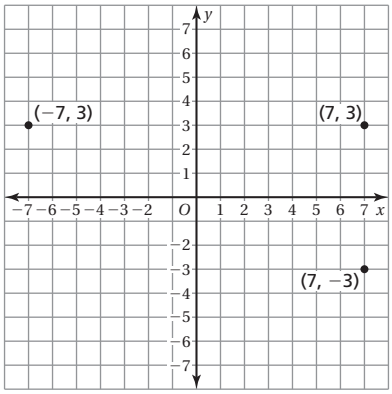
Chapter 2

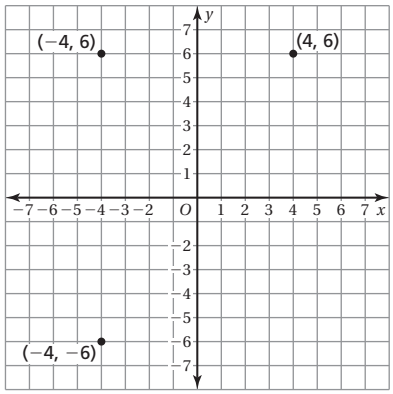
Chapter 2 Opener

Try It Yourself (p. 41)

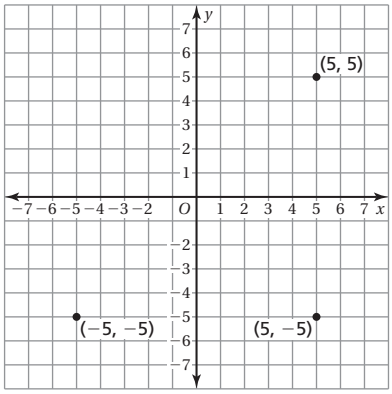
1. a. $(7, -3)$ **b.** $(-7, 3)$



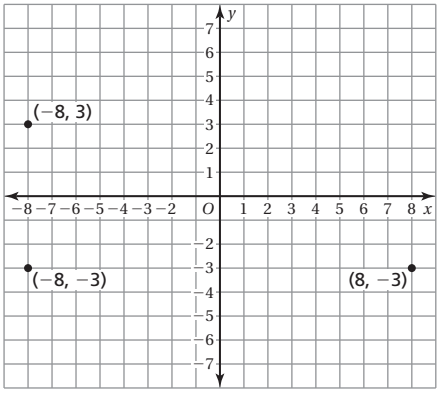
2. a. $(-4, -6)$ **b.** $(4, 6)$



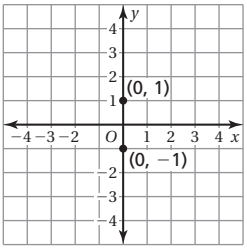
3. a. $(5, 5)$ **b.** $(-5, -5)$



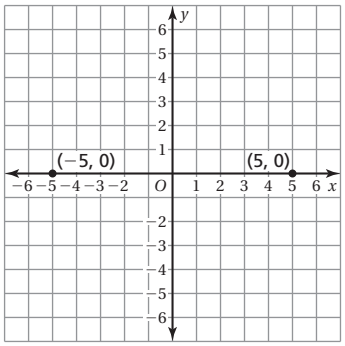
4. a. $(-8, 3)$ **b.** $(8, -3)$



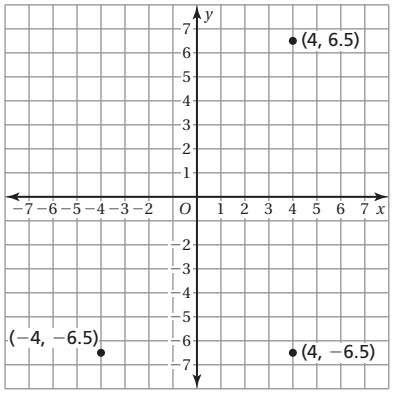
5. a. $(0, -1)$ **b.** $(0, 1)$



6. a. $(-5, 0)$ **b.** $(5, 0)$



7. a. $(4, 6.5)$ **b.** $(-4, -6.5)$



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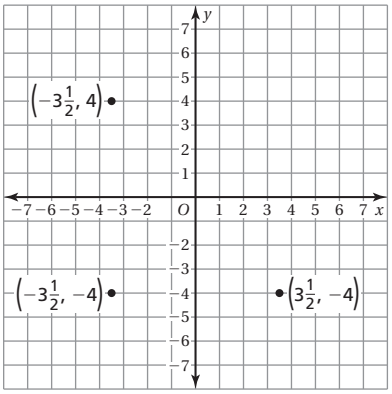
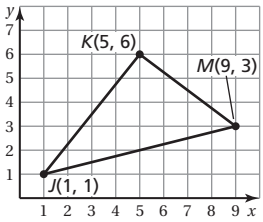
Chapter 2

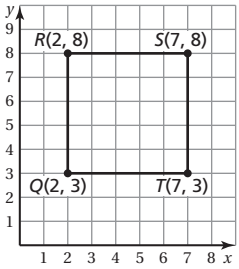
8. a. $\left(-3\frac{1}{2}, 4\right)$ **b.** $\left(3\frac{1}{2}, -4\right)$



9.



10.



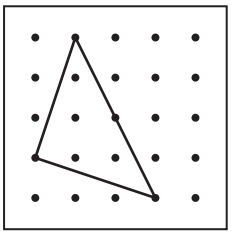
Section 2.1

2.1 Activity (pp. 42–43)

1. *Answer should include, but is not limited to:* Students will form each triangle on a geoboard, measure each side to the nearest millimeter, use their measurements to determine that triangles (a) and (e) are congruent to the yellow triangle, and conclude that the side lengths of congruent triangles are also congruent.

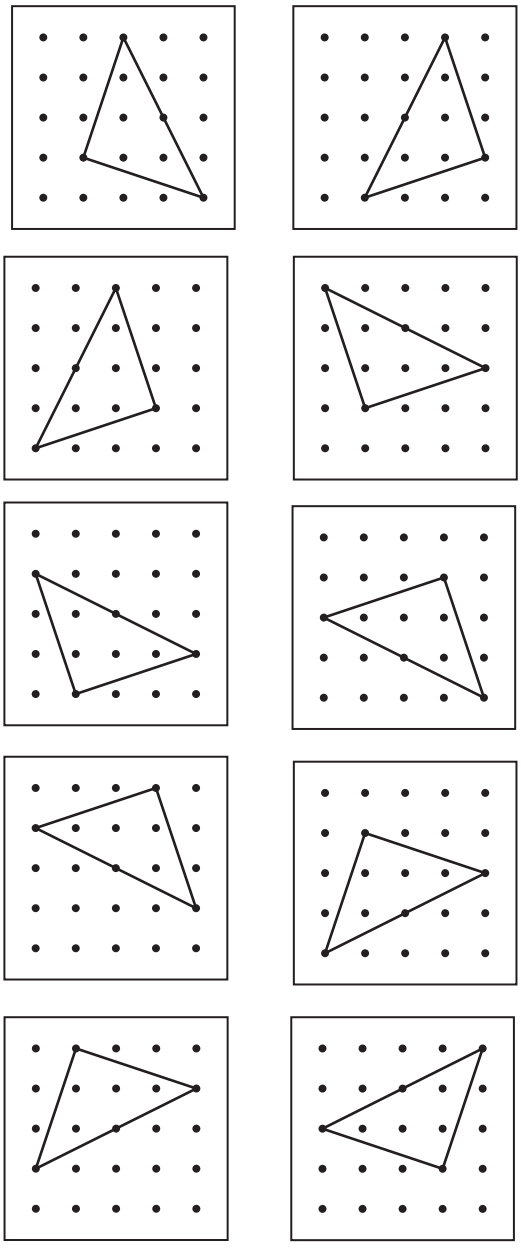
	Side 1	Side 2	Side 3
Given triangle	126 mm	126 mm	180 mm
a	126 mm	126 mm	180 mm
b	120 mm	120 mm	170 mm
c	165 mm	126 mm	200 mm
d	165 mm	126 mm	200 mm
e	126 mm	126 mm	180 mm
f	115 mm	115 mm	160 mm

2. a.



b. yes; *Sample answer:* The new triangle is congruent to the original triangle because the side lengths of the new triangle have the same measures as the side lengths of the original triangle.

c.



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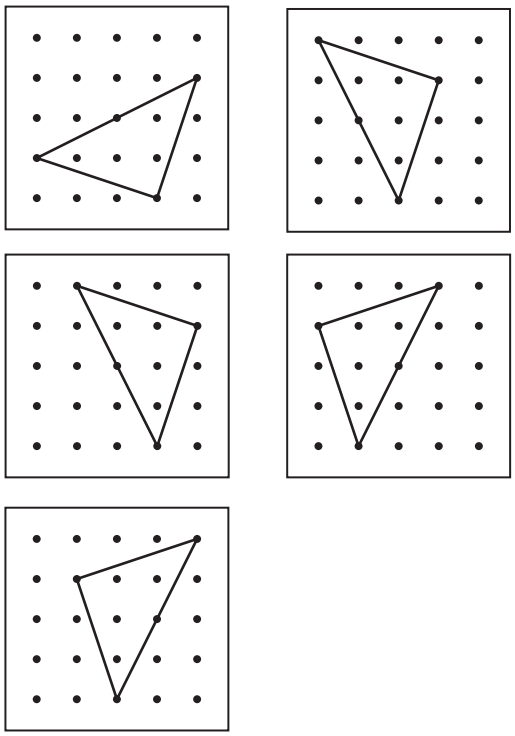
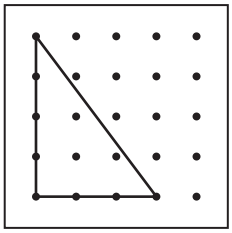
Chapter 2



3. You can identify congruent triangles by checking the measures of their side lengths. Congruent triangles have congruent sides.

4. Yes, it is possible to form a triangle whose side lengths are 3, 4, and 5 units on a geoboard. *Sample answer:* To verify this, form a triangle that has horizontal and vertical side lengths of 3 and 4 units. Measure the distance between 2 pins and mark it as one geoboard unit. Then, use your ruler to measure the unknown side length of your triangle. It should have a measure of 5 geoboard units.



2.1 On Your Own (pp. 44–45)

1. Corresponding angles: $\angle J$ and $\angle S$, $\angle K$ and $\angle R$, $\angle L$ and $\angle Q$, $\angle M$ and $\angle V$, $\angle N$ and $\angle T$

Corresponding sides: Side *JK* and Side *SR,* Side *KL* and Side *RQ,* Side *LM* and Side *QV,* Side *MN* and Side *VT,* Side *NJ* and Side *TS*

2. Each square has four right angles. So, corresponding angles are congruent. Each side length of Square A is 8 and each side length of Square D is 9. So, corresponding sides are not congruent. Each side length of Square C is 8 and each side length of Square D is 9. So, corresponding sides are not congruent. Each side length of Square B and Square D is 9. So, corresponding sides are congruent. Square B is congruent to Square D.

3. $\angle L$ corresponds to $\angle C$.

Side *KJ* corresponds to Side *BA*. So, the length of Side *KJ* is 8 feet.

2.1 Exercises (pp. 46–47)

Vocabulary and Concept Check

1. a. Corresponding angles: $\angle A$ and $\angle D$, $\angle B$ and $\angle E$, $\angle C$ and $\angle F$

b. Corresponding sides: Side *AB* and Side *DE,* Side *BC* and Side *EF,* Side *AC* and Side *DF*

2. Two figures are congruent when they have the same size and the same shape.

3. $\angle V$ does not belong. The other three angles are congruent to each other, but not to $\angle V$.

Practice and Problem Solving

4. The triangles have the same shape, but not the same size. So, the triangles are not congruent.

5. The triangles have the same size and shape, so the triangles are congruent.

6. Corresponding angles: $\angle A$ and $\angle J$, $\angle B$ and $\angle K$, $\angle C$ and $\angle L$, $\angle D$ and $\angle M$

Corresponding sides: Side *AB* and Side *JK,* Side *BC* and Side *KL,* Side *CD* and Side *LM,* Side *DA* and Side *MJ*

7. Corresponding angles: $\angle P$ and $\angle W$, $\angle Q$ and $\angle V$, $\angle R$ and $\angle Z$, $\angle S$ and $\angle Y$, $\angle T$ and $\angle X$

Corresponding sides: Side *PQ* and Side *WV,* Side *QR* and Side *VZ,* Side *RS* and Side *ZY,* Side *ST* and Side *YX,* Side *TP* and Side *XW*

8. The two triangles are congruent because their corresponding angles and corresponding sides are congruent.

9. The two rectangles are not congruent because their corresponding sides are not congruent.

10. The missing piece and the unfinished portion of the puzzle have the same size and the same shape. So, the unfinished portion of the puzzle and the missing piece are congruent.

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11. Corresponding side lengths *and* corresponding angles must be congruent in order for the two figures to be congruent. The error is claiming that because the corresponding side lengths are equal, the figures are congruent. The corresponding angles are not congruent, so the figures are not congruent.

12. a. Side LM corresponds to Side CD. So, the length of Side LM is 32 feet.

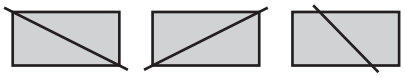
b. $\angle M$ corresponds to $\angle D$.

c. Side AE corresponds to Side JN. So, the length of Side AE is 20 feet. Side AB is congruent to Side AE. So, the length of Side AB is 20 feet.

d. The perimeter of $ABCDE$ is $32 + 12 + 20 + 20 + 12 = 96$ feet.

