
|---|---|
| 1. $JL = \frac{1}{3}JN$, $JK = \frac{1}{3}JM$ | 1. Given |
| 2. $\frac{JL}{JN} = \frac{1}{3}$, $\frac{JK}{JM} = \frac{1}{3}$ | 2. Div. Prop. of = |
| 3. $\frac{JL}{JN} = \frac{JK}{JM}$ | 3. Trans. Prop. of = |
| 4. $\angle J \cong \angle J$ | 4. Reflex. Prop. of ≅ |
| 5. $\triangle JKL \sim \triangle JMN$ | 5. SAS ~ *Steps 3, 4* |

**19.**

| Statements | Reasons |
|---|---|
| 1. $\overline{QR} \parallel \overline{ST}$ | 1. Given |
| 2. $\angle RQP \cong \angle STP$ | 2. Alt. Int. ∠s Thm. |
| 3. $\angle RPQ \cong \angle SPT$ | 3. Vert. ∠s Thm. |
| 4. $\triangle PQR \sim \triangle PTS$ | 4. AA ~ *Steps 2, 3* |

**20.**

| Statements | Reasons |
|---|---|
| 1. $\overline{BC} \parallel \overline{CE}$ | 1. Given |
| 2. $\angle ABD \cong \angle C$ | 2. Corr. ∠s Post. |
| 3. $\angle ADB \cong \angle E$ | 3. Corr. ∠s Post. |
| 4. $\triangle ABD \sim \triangle ACE$ | 4. AA ~ *Steps 2, 3* |
| 5. $\frac{AB}{AC} = \frac{BD}{CE}$ | 5. Def. of ~ polygons |
| 6. $AB(CE) = AC(BD)$ | 6. Cross Products Prop. |

## LESSON 7-4, PAGE 506

**21.** $\frac{CE}{15} = \frac{8}{12}$
$12CE = 120$
$CE = 10$

**22.** $\frac{ST}{10} = \frac{3}{9}$
$9ST = 30$
$ST = 3\frac{1}{3}$

**23.** $\frac{JK}{JM} = \frac{JL}{JN} = \frac{1}{2}$
Since $\frac{JK}{JM} = \frac{JL}{JN}$
$\overline{KL} \parallel \overline{MN}$ by Conv. of △ Prop. Thm.

**24.** $EC/EA = \frac{ED}{EB} = \frac{3}{7}$
Since $\frac{EC}{EA} = \frac{ED}{EB}$
$\overline{AB} \parallel \overline{CD}$ by Conv. of △ Prop. Thm.

**25.** $\frac{SU}{RU} = \frac{SV}{RV}$
$\frac{y+1}{8} = \frac{2y}{12}$
$12(y + 1) = 8(2y)$
$12y + 12 = 16y$
$12 = 4y$
$y = 3$
$SU = 3 + 1 = 4$
$SV = 2(3) = 6$

**26.** $\frac{x+6}{30} = \frac{2x}{24}$
$24(x + 6) = 30(2x)$
$24x + 144 = 60x$
$144 = 36x$
$x = 4$
$AB = x + 6 + 2x$
$= 3x + 6$
$= 3(4) + 6 = 18$

**27.** $P = a + b + c$ where $b = a + x$, $c = 3 + 5 = 8$
$\frac{3}{a} = \frac{5}{a+x}$
$3(a + x) = 5a$
$3a + 3x = 5a$
$2a = 3x$
$P = a + a + x + 8$
$= 2a + x + 8$
$= 4x + 8$

## LESSON 7-5, PAGE 507

**28.** 3 ft = 3(12) in. = 36 in.
5 ft 4 in. = 5(12) + 4 in. = 64 in.
14 ft 3 in. = 14(12) + 3 in. = 171 in.
$\frac{x}{64} = \frac{171}{36}$
$36x = 10{,}944$
$x = 304$ in. = 25 ft 4 in.

**29.** $\frac{6}{x} = \frac{12}{3+x}$
$6(3 + x) = 12x$
$18 + 6x = 12x$
$18 = 6x$
$x = 3$ ft

## LESSON 7-6, PAGE 507

**30.** By the Dist. Formula:
$RS = \sqrt{2^2 + 2^2} = 2\sqrt{2}$; $RU = \sqrt{4^2 + 4^2} = 4\sqrt{2}$
$RT = \sqrt{1^2 + 3^2} = \sqrt{10}$; $RV = \sqrt{2^2 + 6^2} = 2\sqrt{10}$
$\frac{RS}{RU} = \frac{RT}{RV} = \frac{1}{2}$. $\angle R \cong \angle R$ by the Reflex. Prop. of ≅.
So $\triangle RST \sim \triangle RUV$ by SAS ~.

**31.** By the Dist. Formula:
$JK = \sqrt{2^2 + 1^2} = \sqrt{5}$; $JM = \sqrt{8^2 + 4^2} = 4\sqrt{5}$
$JL = |2 - 4| = 2$; $JN = |-4 - 4| = 8$
$\frac{JK}{JM} = \frac{JL}{JN} = \frac{1}{4}$. $\angle J \cong \angle J$ by the Reflex. Prop. of ≅.
So $\triangle JKL \sim \triangle JMN$ by SAS ~.