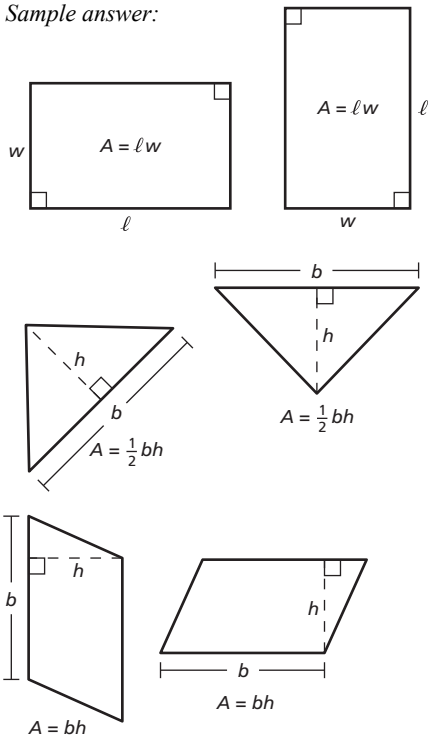
13. Any line that divides the rectangle into two equal parts forms two congruent figures.

Sample answer:



14. yes; The dimensions of congruent figures are equal, so the areas of the figures are equal.

Sample answer:



15. a. true; Side AB corresponds to Side YZ. Because the trapezoids are congruent, their corresponding side lengths are congruent.

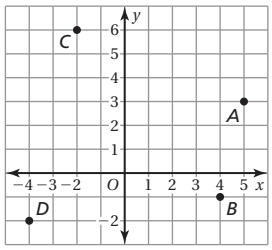
b. true; $\angle A$ and $\angle X$ are both right angles, so they have the same measure.

c. false; $\angle A$ corresponds to $\angle Y$.

d. true; $\angle A$ corresponds to $\angle Y$. So, $\angle A$ has a measure of 90°. $\angle B$ has a measure of 140°. $\angle C$ corresponds to $\angle W$. So, $\angle C$ has a measure of 40°. The measure of $\angle D$ is 90°. The sum of the angle measures of $ABCD$ is $90° + 140° + 40° + 90° = 360°$.

Fair Game Review

16–19.



20. B; You have 2 quarters and 5 dimes, so you have a total of $2 + 5 = 7$ coins.

$$\frac{\text{number of quarters}}{\text{total number of coins}} = \frac{2}{7}, \text{ or } 2 : 7$$

The ratio of quarters to the total number of coins is 2 : 7.

Section 2.2

2.2 Activity (pp. 48–49)

1. b. yes;

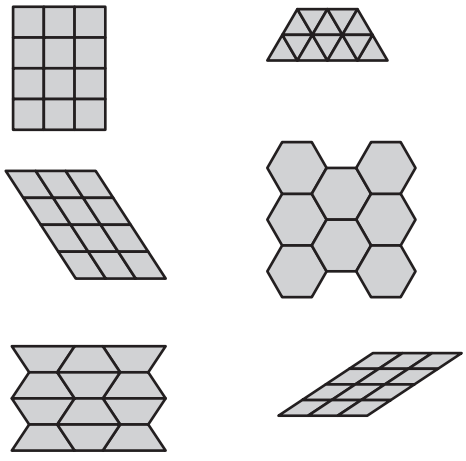
Sample answer:

c. yes;

Sample answer:

2. a. all of them;

Sample answer:



b. The tessellations for the square, parallelograms, and hexagon can be made using only translations. For the triangle and trapezoid, you would have to rotate or flip the pattern blocks to make a tessellation.

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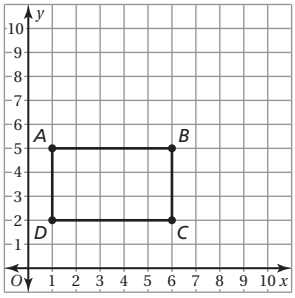
Chapter 2

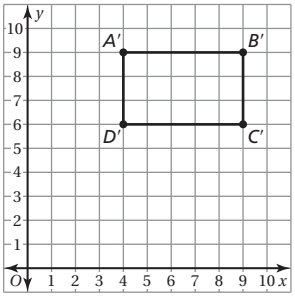
3. *Answer should include, but is not limited to:* Students will design and draw a tessellation. Students will use the sample given as a guide. The tessellation will not have any gaps. Students will neatly color their tessellation.

4. a. *Sample answer*:



5 units long and 3 units wide

b. *Based on sample answer*:



$(4, 9), (9, 9), (9, 6), (4, 6)$

c. *Based on sample answer*: The new and original rectangles are 5 units long and 3 units wide and have four right angles.

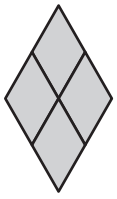
d. yes; Each pair of sides are either horizontal or vertical line segments.

e. yes; *Based on sample answer*: The figures are the same size, 5 units long and 3 units wide, and have the same angle measures, four right angles.

f. yes; All the translated figures remain congruent.

5. A tessellation can be created by translating a tile or design many times so that there are no empty spaces between the tiles.

Sample answer:



6. Any parallelogram can be used with translations to make a tessellation because no matter how you slide them, the parallel sides allow the shapes to fit together nicely without any empty spaces.

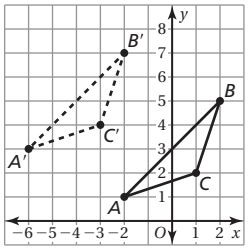
2.2 On Your Own (pp. 50–51)

1. The red figure expands to form the blue figure. So, the blue figure is not a translation of the red figure.

2. The red figure flips to form the blue figure. So, the blue figure is not a translation of the red figure.

3. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

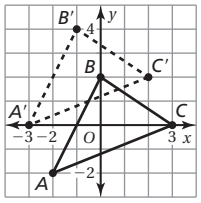
4.



The coordinates of the image are $A'(-6, 3)$, $B'(-2, 7)$, and $C'(-3, 4)$.

5.

Vertices of ABC	$(x - 1, y + 2)$	Vertices of $A'B'C'$
$A(-2, -2)$	$(-2 - 1, -2 + 2)$	$A'(-3, 0)$
$B(0, 2)$	$(0 - 1, 2 + 2)$	$B'(-1, 4)$
$C(3, 0)$	$(3 - 1, 0 + 2)$	$C'(2, 2)$



2.2 Exercises (pp. 52–53)

Vocabulary and Concept Check

1. Figure A is the image.

2. To translate a figure in a coordinate plane, move each vertex of the figure the indicated number of units left or right and/or up or down.

3. yes; You can slide the T and the first O to the right to form the word KYOTO.

Practice and Problem Solving

4. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

5. The red figure turns to form the blue figure. So, the blue figure is not a translation of the red figure.

6. The red figure turns to form the blue figure. So, the blue figure is not a translation of the red figure.

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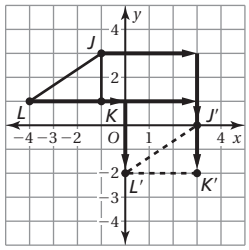
7. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

8. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

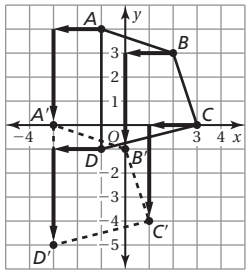
9. The red figure increases in size to form the blue figure. So, the blue figure is not a translation of the red figure.

10.



The coordinates of the image are $J'(3, 0)$, $K'(3, -2)$, $L'(0, -2)$.

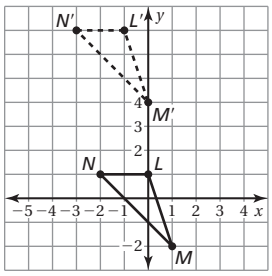
11.



The coordinates of the image are $A'(-3, 0)$, $B'(0, -1)$, $C'(1, -4)$, and $D'(-3, -5)$.

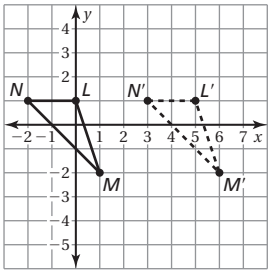
12.

Vertices of LMN	$(x - 1, y + 6)$	Vertices of $L'M'N'$
$L(0, 1)$	$(0 - 1, 1 + 6)$	$L'(-1, 7)$
$M(1, -2)$	$(1 - 1, -2 + 6)$	$M'(0, 4)$
$N(-2, 1)$	$(-2 - 1, 1 + 6)$	$N'(-3, 7)$



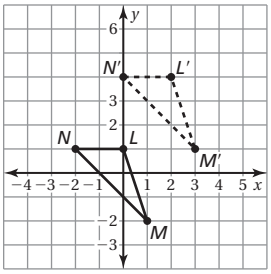
13.

Vertices of LMN	$(x + 5, y)$	Vertices of $L'M'N'$
$L(0, 1)$	$(0 + 5, 1)$	$L'(5, 1)$
$M(1, -2)$	$(1 + 5, -2)$	$M'(6, -2)$
$N(-2, 1)$	$(-2 + 5, 1)$	$N'(3, 1)$



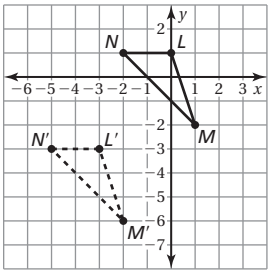
14.

Vertices of LMN	$(x + 2, y + 3)$	Vertices of $L'M'N'$
$L(0, 1)$	$(0 + 2, 1 + 3)$	$L'(2, 4)$
$M(1, -2)$	$(1 + 2, -2 + 3)$	$M'(3, 1)$
$N(-2, 1)$	$(-2 + 2, 1 + 3)$	$N'(0, 4)$



15.

Vertices of LMN	$(x - 3, y - 4)$	Vertices of $L'M'N'$
$L(0, 1)$	$(0 - 3, 1 - 4)$	$L'(-3, -3)$
$M(1, -2)$	$(1 - 3, -2 - 4)$	$M'(-2, -6)$
$N(-2, 1)$	$(-2 - 3, 1 - 4)$	$N'(-5, -3)$



16. yes; When you click and drag an icon, the icon slides and does not change size or shape.

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Chapter 2

17. Because $3 - 2 = 1$ and $-2 + 2 = 0$, the figure is translated two units left and two units up.

18. Because $-8 + 5 = -3$ and $-4 + 9 = 5$, the figure is translated five units right and nine units up.

19. Each vertex is translated six units right and three units down.

20. Each vertex is translated five units left and two units down.

21. a. The school of fish translates five units right and one unit up.

b. no; The fishing boat cannot make a similar translation because it would hit the island.

c. For the fishing boat to get from point B to point D, it should translate four units up and four units right.

22. yes; You can write one translation to get from the original triangle to the final triangle, which is $(x + 2, y - 10)$.

So, the triangles are congruent. You can also measure the sides and angles to determine that the triangles are congruent.

23. *Sample answer:*

1. Move two units down to g6, then move one unit left to f6.
2. Move one unit left to e6, then move two units down to e4.
3. Move two units right to g4, then move one unit up to g5.

Fair Game Review

24. The figure can be folded in half vertically or horizontally so that one side matches the other.

25. The figure cannot be folded in half so that one side matches the other.

26. The figure cannot be folded in half so that one side matches the other.

27. The figure can be folded in half vertically so that one side matches the other.

28. B; $I = Prt = 550(0.044)\left(\frac{6}{12}\right) = 12.10$

You earn $12.10 in interest in 6 months.

Section 2.3

2.3 Activity (pp. 54–55)

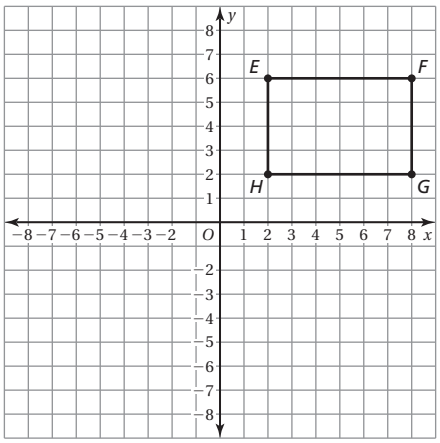
1. a. yes; The pattern coincides.

b. yes; The pattern coincides.

2. a. When folded on the horizontal axis, the pattern does not coincide. When folded on the vertical axis, the pattern does not coincide. So, the frieze pattern is neither a reflection of itself horizontally or vertically.

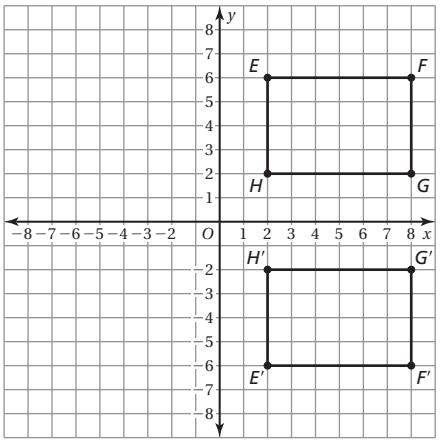
b. When folded on the horizontal axis, the pattern coincides. When folded on the vertical axis, the pattern does not coincide. So, the frieze pattern is a reflection of itself horizontally.

3. a. *Sample answer:*



6 units long and 4 units wide

b. *Based on sample answer*:



$(2, -6), (8, -6), (8, -2), (2, -2)$

c. *Based on sample answer*: The new and original rectangles are 6 units long and 4 units wide and have four right angles.

d. yes; Each pair of sides are either horizontal or vertical line segments.

e. yes; *Based on sample answer*: The figures are the same size, 6 units long and 4 units wide, and have the same angle measures, four right angles.

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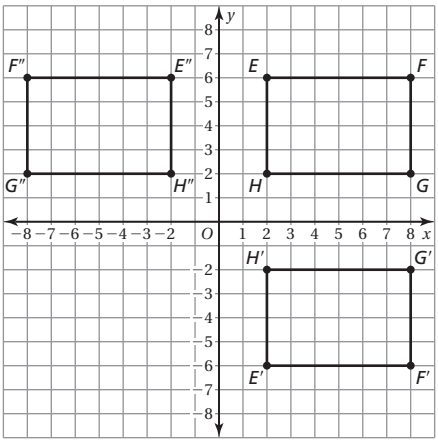
f. *Based on sample answer*:



$(-2, 6), (-8, 6), (-8, 2), (-2, 2)$

Based on sample answer: The new and original rectangles are 6 units long and 4 units wide and have four right angles.

yes; Each pair of sides are either horizontal or vertical line segments.

yes; *Based on sample answer*: The figures are the same size, 6 units long and 4 units wide, and have the same angle measures, four right angles.

g. yes; All the reflected figures remain congruent.

4. By folding a frieze pattern on its horizontal axis and vertical axis and then determining if the pattern coincides after folding, you can classify the frieze pattern.

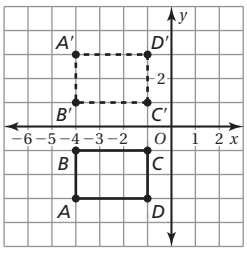
2.3 On Your Own (pp. 56–57)

1. If the red figure was flipped, it would not form the blue figure. So, the blue figure is not a reflection of the red figure.

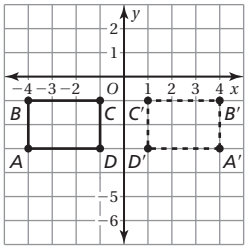
2. If the red figure was flipped, it would not form the blue figure. So, the blue figure is not a reflection of the red figure.

3. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection of the red figure.

4. a.



b.



c. yes; A reflection does not change the size and shape of the image.

2.3 Exercises (pp. 58–59)

Vocabulary and Concept Check

1. The third transformation does not belong because it represents a translation, whereas the other three transformations represent a reflection.

2. One figure is a reflection of another figure if one is a mirror image of the other.

3. A reflection in the x-axis represents a horizontal reflection. So, the figure is in Quadrant IV.

Practice and Problem Solving

4. If the red figure was flipped, it would not form the blue figure. So, the blue figure is not a reflection of the red figure.

5. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection of the red figure.

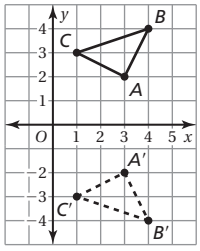
6. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection of the red figure.

7. If the red figure was flipped, it would not form the blue figure. So, the blue figure is not a reflection of the red figure.

8. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection on the red figure.

9. If the red figure was flipped, it would not form the blue figure. So, the blue figure is not a reflection of the red figure.

10.



The coordinates of the image are $A'(3, -2)$, $B'(4, -4)$, and $C'(1, -3)$.

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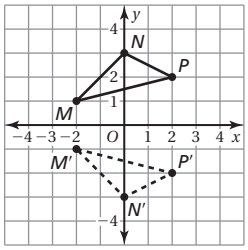
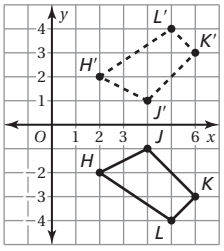
Chapter 2

11.



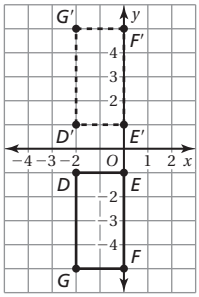
The coordinates of the image are $M'(-2, -1)$, $N'(0, -3)$, and $P'(2, -2)$.

12.



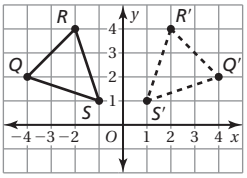
The coordinates of the image are $H'(2, 2)$, $J'(4, 1)$, $K'(6, 3)$, and $L'(5, 4)$.

13.



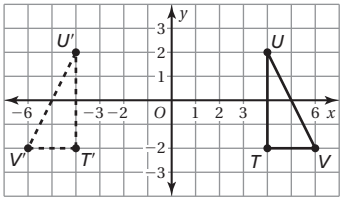
The coordinates of the image are $D'(-2, 1)$, $E'(0, 1)$, $F'(0, 5)$, and $G'(-2, 5)$.

14.



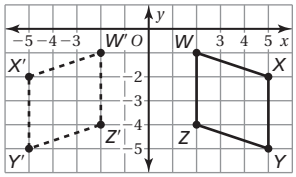
The coordinates of the image are $Q'(4, 2)$, $R'(2, 4)$, and $S'(1, 1)$.

15.



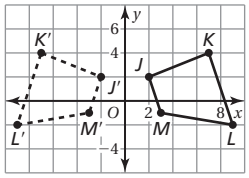
The coordinates of the image are $T'(-4, -2)$, $U'(-4, 2)$, and $V'(-6, -2)$.

16.



The coordinates of the image are $W'(-2, -1)$, $X'(-5, -2)$, $Y'(-5, -5)$, and $Z'(-2, -4)$.

17.



The coordinates of the image are $J'(-2, 2)$, $K'(-7, 4)$, $L'(-9, -2)$, and $M'(-3, -1)$.

18. The letters B, C, D, E, H, I, K, O, and X look the same when reflected horizontally.

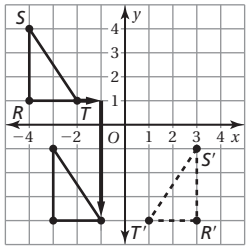
19. The original point is in Quadrant IV and the image is in Quadrant I. So, the reflection is in the *x*-axis.

20. The original point is in Quadrant II and the image is in Quadrant I. So, the reflection is in the *y*-axis.

21. The original point is in Quadrant III and the image is in Quadrant IV. So, the reflection is in the *y*-axis.

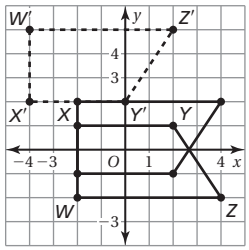
22. The original point is in Quadrant III and the image is in Quadrant II. So, the reflection is in the *x*-axis.

23.



The coordinates of the image are $R'(3, -4)$, $S'(3, -1)$, and $T'(1, -4)$.

24.



The coordinates of the image are $W'(-4, 5)$, $X'(-4, 2)$, $Y'(0, 2)$, and $Z'(2, 5)$.

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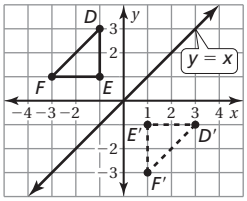
25. yes; Translations and reflections produce images that are congruent to the original figure. So, in Exercise 23, the original figure is congruent to the image after the translation, which is congruent to the image after the reflection. Similarly, in Exercise 24, the original figure is congruent to the image after the reflection, which is congruent to the image after the translation. You can also measure the sides and angles to determine that the figures are congruent.

26. Reflecting (x, y) in the x-axis results in the point $(x, -y)$. Reflecting $(x, -y)$ in the y-axis results in the point $(-x, -y)$. So, the coordinates of the final image are $(-x, -y)$.

27. a. You see the word AMBULANCE.

b. The word is written that way so that when drivers look in their vehicle's rear-view mirror, they can read the word.

28.



The x-coordinate and the y-coordinate for each point are switched in the image.

Fair Game Review

29. The angle measure is greater than $90°$. So, the angle is obtuse.

30. The angle measure is $180°$. So, the angle is straight.

31. The angle measure is $90°$. So, the angle is right.

32. The angle measure is less than $90°$. So, the angle is acute.

33. B; $a = p \bullet w$

$36 = 0.75w$

$48 = w$

So, 36 is 75% of 48.

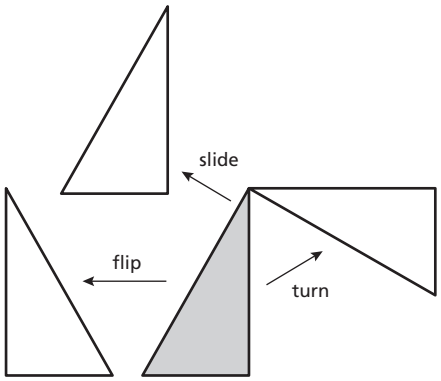
Section 2.4

2.4 Activity (pp. 60–61)

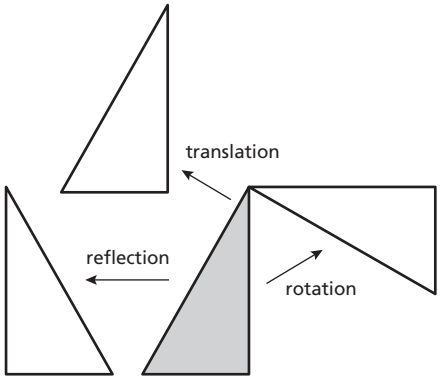
1. translate; reflect; rotate

a. right scalene; yes; All the triangles have the same angle measures and the same side lengths.

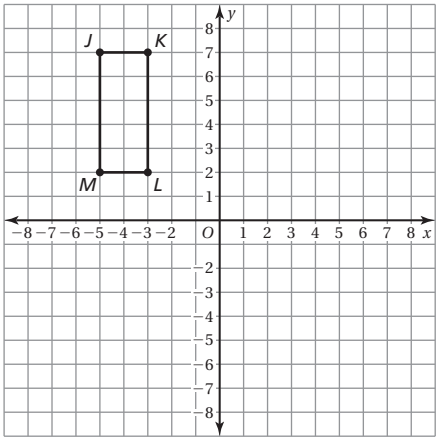
b. *Sample answer:*



c. *Sample answer:*



2. a. *Sample answer*:



5 units long and 2 units wide

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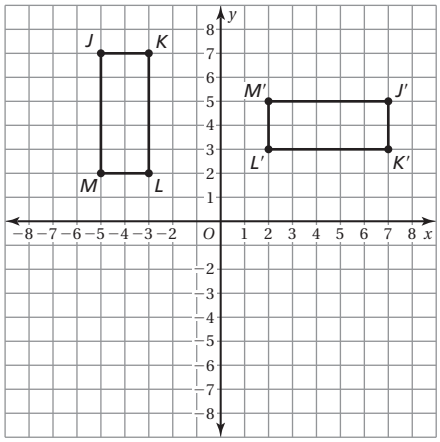
b. *Based on sample answer*:



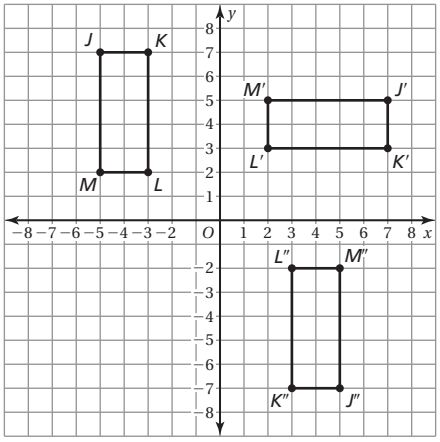
$(7, 5), (7, 3), (2, 3), (2, 5)$

c. *Based on sample answer*: The new and original rectangles are 5 units long and 2 units wide and have four right angles.

d. yes; Each pair of sides are either horizontal or vertical line segments.

e. yes; *Based on sample answer*: The figures are the same size, 5 units long and 2 units wide, and have the same angle measures, four right angles.

f. *Based on sample answer*:



$(5, -7), (3, -7), (3, -2), (5, -2)$

Based on sample answer: The new and original rectangles are 5 units long and 2 units wide and have four right angles.

yes; Each pair of sides are either horizontal or vertical line segments.

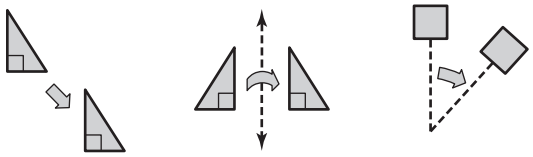
yes; *Based on sample answer*: The figures are the same size, 5 units long and 2 units wide, and have the same angle measures, four right angles.

g. yes; All the rotated figures remain congruent.

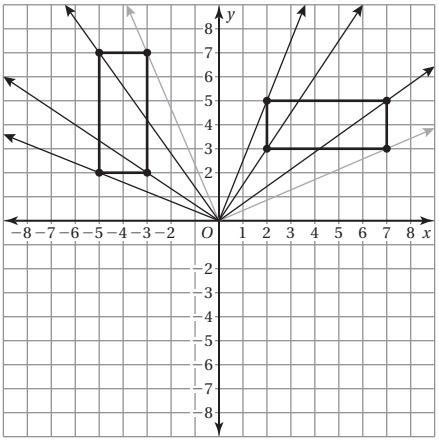
3. The three basic ways to move an object in a plane is to translate the object, reflect the object, or rotate the object.