**32.** $\frac{AO}{CO} = \frac{OB}{OD}$
$\frac{12}{18} = \frac{OB}{-9}$
$-108 = 18OB$
$OB = -6$
Since $x$-coord. of $B$ is 0, $B = (0, -6)$.
Scale factor $= \frac{12}{18} = \frac{2}{3}$.

**33.** Image vertices are $K'(0, 9)$, $L'(0, 0)$, $M'(12, 0)$.
By the Dist. Formula:
$KL = 3$; $K'L' = 9$; $LM = 4$; $L'M' = 12$
$KM = \sqrt{3^2 + 4^2} = 5$; $K'M' = \sqrt{9^2 + 12^2} = 15$
All proportions = 3, so $\triangle KLM \sim \triangle K'L'M'$ by SSS ~.

## CHAPTER TEST, PAGE 508

**1.** slope of $\ell = \frac{-6 - 4}{10 + 6} = -\frac{5}{8}$

**2.** $\frac{5}{8} = \frac{3.5}{w}$
$5w = 28$
$w = 5.6$ in.

**3.** $\angle B \cong \angle N$ and $\angle C \cong \angle P$; yes, by AA ~;
~ ratio $= \frac{AB}{MN} = \frac{40}{60} = \frac{2}{3}$; $\triangle ABC \sim \triangle MNP$

4. $\frac{DE}{HJ} = \frac{55}{22} = \frac{5}{2}; \frac{DG}{HL} = \frac{40}{16} = \frac{5}{2}$
yes; since all ∠s are rt. ∠s and therefore ≅;
$\sim$ ratio $= \frac{5}{2}$; $DEFG \sim HJKL$ by def.

5.

| Statements | Reasons |
|---|---|
| 1. *RSTU* is a ▱. | 1. Given |
| 2. $\overline{RU} \parallel \overline{ST}$ | 2. Def. of ▱ |
| 3. $\angle VRW \cong \angle TSW$ | 3. Alt. Int. ∠s Thm. |
| 4. $\angle RWV \cong \angle SWT$ | 4. Vert ∠s Thm. |
| 5. $\triangle RWV \sim \triangle SWT$ | 5. AA ~ *Steps 3, 4* |

6. $\frac{CD}{AB} = \frac{DG}{BG}$
$\frac{CD}{2.5} = \frac{6}{9}$
$9CD = 2.5(6) = 15$
$CD \approx 1.7$ ft
$\frac{EF}{AB} = \frac{FG}{BG}$
$\frac{EF}{2.5} = \frac{3}{9}$
$9FG = 7.5$
$FG \approx 0.8$ ft

7. $\frac{PR}{21} = \frac{10}{18}$
$18PR = 210$
$PR = 11\frac{2}{3}$

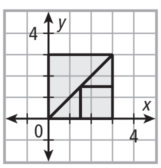
8. $\frac{YW}{XY} = \frac{WZ}{XZ}$
$\frac{\frac{t}{2}}{8} = \frac{t-2}{12.8}$
$12.8\left(\frac{t}{2}\right) = 8(t-2)$
$6.4t = 8t - 16$
$16 = 1.6t$
$t = 10$
$YW = \frac{t}{2} = 5$
$WZ = t - 2 = 8$

9. 5 ft 8 in. = 5(12) + 8 in. = 68 in.
3 ft = 36 in.; 27 ft = 324 in.
$\frac{h}{68} = \frac{324}{36} = 9$
$h = 68(9) = 612$ in. $= 51$ ft

10. $\frac{\text{plan length of } \overline{AB}}{AB} = \frac{1.5}{30}$
$\frac{1.25}{AB} = \frac{1.5}{30}$
$37.5 = 1.5AB$
$AB = 25$ ft

11. By the Dist. Formula:
$AB = \sqrt{3^2 + 1^2} = \sqrt{10}$; $AD = \sqrt{9^2 + 3^2} = 3\sqrt{10}$
$AC = |3 - 5| = 2$; $AE = |-1 - 5| = 6$
$\frac{AB}{AD} = \frac{AC}{AE} = \frac{1}{3}$. $\angle A \cong \angle A$ by the Reflex. Prop. of ≅.
So $\triangle JKL \sim \triangle JMN$ by SAS ~.

12.




## COLLEGE ENTRANCE EXAM PRACTICE, PAGE 509

1. A
$\frac{BC}{CD} = \frac{AB}{DE}$
$\frac{BC}{9 - BC} = \frac{4}{8} = \frac{1}{2}$
$2BC = 9 - BC$
$3BC = 9$
$BC = 3$
Since $\overline{BD}$ is horiz., *y*-coord. of *C* is 1;
so $C = (1 + 3, 1) = (4, 1)$.

2. C
$\frac{x}{21} = \frac{6}{14}$
$14x = 126$
$x = 9$

3. D; $x + y + z = 750{,}000$ and $x:y:z = 4:5:6$
$\frac{z}{750{,}000} = \frac{6}{4 + 5 + 6} = \frac{2}{5}$
$5z = 1{,}500{,}000$
$z = 300{,}000$

4. D
$\frac{35}{9} = \frac{h}{1.2}$
$42 = 9h$
$h = 4\frac{2}{3}$ ft = 4 ft 8 in.

5. D
In any square, all ∠s are rt ∠s, so ≅; all sides are ≅.