Sample answer:

Translation Reflection Rotation



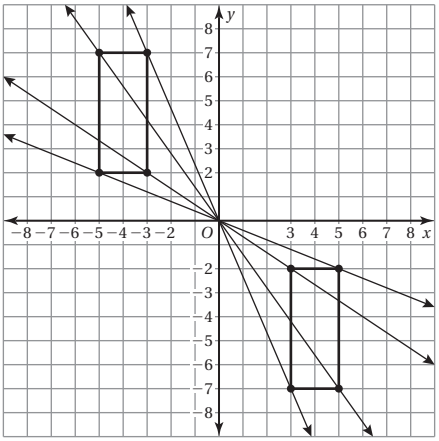
4. a. *Sample answer:*



b. All angle measures are 90°. The distances are equal.

c. *Sample answer*: You can use a ruler and a protractor to rotate each vertex of a figure.

5. a. *Sample answer*:



b. All angle measures are 180°. The distances are equal.

c. *Sample answer*: You can use a ruler and a protractor to rotate each vertex of a figure.

2.4 On Your Own (pp. 62–64)

1. Choice C is a 90° counterclockwise rotation about point *P*.

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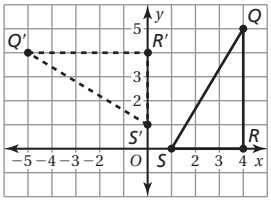
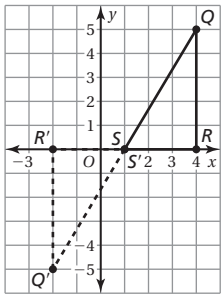
2. no; Choice D is a vertical reflection of the original piece.

3. a.

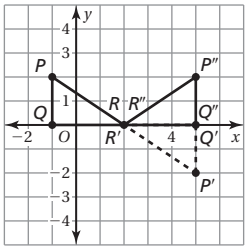


b.



c. yes; The images are congruent because a rotation does not change the size and shape of an image.

4.



The coordinates of the image are $P''(5,2)$, $Q''(5,0)$, and $R''(2,0)$.

5. *Sample answer*: 90° clockwise rotation about the origin followed by translation 4 units right and 1 unit up.

2.4 Exercises (pp. 65–67)

Vocabulary and Concept Check

1. The figure in Example 2 is rotated about the origin. So, the center of rotation is $(0, 0)$. The figure in Example 3 is rotated about the vertex L. So, the center of rotation is $(1, -3)$.

2. The figure will lie entirely in Quadrant I after a $90°$ clockwise rotation.

3. The figure will lie entirely in Quadrant IV after a $180°$ clockwise rotation.

4. The figure will lie entirely in Quadrant III after a $270°$ clockwise rotation.

5. The figure will be in its original location in Quadrant II after a $360°$ clockwise rotation.

6. What are the coordinates of the figure after a 270° clockwise rotation about the origin?; 270° clockwise rotation: $A'(-4, 2)$, $B'(-4, 4)$, $C'(-1, 4)$, $D'(-1, 2)$; other rotations: $A'(4, -2)$, $B'(4, -4)$, $C'(1, -4)$, $D'(1, -2)$;

Practice and Problem Solving

7. reflection

8. rotation

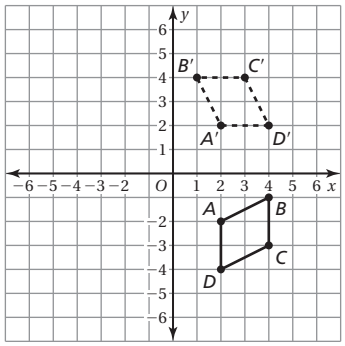
9. translation

10. The blue figure is not a rotation of the red figure.

11. The blue figure is a $90°$ counterclockwise rotation of the red figure.

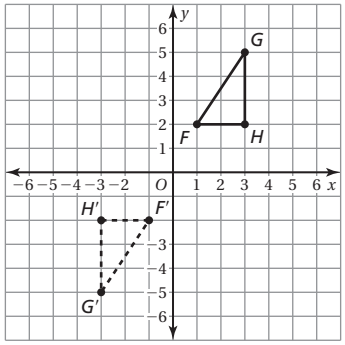
12. The blue figure is a 180° counterclockwise (or clockwise) rotation of the red figure.

13.



The coordinates of the image are $A'(2,2)$, $B'(1,4)$, $C'(3, 4)$, and $D'(4, 2)$.

14.



The coordinates of the image are $F'(-1, -2)$, $G'(-3, -5)$, and $H'(-3, -2)$.

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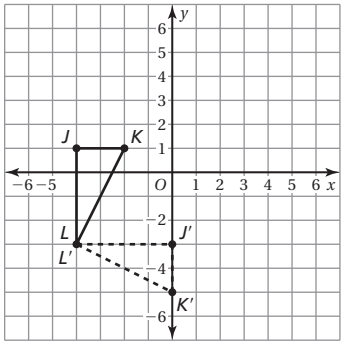
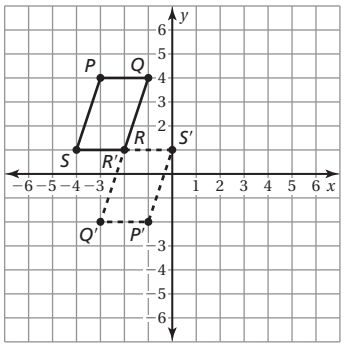
15.



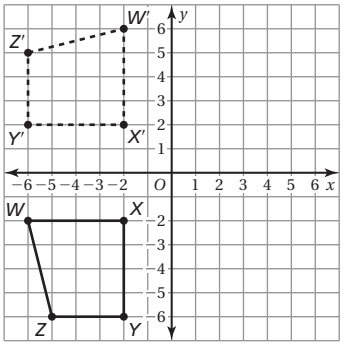
The coordinates of the image are $J'(0, -3)$, $K'(0, -5)$, and $L'(-4, -3)$.

16.



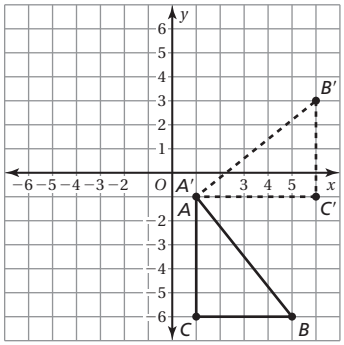
The coordinates of the image are $P'(-1, -2)$, $Q'(-3, -2)$, $R'(-2, 1)$ and $S'(0, 1)$.

17.



The coordinates of the image are $W'(-2, 6)$, $X'(-2, 2)$, $Y'(-6, 2)$ and $Z'(-6, 5)$.

18.



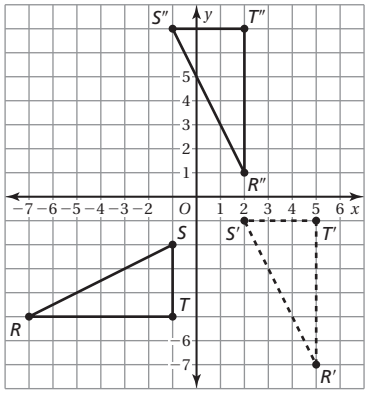
The coordinates of the image are $A'(1, -1)$, $B'(6, 3)$, and $C'(6, -1)$.

19. If you rotate the figure 120°, it will produce an image that fits exactly on the original figure.

20. If you rotate the figure 90°, it will produce an image that fits exactly on the original figure.

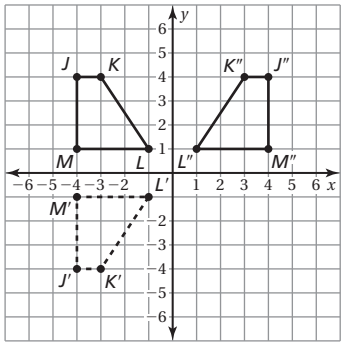
21. If you rotate the figure 180°, it will produce an image that fits exactly on the original figure.

22.



The coordinates of the image are $R''(2, 1)$, $S''(-1, 7)$, and $T''(2, 7)$.

23.



The coordinates of the image are $J''(4, 4)$, $K''(3, 4)$, $L''(1, 1)$ and $M''(4, 1)$.

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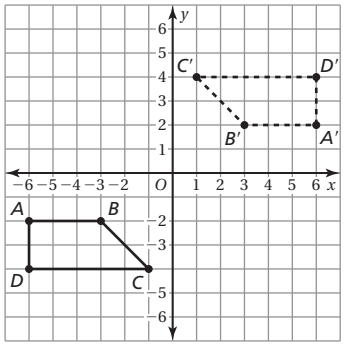
24. *Sample answer:* Rotate 90° counterclockwise about the origin and then translate 5 units left; Rotate 90° clockwise about the origin and then translate 1 unit right and 5 units up.

25. *Sample answer:* Rotate 90° counterclockwise about vertex (1, 0) and then translate 2 units left; Rotate 90° counterclockwise about the origin and then translate 1 unit left and 1 unit down.

26. a.



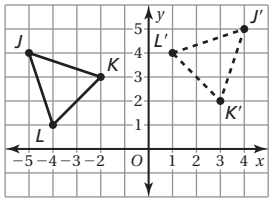
The coordinates of the image are $A'(6, 2)$, $B'(3, 2)$, $C'(1, 4)$ and $D'(6, 4)$.

b. Reflect the trapezoid in the x-axis and then in the y-axis, or reflect the trapezoid in the y-axis and then in the x-axis.

27. The correct order is:

1. Rotate 180° about the origin.
2. Rotate 90° counterclockwise about the origin.
3. Reflect in the y-axis.
4. Translate 1 unit right and 1 unit up.

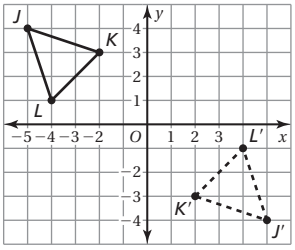
28. a.



The coordinates of the image are $J'(4, 5)$, $K'(3, 2)$, and $L'(1, 4)$.

The x-coordinates of Triangle $J'K'L'$ are the same as the y-coordinates of Triangle JKL.
The y-coordinates of Triangle $J'K'L'$ are the opposites of the x-coordinates of Triangle JKL.

b.



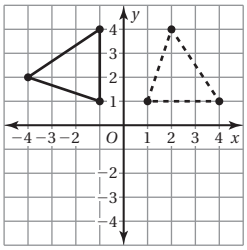
The coordinates of the image are $J'(5, -4)$, $K'(2, -3)$, and $L'(4, -1)$.

The x-coordinates of Triangle $J'K'L'$ are the opposites of the x-coordinates of Triangle JKL.
The y-coordinates of Triangle $J'K'L'$ are the opposites of the y-coordinates of Triangle JKL.

c. yes; Explanations will vary.

29. Work backwards using the vertices of the final triangle. Translate the vertices one unit right and two units up. Then rotate the triangle 90° clockwise about the origin.

Final vertices	$(x + 1, y + 2)$	New vertices
$(-5, 0)$	$(-5 + 1, 0 + 2)$	$(-4, 2)$
$(-2, 2)$	$(-2 + 1, 2 + 2)$	$(-1, 4)$
$(-2, -1)$	$(-2 + 1, -1 + 2)$	$(-1, 1)$



So, the vertices of the original triangle are $(2, 4)$, $(4, 1)$, and $(1, 1)$.

Fair Game Review

30. no; $\frac{15}{20}$ reduces to $\frac{3}{4}$.

The ratios $\frac{3}{5}$ and $\frac{15}{20}$ are not equivalent and therefore do not form a proportion.

31. yes; $\frac{12}{18}$ reduces to $\frac{2}{3}$.

The ratios $\frac{2}{3}$ and $\frac{12}{18}$ are equivalent and therefore form a proportion.

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32. yes; $\frac{7}{28}$ and $\frac{12}{48}$ both reduce to $\frac{1}{4}$.

The ratios $\frac{7}{28}$ and $\frac{12}{48}$ are equivalent and therefore form a proportion.

33. no; $\frac{54}{72}$ reduces to $\frac{3}{4}$, and $\frac{36}{45}$ reduces to $\frac{4}{5}$.

The ratios $\frac{54}{72}$ and $\frac{36}{45}$ are not equivalent and therefore do not form a proportion.

34. B; $x + 6 \div 2 = 5$

$x + 3 = 5$

$x = 2$

Study Help

Available at *BigIdeasMath.com*.

Quiz 2.1–2.4

1. The corresponding sides of the triangles do not have the same measure. So, the triangles are not congruent.

2. The corresponding angles of the rectangles have the same measure and the corresponding sides of the rectangles have the same measure. So, the rectangles are congruent.

3. The red figure turns to form the blue figure. So, the blue figure is not a translation of the red figure.

4. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

5. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection of the red figure.

6. If the red figure was flipped, it would not create a mirror image. So, the blue figure is not a reflection of the red figure.

7. *Sample answer*: Rotate 90° clockwise about the origin and then translate 1 unit left and 1 unit down; rotate 90° clockwise about the vertex $(-1, 1)$ and then translate to the 1 unit right and 1 unit down.

8. *Sample answer*: rotate 180° degrees clockwise about the origin and then translate 1 unit right and 1 unit down; translate 1 unit left and 1 unit up and then reflect in the x-axis and reflect in the y-axis

9. *Sample answer:* Translate point A 6 units right and 4 units down to get point B.

10. no; After reflecting the ball in the y-axis, the ball will be at the point $(-2, 4)$, which is not contained in the radius of the hole.

Section 2.5

2.5 Activity (pp. 70–71)

1. a. Ratio of length to width of original photograph: $\frac{6 \text{ in.}}{5 \text{ in.}}$

Ratio of length to width of reduced photograph: $\frac{5 \text{ in.}}{4 \text{ in.}}$

The ratios $\frac{6}{5}$ and $\frac{5}{4}$ are not equivalent and therefore do not form a proportion. So, you cannot reduce the photograph without distorting or cropping.

b. Ratio of length to width of original photograph: $\frac{8 \text{ in.}}{6 \text{ in.}} = \frac{4 \text{ in.}}{3 \text{ in.}}$

Ratio of length to width of reduced photograph: $\frac{4 \text{ in.}}{3 \text{ in.}}$

The ratios $\frac{8}{6}$ and $\frac{4}{3}$ are equivalent and therefore form a proportion. So, you can reduce the photograph without distorting or cropping.

2. a. Ratios of side lengths of original design: $\frac{8}{7}$ and $\frac{8}{8} = \frac{1}{1}$

Ratios of side lengths of design 1: $\frac{7}{6}$ and $\frac{7}{7} = \frac{1}{1}$

Ratios of side lengths of design 2: $\frac{6\frac{6}{7}}{6} = \frac{\frac{48}{7}}{6} = \frac{48}{7 \bullet 6} = \frac{48}{42} = \frac{8}{7}$ and $\frac{6\frac{6}{7}}{6\frac{6}{7}} = \frac{1}{1}$

The ratios of the side lengths of the original design and design 2 are equivalent. So, the original design is proportional to design 2.

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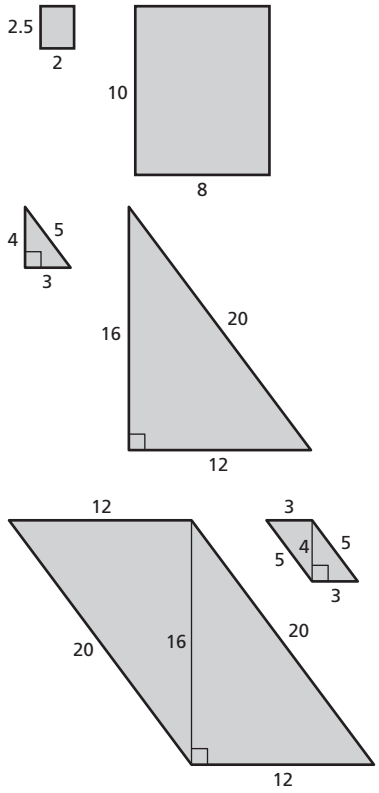
b. *Sample answer:*



3. You can use proportions to reduce or enlarge images and figures so they are not cropped or distorted.

Answer should include, but is not limited to: Students will give two examples demonstrating how to use proportions to enlarge or reduce an image so that it is not cropped or distorted. Students will show their work and provide drawings.

4. a–d. *Answer should include, but is not limited to:* Students will use a computer art program to draw two rectangles that are proportional to each other. Students will print out the rectangles on the same piece of paper and then measure the dimensions of each rectangle in centimeters. Students will find the given ratios and conclude that the ratios are equivalent.

2.5 On Your Own (pp. 72–73)

1. Each figure is a rectangle. So, corresponding angles have the same measure.

$$\frac{\text{Length of A}}{\text{Length of D}} = \frac{6}{3} = 2 \qquad \frac{\text{Width of A}}{\text{Width of D}} = \frac{3}{1} = 3$$

$$\frac{\text{Length of B}}{\text{Length of D}} = \frac{6}{3} = 2 \qquad \frac{\text{Width of B}}{\text{Width of D}} = \frac{2}{1} = 2$$

$$\frac{\text{Length of C}}{\text{Length of D}} = \frac{4}{3} \qquad \frac{\text{Width of C}}{\text{Width of D}} = \frac{2}{1} = 2$$

The corresponding side lengths of Rectangle B and Rectangle D are proportional. So, Rectangle B is similar to Rectangle D.

2. $\frac{6}{9} = \frac{x}{6}$

$\frac{36}{9} = x$

$4 = x$

So, x is 4 feet.

3. $\frac{14}{7} = \frac{x}{12}$

$2 = \frac{x}{12}$

$24 = x$

So, x is 24 centimeters.

4. $\frac{3.75}{15} = \frac{4.5}{b}$

$3.75b = 67.5$

$b = 18$

So, the length of the longer base in the painting is 18 inches.

2.5 Exercises (pp. 74–75)

Vocabulary and Concept Check

1. Corresponding angles of two similar figures have the same measure.

2. Corresponding side lengths of two similar figures are proportional.

3. yes; Two figures that have the same size and shape are similar because corresponding angles have the same measure and corresponding side lengths are equal, so corresponding side lengths are proportional.

Practice and Problem Solving

4. Ratios of corresponding side lengths:

$\frac{6}{9} = \frac{2}{3}$

$\frac{8}{12} = \frac{2}{3}$

$\frac{4}{6} = \frac{2}{3}$

All ratios are equivalent, so the side lengths are proportional. Corresponding angles have the same measure. So, the figures are similar.

5. Ratios of corresponding side lengths:

$\frac{6}{9} = \frac{2}{3}$

$\frac{9}{15} = \frac{3}{5}$

The ratios are not equivalent, so the side lengths are not proportional. The figures are not similar.

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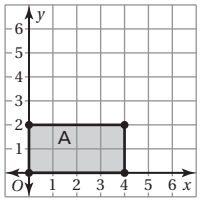
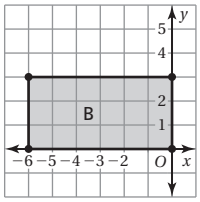
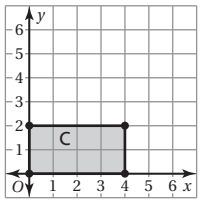
6.





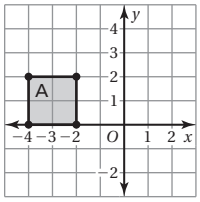


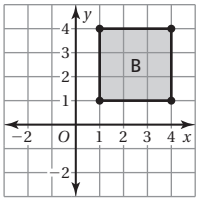
Rectangle A and Rectangle B:

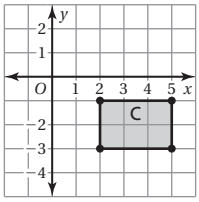
$$\frac{\text{Length of A}}{\text{Length of B}} = \frac{4}{6} = \frac{2}{3} \qquad \frac{\text{Width of A}}{\text{Width of B}} = \frac{2}{3}$$

Rectangle A and Rectangle C are the same. So, Rectangles A, B, and C are all similar because corresponding side lengths are proportional and corresponding angles have the same measure.

7.







Rectangle A and Rectangle B:

$$\frac{\text{Length of A}}{\text{Length of B}} = \frac{2}{3} \qquad \frac{\text{Width of A}}{\text{Width of B}} = \frac{2}{3}$$

Rectangle A and Rectangle C:

$$\frac{\text{Length of A}}{\text{Length of C}} = \frac{2}{3} \qquad \frac{\text{Width of A}}{\text{Width of C}} = \frac{2}{2} = 1$$

So, Rectangle A is similar to Rectangle B because corresponding side lengths are proportional and corresponding angles are congruent.

8.
$$\frac{8}{20} = \frac{6}{x}$$
$$8x = 120$$
$$x = 15$$
So, $x = 15$.

9.
$$\frac{9}{4} = \frac{15}{x}$$
$$9x = 60$$
$$x = 6\frac{2}{3}$$
So, $x = 6\frac{2}{3}$.

10.
$$\frac{x}{8} = \frac{9}{5}$$
$$5x = 72$$
$$x = 14.4$$
So, $x = 14.4$.

11.
$$\frac{9}{21} = \frac{6}{x}$$
$$9x = 126$$
$$x = 14$$
So, $x = 14$.

12.
$$\frac{\text{Length of drawing}}{\text{Length of flag}} = \frac{11}{63}$$
$$\frac{\text{Width of drawing}}{\text{Width of flag}} = \frac{8.5}{36} = \frac{17}{72}$$

The side lengths are not proportional. So, the drawing is not similar to the Mexican flag.

13.
$$\frac{\text{Width of teacher's desk}}{\text{Width of student's desk}} = \frac{\text{Length of teacher's desk}}{\text{Length of student's desk}}$$
$$\frac{w}{18} = \frac{50}{30}$$
$$\frac{w}{18} = \frac{5}{3}$$
$$\frac{w}{18} \cdot 18 = \frac{5}{3} \cdot 18$$
$$w = 30$$

The width of the teacher's desk is 30 inches.

14. a. Two triangles are *sometimes* similar because not all triangles have the same shape.

b. Two squares are *always* similar because all squares have the same shape.

c. Two rectangles are *sometimes* similar because not all rectangles have the same shape.

d. A square and a triangle are *never* similar because the figures do not have the same shape.

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15. yes; It is possible to draw two quadrilaterals each having two $130°$ angles and two $50°$ angles that are not similar. You can draw a trapezoid and a parallelogram with the given angle measures.

16. a. yes; The angle measures will remain the same and the side lengths will increase by the same percentage and therefore will remain proportional.

b. no; For example, if the length is 10 feet and the width is 4 feet, then after the increase, the length is 16 feet and the width is 10 feet. The ratio of lengths is $\frac{10}{16} = \frac{5}{8}$ and the ratio of widths is $\frac{4}{10} = \frac{2}{5}$. The side lengths are not proportional.

17. Let x be the height of the streetlight. The distance from the streetlight to the tip of the person's shadow is $20 + 10 = 30$ feet.

$$\frac{x}{6} = \frac{30}{10}$$
$$x = \frac{180}{10}$$
$$x = 18$$

The height of the streetlight is 18 feet, which is $18 \div 6 = 3$ times taller than the person.

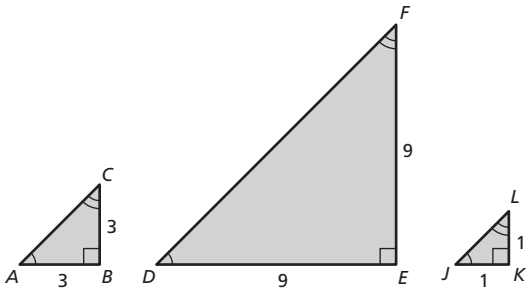
18. yes; A scale drawing is a proportional drawing of an object, so corresponding angles are congruent and corresponding side lengths are proportional.

19. *Answer should include, but is not limited to:* Students will draw two different isosceles triangles similar to the one given. Students will measure the height of the triangles to the nearest centimeter. Triangles should be labeled clearly.

a. yes; The ratio of corresponding heights is proportional to the ratio of corresponding side lengths.

b. yes; This is true for all similar triangles because the height of a triangle is a dimension of the triangle like the side lengths.

20. yes; *Sample answer:*



$$\frac{\text{Base of } \triangle ABC}{\text{Base of } \triangle DEF} = \frac{3}{9} = \frac{1}{3}$$

$$\frac{\text{Height of } \triangle ABC}{\text{Height of } \triangle DEF} = \frac{3}{9} = \frac{1}{3}$$

Corresponding side lengths are proportional and corresponding angles have the same measure. So, $\triangle ABC$ is similar to $\triangle DEF$.

$$\frac{\text{Base of } \triangle DEF}{\text{Base of } \triangle JKL} = \frac{9}{1} = 9$$

$$\frac{\text{Height of } \triangle DEF}{\text{Height of } \triangle JKL} = \frac{9}{1} = 9$$

Corresponding side lengths are proportional and corresponding angles have the same measure. So, $\triangle DEF$ is similar to $\triangle JKL$.

$$\frac{\text{Base of } \triangle ABC}{\text{Base of } \triangle JKL} = \frac{3}{1} = 3$$

$$\frac{\text{Height of } \triangle ABC}{\text{Height of } \triangle JKL} = \frac{3}{1} = 3$$

Corresponding side lengths are proportional and corresponding angles have the same measure. So, $\triangle ABC$ is similar to $\triangle JKL$.

Fair Game Review

21. $\left(\frac{4}{9}\right)^2 = \frac{4}{9} \bullet \frac{4}{9} = \frac{16}{81}$

22. $\left(\frac{3}{8}\right)^2 = \frac{3}{8} \bullet \frac{3}{8} = \frac{9}{64}$

23. $\left(\frac{7}{4}\right)^2 = \frac{7}{4} \bullet \frac{7}{4} = \frac{49}{16}$

24. $\left(\frac{6.5}{2}\right)^2 = \frac{6.5}{2} \bullet \frac{6.5}{2} = \frac{42.25}{4} = \frac{169}{16}$

25. C;
$$S = \ell w + 2wh$$
$$S = (\ell + 2h)w$$
$$\frac{S}{\ell + 2h} = w$$

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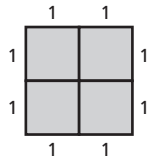
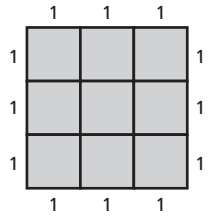
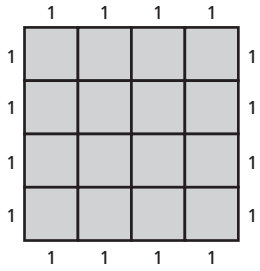
Section 2.6

2.6 Activity (pp. 76–77)

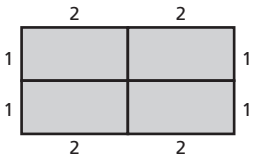
1. a.

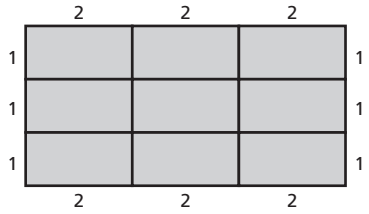


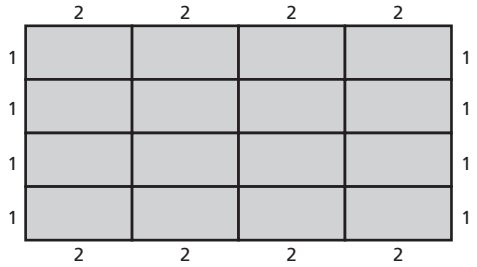




b.







2.

Figure	Original Side Lengths	Double Side Lengths	Triple Side Lengths	Quadruple Side Lengths
	$P = 4$	8	12	16
	$P = 6$	12	18	24

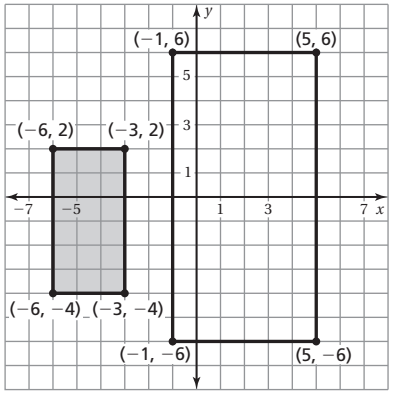
When the side lengths are multiplied by a number, the perimeter is multiplied by the same number.

3.

Figure	Original Side Lengths	Double Side Lengths	Triple Side Lengths	Quadruple Side Lengths
	$A = 1$	4	9	16
	$A = 2$	8	18	32

When the side lengths are multiplied by a number, the area is multiplied by the square of that number.

4. a.



$$\frac{\text{Red Length}}{\text{Blue Length}} \stackrel{?}{=} \frac{\text{Red Width}}{\text{Blue Width}}$$

$$\frac{\text{change in } y}{\text{change in } y} \stackrel{?}{=} \frac{\text{change in } x}{\text{change in } x}$$

$$\frac{6}{12} \stackrel{?}{=} \frac{3}{6}$$

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

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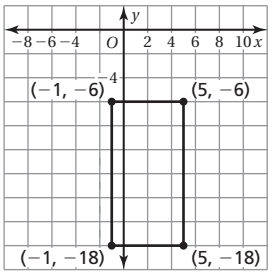
b. perimeter of red rectangle: 18 units; perimeter of blue rectangle: 36 units

area of red rectangle: 18 units^2; area of blue rectangle: 72 units^2

yes; The dimensions are doubled. So, the perimeter of the blue rectangle is twice the perimeter of the red rectangle, and the area of the blue rectangle is 4 times the area of the red rectangle.

c.



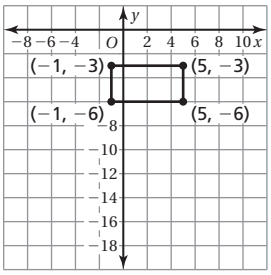
$$\frac{\text{Red Length}}{\text{Blue Length}} \stackrel{?}{=} \frac{\text{Red Width}}{\text{Blue Width}}$$

$$\frac{\text{change in } y}{\text{change in } y} \stackrel{?}{=} \frac{\text{change in } x}{\text{change in } x}$$

$$\frac{6}{12} \stackrel{?}{=} \frac{3}{6}$$

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

The ratios are equal. So, the rectangles are similar.



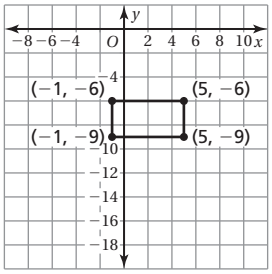
$$\frac{\text{Red Length}}{\text{Blue Length}} \stackrel{?}{=} \frac{\text{Red Width}}{\text{Blue Width}}$$

$$\frac{\text{change in } y}{\text{change in } y} \stackrel{?}{=} \frac{\text{change in } x}{\text{change in } x}$$

$$\frac{6}{6} \stackrel{?}{=} \frac{3}{3}$$

$$1 = 1$$

The ratios are equal. So, the rectangles are similar.



$$\frac{\text{Red Length}}{\text{Blue Length}} \stackrel{?}{=} \frac{\text{Red Width}}{\text{Blue Width}}$$

$$\frac{\text{change in } y}{\text{change in } y} \stackrel{?}{=} \frac{\text{change in } x}{\text{change in } x}$$

$$\frac{6}{6} \stackrel{?}{=} \frac{3}{3}$$

$$1 = 1$$

The ratios are equal. So, the rectangles are similar.

5. When the dimensions of a figure are k times larger than a similar figure, then the perimeter is k times the perimeter of the similar figure and the area is k^2 times the area of the similar figure.

6. To find the dimensions of a figure that is similar to another figure, you need to know the lengths of a pair of corresponding sides and the length of the side that corresponds with the unknown length.

Sample answer: A rectangle has a length of 5 inches and a width of 3 inches. A similar rectangle has a width of 6 inches. You can solve the proportion $\frac{5 \text{ in.}}{x \text{ in.}} = \frac{3 \text{ in.}}{6 \text{ in.}}$ to find the length of the similar rectangle.

The lengths of two similar rectangles are 8 feet and 4 inches, respectively, and the width of the first rectangle is 1 foot. You can solve the proportion $\frac{8 \text{ ft.}}{4 \text{ in.}} = \frac{1 \text{ ft.}}{x \text{ in.}}$ to find the length of the second rectangle.

2.6 On Your Own (pp. 78–79)

1. $\frac{\text{Perimeter of Figure A}}{\text{Perimeter of Figure B}} = \frac{9}{15} = \frac{3}{5}$

The ratio of the perimeter of Figure A to the perimeter of Figure B is $\frac{3}{5}$.

2. $\frac{\text{Area of Triangle P}}{\text{Area of Triangle Q}} = \left(\frac{8}{7}\right)^2 = \frac{64}{49}$

The ratio of the area of Triangle P to the area of Triangle Q is $\frac{64}{49}$.

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Chapter 2

3. $\frac{\text{Perimeter of court}}{\text{Perimeter of pool}} = \frac{\text{Width of court}}{\text{Width of pool}}$

$$\frac{60}{P} = \frac{10}{16}$$
$$960 = 10P$$
$$96 = P$$

$\frac{\text{Area of court}}{\text{Area of pool}} = \left(\frac{\text{Width of court}}{\text{Width of pool}}\right)^2$

$$\frac{200}{A} = \left(\frac{10}{16}\right)^2$$
$$\frac{200}{A} = \frac{100}{256}$$
$$51{,}200 = 100A$$
$$512 = A$$

The perimeter of the pool is 96 yards and the area is 512 square yards.

2.6 Exercises (pp. 80–81)

Vocabulary and Concept Check

1. If two figures are similar, then the ratio of their perimeters is equal to the ratio of their corresponding side lengths.

2. If two figures are similar, then the ratio of their areas is equal to the square of the ratio of their corresponding side lengths.

3. The ratio of the areas is $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$. Use a proportion to find the area of $WXYZ$.

$$\frac{1}{4} = \frac{\text{Area of } ABCD}{\text{Area of } WXYZ}$$
$$\frac{1}{4} = \frac{30}{x}$$
$$x = 4 \cdot 30$$
$$x = 120$$

The area of $WXYZ$ is 120 square inches.

Practice and Problem Solving

4. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{11}{6}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{11}{6}\right)^2 = \frac{121}{36}$

The ratio of the perimeters is $\frac{11}{6}$ and the ratio of the areas is $\frac{121}{36}$.

5. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{5}{8}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{5}{8}\right)^2 = \frac{25}{64}$

The ratio of the perimeters is $\frac{5}{8}$ and the ratio of the areas is $\frac{25}{64}$.

6. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{4}{7}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{4}{7}\right)^2 = \frac{16}{49}$

The ratio of the perimeters is $\frac{4}{7}$ and the ratio of the areas is $\frac{16}{49}$.

7. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{14}{9}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{14}{9}\right)^2 = \frac{196}{81}$

The ratio of the perimeters is $\frac{14}{9}$ and the ratio of the areas is $\frac{196}{81}$.

8. The perimeter doubles.

9. The area is 9 times larger.

10. $\frac{7}{10} = \frac{x}{12}$

$$\frac{84}{10} = x$$
$$8.4 = x$$

So, $x = 8.4$.

11. $\frac{8}{5} = \frac{x}{16}$

$$\frac{128}{5} = x$$
$$25.6 = x$$

So, $x = 25.6$.

12. Ratio of areas $= \left(\frac{10}{7}\right)^2 = \frac{100}{49}$

The ratio of the areas is 100 : 49.

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Chapter 2

13. $\dfrac{\text{Perimeter of banner}}{\text{Perimeter of sign}} = \dfrac{\text{Length of banner}}{\text{Length of sign}}$

$$\frac{156}{P} = \frac{44}{11}$$
$$\frac{156}{P} = 4$$
$$156 = 4P$$
$$39 = P$$

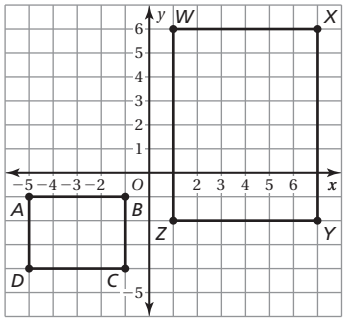
The perimeter of the sign is 39 inches.

$$\frac{\text{Area of banner}}{\text{Area of sign}} = \left(\frac{\text{Length of banner}}{\text{Length of sign}}\right)^2$$

$$\frac{1496}{A} = \left(\frac{44}{11}\right)^2$$
$$\frac{1496}{A} = 4^2$$
$$\frac{1496}{A} = 16$$
$$1496 = 16A$$
$$\frac{1496}{16} = A$$
$$93.5 = A$$

The area of the sign is 93.5 square inches.

14.



Perimeter of $ABCD$

$= 2\ell + 2w = 2(4) + 2(3) = 14$ units

Perimeter of $WXYZ$

$= 2\ell + 2w = 2(6) + 2(8) = 28$ units

The perimeter of $WXYZ$ is 2 times larger than the perimeter of $ABCD$.

Area of $ABCD = \ell w = (4)(3) = 12$ units^2

Area of $WXYZ = \ell w = (6)(8) = 48$ units^2

The area of $WXYZ$ is $2^2 = 4$ times larger than the area of $ABCD$.

The rectangles are similar because corresponding side lengths are proportional and corresponding angles are congruent.

15. The perimeter of Square A is $P = 4(12) = 48$ yards.

$$\frac{\text{Perimeter of Square A}}{\text{Perimeter of Square B}} = \frac{\text{Side length of Square A}}{\text{Side length of Square B}}$$

$$\frac{48}{P} = \frac{4}{9}$$
$$432 = 4P$$
$$108 = P$$

The perimeter of Square B is 108 yards.

16. Ratio of areas $= \left(\dfrac{9}{18}\right)^2 = \left(\dfrac{1}{2}\right)^2 = \dfrac{1}{4}$

$$\frac{1}{4} = \frac{\text{Cost of smaller piece}}{\text{Cost of larger piece}}$$
$$\frac{1}{4} = \frac{1.31}{x}$$
$$x = 5.24$$

You can expect to pay \$5.24 for a similar piece of fabric.

17. a. First, convert 10 feet to inches, so that both have the same units.

$$10 \text{ ft} \times \frac{12 \text{ in.}}{1 \text{ ft}} = 120 \text{ in.}$$

$$\frac{\text{Actual base area}}{\text{Model base area}} = \left(\frac{120 \text{ in.}}{6 \text{ in.}}\right)^2 = \left(\frac{20}{1}\right)^2 = \frac{400}{1}$$

The base area of the actual merry-go-round is 400 times greater than the base area of the model.

b. Let x represent the actual base area.

$$\frac{x}{450} = \frac{400}{1}$$
$$x = 450 \bullet 400$$
$$x = 180{,}000$$

The actual base area of the merry-go-round is 180,000 square inches. Convert 180,000 square inches to square feet.

$$180{,}000 \text{ in.}^2 \times \left(\frac{1 \text{ ft}}{12 \text{ in.}}\right)^2 = 180{,}000 \text{ in.}^2 \times \frac{1 \text{ ft}^2}{144 \text{ in.}^2}$$
$$= 1250 \text{ ft}^2$$

So, the actual base area of the merry-go-round is 1250 square feet.

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Chapter 2

18. a. $\dfrac{\text{Circumference of Circle K}}{\text{Circumference of Circle L}} = \dfrac{\pi}{4\pi} = \dfrac{1}{4}$

The ratio of their circumferences is $\frac{1}{4}$.

Radius of Circle K: $C = 2\pi r$

$$\frac{\pi}{2\pi} = \frac{2\pi r}{2\pi}$$

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

Radius of Circle L: $C = 2\pi r$

$$\frac{4\pi}{2\pi} = \frac{2\pi r}{2\pi}$$

$$2 = r$$

$$\frac{\text{Radius of Circle K}}{\text{Radius of Circle L}} = \frac{\frac{1}{2}}{2} = \frac{1}{4}$$

The ratio of their radii is $\frac{1}{4}$.

Area of Circle K: $A = \pi r^2$

$$= \pi\left(\frac{1}{2}\right)^2$$

$$= \frac{1}{4}\pi$$

Area of Circle L: $A = \pi r^2$

$$= \pi(2)^2$$

$$= 4\pi$$

$$\frac{\text{Area of Circle K}}{\text{Area of Circle L}} = \frac{\frac{1}{4}\pi}{4\pi} = \frac{\frac{1}{4}\cancel{\pi}}{4\cancel{\pi}} = \frac{1}{16}$$

The ratio of their areas is $\frac{1}{16}$.

b. The ratio of the circumferences is equal to the ratio of the radii. The ratio of the square of the radii is equal to the ratio of the areas. These are the same proportions that are used for similar figures.

19. Smaller triangle:

$$A = \frac{bh}{2}$$

$$10 = \frac{4h}{2}$$

$$10 = 2h$$

$$5 = h$$

So, the height of the smaller triangle is 5 meters.

The scale factor of the area of the smaller triangle to the area of the larger triangle is $\frac{10}{90} = \frac{1}{9}$.

This scale factor has been squared because it describes the relationship between the areas.

Think: $(?)^2 = \frac{1}{9}$

$$\text{Scale factor} = \frac{1}{3}$$

The height of the larger triangle should be three times as big as the height of the smaller triangle.

$3 \bullet$ height of smaller triangle $= 3 \bullet 5 = 15$

So, the height of the larger triangle is 15 meters.

20. $\dfrac{\text{Perimeter of unknown garden}}{\text{Perimeter of known garden}} = \dfrac{105}{42} = \dfrac{5}{2}$

$$\frac{\text{Area of unknown garden}}{\text{Area of known garden}} = \left(\frac{5}{2}\right)^2 = \frac{25}{4} = 6.25$$

The area of the unknown garden is 6.25 times larger than the known garden. So, the unknown garden requires $6.25 \times 2 = 12.5$ bottles of fertilizer.

Fair Game Review

21. $4x + 12 = -2x$

$$12 = -6x$$

$$-2 = x$$

So, $x = -2$.

22. $2b + 6 = 7b - 2$

$$2b + 8 = 7b$$

$$8 = 5b$$

$$\frac{8}{5} = b$$

So, $b = \frac{8}{5}$, or $1\frac{3}{5}$.

23. $8(4n + 13) = 6n$

$$32n + 104 = 6n$$

$$104 = -26n$$

$$-4 = n$$

So, $n = -4$.

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Chapter 2

24. B;

$$\text{percent of increase} = \frac{\text{new amount} - \text{original amount}}{\text{original amount}}$$
$$= \frac{25 - 20}{20}$$
$$= \frac{5}{20}$$
$$= \frac{1}{4}, \text{ or } 25\%$$

The weight of the cans increased 25%.

Section 2.7

2.7 Activity (pp. 80–83)

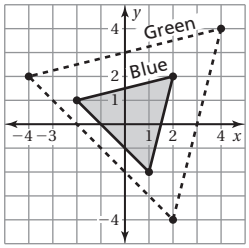
1. Blue triangle: $(-2, 1), (2, 2), (1, -2)$

Red triangle: $(-6, 3), (6, 6), (3, -6)$

a. The red coordinates are each 3 times the corresponding blue coordinates.

b. The red triangle is similar to the blue triangle because its side lengths are 3 times greater than the corresponding side lengths of the blue triangle.

c.



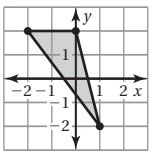
The green triangle is similar to the blue triangle because its side lengths are 2 times greater than the corresponding side lengths of the blue triangle.

d. Red triangle: $(-6, 3), (6, 6), (3, -6)$

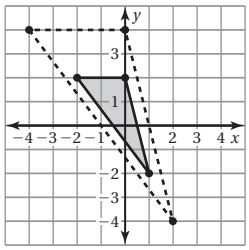
Green triangle: $(-4, 2), (4, 4), (2, -4)$

The green coordinates are $\frac{2}{3}$ times the corresponding red coordinates. The red triangle is similar to the green triangle because its side lengths are $\frac{3}{2}$ times greater than the corresponding side lengths of the green triangle.

2. a.



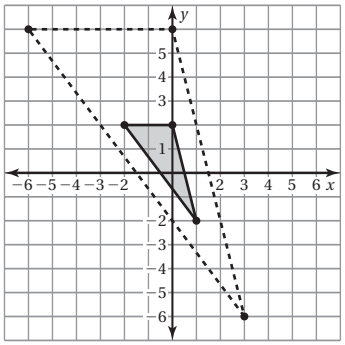
b.



New vertices: $(0, 4), (-4, 4)$, and $(2, -4)$

The new triangle is similar to the original triangle.

c.



New vertices: $(0, 6), (-6, 6)$, and $(3, -6)$

The new triangle is similar to the original triangle.

3. *Sample answer:*

Translation	same size and shape, slides left, right, up and/or down
Reflection	same size and shape, mirror image of original
Rotation	same size and shape, rotated about a point
Dilation	different size, same shape, similar to original, enlargement or reduction

4. You can enlarge or reduce a polygon in the coordinate plane by multiplying each coordinate of the vertices by the same number. To enlarge a polygon, multiply each coordinate of the vertices by a number greater than 1. To reduce a polygon, multiply each coordinate by a number between 0 and 1.

5. *Sample answer:* People in drafting careers have to create scale drawings of real-life objects.

2.7 On Your Own (pp. 84–86)

1. no; The figures have the same size and shape. The red figure flips to form the blue figure. So, the blue figure is not a dilation of the red figure. It is a reflection.

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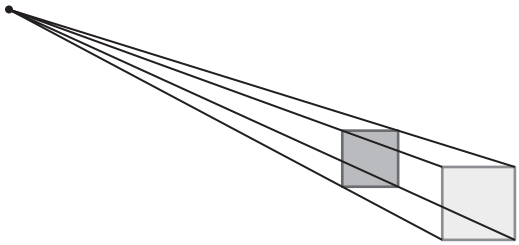
2. yes; Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.



3.

Vertices of ABC	$(2x, 2y)$	Vertices of $A'B'C'$
$A(1, 3)$	$(2 \bullet 1, 2 \bullet 3)$	$A'(2, 6)$
$B(2, 3)$	$(2 \bullet 2, 2 \bullet 3)$	$B'(4, 6)$
$C(2, 1)$	$(2 \bullet 2, 2 \bullet 1)$	$C'(4, 2)$

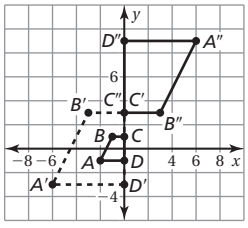
The coordinates of the image are $A'(2, 6)$, $B'(4, 6)$, and $C'(4, 2)$.

4.

Vertices of $WXYZ$	$\left(\frac{1}{4}x, \frac{1}{4}y\right)$	Vertices of $W'X'Y'Z'$
$W(-4, -6)$	$\left(\frac{1}{4} \bullet (-4), \frac{1}{4} \bullet (-6)\right)$	$W'\left(-1, -\frac{3}{2}\right)$
$X(-4, 8)$	$\left(\frac{1}{4} \bullet (-4), \frac{1}{4} \bullet 8\right)$	$X'(-1, 2)$
$Y(4, 8)$	$\left(\frac{1}{4} \bullet 4, \frac{1}{4} \bullet 8\right)$	$Y'(1, 2)$
$Z(4, -6)$	$\left(\frac{1}{4} \bullet 4, \frac{1}{4} \bullet (-6)\right)$	$Z'\left(1, -\frac{3}{2}\right)$

The coordinates of the image are $W'\left(-1, -\frac{3}{2}\right)$, $X'(-1, 2)$, $Y'(1, 2)$, and $Z'\left(1, -\frac{3}{2}\right)$.

5.



The coordinates of the image are $A''(6, 9)$, $B''(3, 3)$, $C''(0, 3)$, and $D''(0, 9)$.

6. yes; The order of the transformations does not matter for reflections and dilations.

2.7 Exercises (pp. 87–89)

Vocabulary and Concept Check

1. A dilation is different from other translations because the original figure and its image have the same shape but not the same size. The image is similar, not congruent, to the original figure.

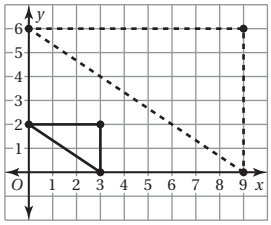
2. A dilation is an enlargement when $k > 1$ and a reduction when $k > 0$ and $k < 1$.

3. The middle red figure is not a dilation of the blue figure because the height is half of the blue figure and the base is the same. The left red figure is a reduction of the blue figure and the right red figure is an enlargement of the blue figure.

Practice and Problem Solving

4.

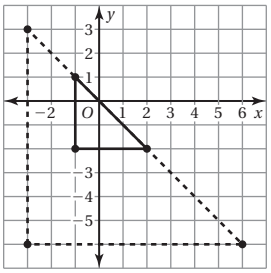
Original vertices	$(3x, 3y)$	New vertices
$(0, 2)$	$(3 \bullet 0, 3 \bullet 2)$	$(0, 6)$
$(3, 2)$	$(3 \bullet 3, 3 \bullet 2)$	$(9, 6)$
$(3, 0)$	$(3 \bullet 3, 3 \bullet 0)$	$(9, 0)$



The new triangle is similar to the original triangle.

5.

Original vertices	$(3x, 3y)$	New vertices
$(-1, 1)$	$(3 \bullet (-1), 3 \bullet 1)$	$(-3, 3)$
$(-1, -2)$	$(3 \bullet (-1), 3 \bullet (-2))$	$(-3, -6)$
$(2, -2)$	$(3 \bullet 2, 3 \bullet (-2))$	$(6, -6)$



The new triangle is similar to the original triangle.

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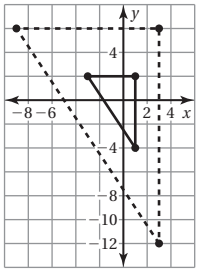
Chapter 2

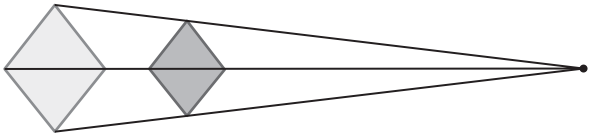
6.

Original vertices	$(3x, 3y)$	New vertices
$(-3, 2)$	$(3 \bullet (-3), 3 \bullet 2)$	$(-9, 6)$
$(1, 2)$	$(3 \bullet 1, 3 \bullet 2)$	$(3, 6)$
$(1, -4)$	$(3 \bullet 1, 3 \bullet (-4))$	$(3, -12)$



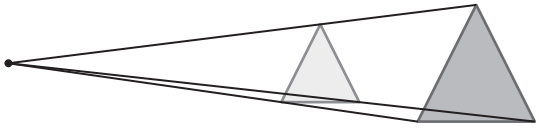
The new triangle is similar to the original triangle.

7. yes;



Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

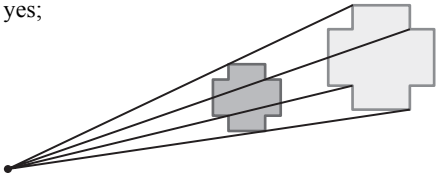
8. yes;



Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

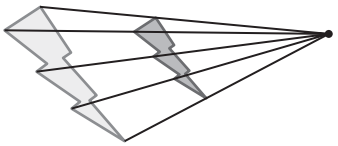
9. no; The figures have the same size and shape. The red figure turns to form the blue figure. So, the blue figure is not a dilation of the red figure. It is a rotation.

10. yes;



Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

11. yes;

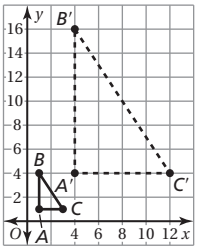


Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

12. no; The figures have the same size and shape. The red figure flips to form the blue figure. So, the blue figure is not a dilation of the red figure. It is a reflection.

13.

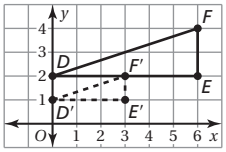
Vertices of ABC	$(4x, 4y)$	Vertices of $A'B'C'$
$A(1, 1)$	$(4 \bullet 1, 4 \bullet 1)$	$A'(4, 4)$
$B(1, 4)$	$(4 \bullet 1, 4 \bullet 4)$	$B'(4, 16)$
$C(3, 1)$	$(4 \bullet 3, 4 \bullet 1)$	$C'(12, 4)$



The dilation is an enlargement because the scale factor is greater than 1.

14.

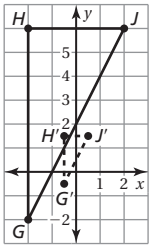
Vertices of DEF	$(0.5x, 0.5y)$	Vertices of $D'E'F'$
$D(0, 2)$	$(0.5 \bullet 0, 0.5 \bullet 2)$	$D'(0, 1)$
$E(6, 2)$	$(0.5 \bullet 6, 0.5 \bullet 2)$	$E'(3, 1)$
$F(6, 4)$	$(0.5 \bullet 6, 0.5 \bullet 4)$	$F'(3, 2)$



The dilation is a reduction because the scale factor is greater than 0 and less than 1.

15.

Vertices of GHJ	$(0.25x, 0.25y)$	Vertices of $G'H'J'$
$G(-2, -2)$	$(0.25 \bullet (-2), 0.25 \bullet (-2))$	$G'(-0.5, -0.5)$
$H(-2, 6)$	$(0.25 \bullet (-2), 0.25 \bullet 6)$	$H'(-0.5, 1.5)$
$J(2, 6)$	$(0.25 \bullet 2, 0.25 \bullet 6)$	$J'(0.5, 1.5)$



The dilation is a reduction because the scale factor is greater than 0 and less than 1.

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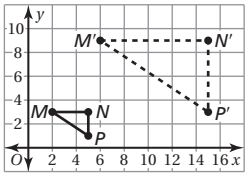
Chapter 2

16.

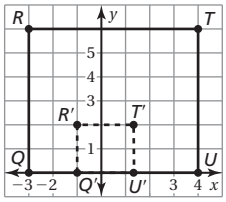
Vertices of MNP	$(3x, 3y)$	Vertices of $M'N'P'$
$M(2, 3)$	$(3 \bullet 2, 3 \bullet 3)$	$M'(6, 9)$
$N(5, 3)$	$(3 \bullet 5, 3 \bullet 3)$	$N'(15, 9)$
$P(5, 1)$	$(3 \bullet 5, 3 \bullet 1)$	$P'(15, 3)$



The dilation is an enlargement because the scale factor is greater than 1.

17.

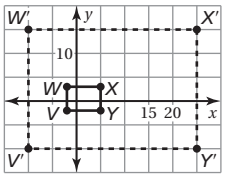
Vertices of $QRTU$	$\left(\frac{1}{3}x, \frac{1}{3}y\right)$	Vertices of $Q'R'T'U'$
$Q(-3, 0)$	$\left(\frac{1}{3} \bullet (-3), \frac{1}{3} \bullet 0\right)$	$Q'(-1, 0)$
$R(-3, 6)$	$\left(\frac{1}{3} \bullet (-3), \frac{1}{3} \bullet 6\right)$	$R'(-1, 2)$
$T(4, 6)$	$\left(\frac{1}{3} \bullet 4, \frac{1}{3} \bullet 6\right)$	$T'\left(\frac{4}{3}, 2\right)$
$U(4, 0)$	$\left(\frac{1}{3} \bullet 4, \frac{1}{3} \bullet 0\right)$	$U'\left(\frac{4}{3}, 0\right)$



The dilation is a reduction because the scale factor is greater than 0 and less than 1.

18.

Vertices of $VWXY$	$(5x, 5y)$	Vertices of $V'W'X'Y'$
$V(-2, -2)$	$(5 \bullet (-2), 5 \bullet (-2))$	$V'(-10, -10)$
$W(-2, 3)$	$(5 \bullet (-2), 5 \bullet 3)$	$W'(-10, 15)$
$X(5, 3)$	$(5 \bullet 5, 5 \bullet 3)$	$X'(25, 15)$
$Y(5, -2)$	$(5 \bullet 5, 5 \bullet (-2))$	$Y'(25, -10)$



The dilation is an enlargement because the scale factor is greater than 1.

19. For a dilation with a scale factor of $\frac{1}{2}$, the x- and y-coordinates should be multiplied by $\frac{1}{2}$, not 2.

Vertices of ABC	$\left(\frac{1}{2}x, \frac{1}{2}y\right)$	Vertices of $A'B'C'$
$A(2, 5)$	$\left(\frac{1}{2} \bullet 2, \frac{1}{2} \bullet 5\right)$	$A'\left(1, \frac{5}{2}\right)$
$B(2, 0)$	$\left(\frac{1}{2} \bullet 2, \frac{1}{2} \bullet 0\right)$	$B'(1, 0)$
$C(4, 0)$	$\left(\frac{1}{2} \bullet 4, \frac{1}{2} \bullet 0\right)$	$C'(2, 0)$

20. The coordinates of the red figure are $A(1, 3)$, $B(4, 3)$, and $C(1, 1)$. The coordinates of the blue figure are $A'(2, 6)$, $B'(8, 6)$, and $C'(2, 2)$. Each x- and y-coordinate of ABC is multiplied by 2 to produce the vertices of $A'B'C'$. So, the dilation is an enlargement with a scale factor of 2.

21. The coordinates of the red figure are $X(-4, 4)$, $Y(-4, -4)$, and $Z(4, -4)$. The coordinates of the blue figure are $X'(-1, 1)$, $Y'(-1, -1)$, and $Z'(1, -1)$. Each x- and y-coordinate of XYZ is multiplied by $\frac{1}{4}$ to produce the vertices of $X'Y'Z'$. So, the dilation is a reduction with a scale factor of $\frac{1}{4}$.

22. The coordinates of the red figure are $J(-6, 4)$, $K(4, 4)$, $L(4, -6)$, and $M(-6, -6)$. The coordinates of the blue figure are $J'(-9, 6)$, $K'(6, 6)$, $L'(6, -9)$ and $M'(-9, -9)$. Each x- and y-coordinate of $JKLM$ is multiplied by $\frac{3}{2}$ to produce the vertices of $J'K'L'M'$. So, the dilation is an enlargement with a scale factor of $\frac{3}{2}$.

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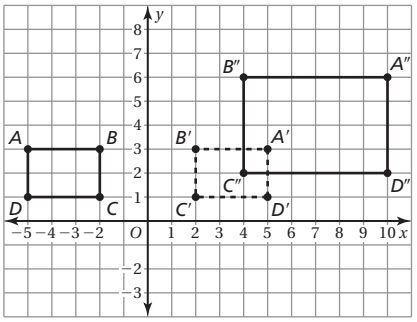
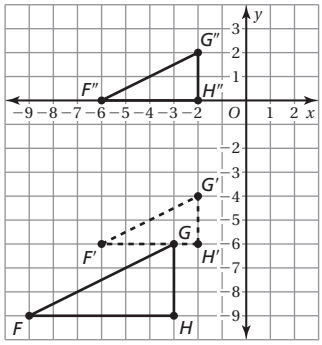
Chapter 2

23.



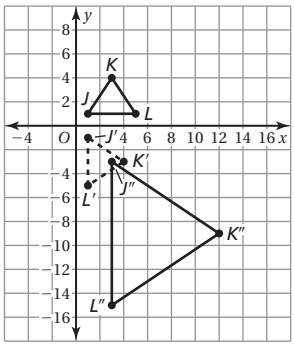
The coordinates of the image are $A''(10, 6)$, $B''(4, 6)$, $C''(4, 2)$, and $D''(10, 2)$.

24.



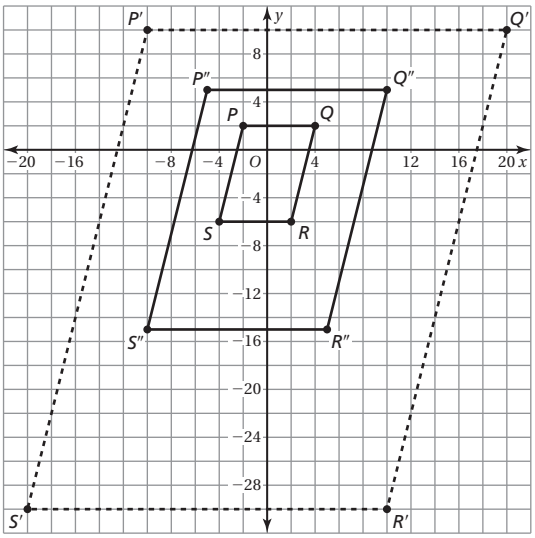
The coordinates of the image are $F''(-6, 0)$, $G''(-2, 2)$, and $H''(-2, 0)$.

25.



The coordinates of the image are $J''(3, -3)$, $K''(12, -9)$, and $L''(3, -15)$.

26.



The coordinates of the image are $P''(-5, 5)$, $Q''(10, 5)$, $R''(5, -15)$, and $S''(-10, -15)$.

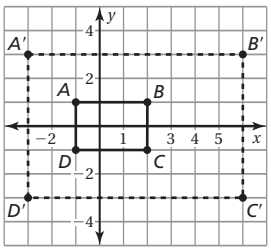
27. *Sample answer:* Rotate 90° counterclockwise about the origin and then dilate with respect to the origin using a scale factor of 2

28. *Sample answer*: Dilate with respect to the origin using a scale factor of 3 and then translate 11 units left and 11 units up

29. Exercise 27: yes; Exercise 28: no; Explanations will vary based on sequences chosen in Exercises 27 and 28.

30. *Sample answer:*

Vertices of $ABCD$	$(3x, 3y)$	Vertices of $A'B'C'D'$
$A(-1, 1)$	$(3 \bullet (-1), 3 \bullet 1)$	$A'(-3, 3)$
$B(2, 1)$	$(3 \bullet 2, 3 \bullet 1)$	$B'(6, 3)$
$C(2, -1)$	$(3 \bullet 2, 3 \bullet (-1))$	$C'(6, -3)$
$D(-1, -1)$	$(3 \bullet (-1), 3 \bullet (-1))$	$D'(-3, -3)$



Area of $ABCD = 3 \bullet 2 = 6$

Area of $A'B'C'D' = 9 \bullet 6 = 54$

Rectangle $A'B'C'D'$ is an enlargement of $ABCD$ with a scale factor of 3, and its area is $54 \div 6 = 9$ times greater than the area of $ABCD$.

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Chapter 2

31. a. The dilation is an enlargement.

b. The flashlight represents the center of dilation.

c. The shadow is the image, and the shadow puppet is the original figure. So, the scale factor is

$$\frac{\text{shadow ear length}}{\text{puppet ear length}} = \frac{4 \text{ in.}}{3 \text{ in.}} = \frac{4}{3}.$$

d. As the shadow puppet moves closer to the flashlight, the shadow gets bigger. The scale factor increases.

32. $\frac{3}{2}$; Let x represent a side length of the original triangle. After the first dilation, the side length is $3 \bullet x$, and after the second dilation, the side length is $\frac{1}{2} \bullet (3 \bullet x) = \frac{3}{2}x$. So, you could use a scale factor of $\frac{3}{2}$ to dilate the original triangle to get the final triangle.

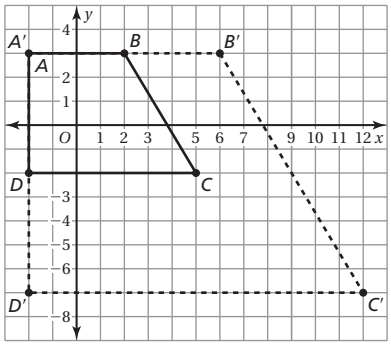
33. similar; The transformations are a dilation using a scale factor of 2 and then a translation of 4 units right and 3 units down. A dilation produces a similar figure and a translation produces a congruent figure, so the final image is similar.

34. congruent; The transformations are a reflection in the y-axis and then a translation of 1 unit left and two units down. A reflection produces a congruent figure and a translation produces a congruent figure, so the final image is congruent.

35. similar; The transformations are a dilation using a scale factor of $\frac{1}{3}$ and then a reflection in the x-axis. A dilation produces a similar figure and a reflection produces a congruent figure, so the final image is similar.

36. $(2x + 3, 2y - 1)$ is a dilation using a scale factor of 2 followed by a translation 3 units right and 1 unit down. $(2(x + 3), 2(y - 1))$ is a translation 3 units right and 1 unit down followed by a dilation using a scale factor of 2.

37.



The coordinates of the image are $A'(-2, 3)$, $B'(6, 3)$, $C'(12, -7)$, and $D'(-2, -7)$.

Methods vary. *Sample answers:*

Method 1: Start at vertex A and draw segments $A'B'$, $A'D'$, and $C'D'$, whose lengths are twice that of segments AB, AD, and CD, respectively. Then, connect vertices B' and C' and find the coordinates of the image.

Method 2: Translate the trapezoid so that vertex A is at the origin. Then, dilate the figure by a factor of 2, and translate the image back so that vertex A' is the same as vertex A. Find the coordinates of the image.

Fair Game Review

38. The angles make up a right angle. So, the angles are complementary angles, and the sum of their measures is 90°.

$$\begin{aligned} x + (x - 10) &= 90 \\ 2x - 10 &= 90 \\ 2x &= 100 \\ x &= 50 \end{aligned}$$

So, x is 50.

39. The two angles make up a straight angle. So, the angles are supplementary, and the sum of their measures is 180°.

$$\begin{aligned} (3x + 20) + 7x &= 180 \\ 10x + 20 &= 180 \\ 10x &= 160 \\ x &= 16 \end{aligned}$$

So, x is 16.

40. The angles make up a right angle. So, the angles are complementary angles, and the sum of their measures is 90°.

$$\begin{aligned} 5x + 45 &= 90 \\ 5x &= 45 \\ x &= 9 \end{aligned}$$

So, x is 9.

41. B

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Chapter 2

Quiz 2.5–2.7

1. Each figure is a rectangle. So, corresponding angles have the same measure.

Ratio of corresponding widths: $\frac{4}{10} = \frac{2}{5}$

Ratio of corresponding lengths: $\frac{8}{20} = \frac{2}{5}$

The ratios are equivalent, so the side lengths are proportional. The rectangles are similar.

2. $\frac{x}{3} = \frac{22}{4}$

$\frac{x}{3} = \frac{11}{2}$

$x = \frac{33}{2}$

So, $x = \frac{33}{2}$, or $16\frac{1}{2}$.

3. $\frac{6}{14} = \frac{8}{x}$

$\frac{3}{7} = \frac{8}{x}$

$3x = 56$

$x = \frac{56}{3}$

So, $x = \frac{56}{3}$, or $18\frac{2}{3}$.

4. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{12}{8} = \frac{3}{2}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{12}{8}\right)^2 = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$

The ratio of the perimeters is $\frac{3}{2}$ and the ratio of the areas is $\frac{9}{4}$.

5. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{4}{15}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{4}{15}\right)^2 = \frac{16}{225}$

The ratio of the perimeters is $\frac{4}{15}$ and the ratio of the areas is $\frac{16}{225}$.

6. yes;

Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

7. no; The figures have the same size and shape. The red figure slides to form the blue figure. So, the blue figure is not a dilation of the red figure. It is a translation.

8. $\frac{\text{Area of TV screen}}{\text{Area of computer screen}} = \left(\frac{20}{12}\right)^2$

$\frac{A}{108} = \left(\frac{5}{3}\right)^2$

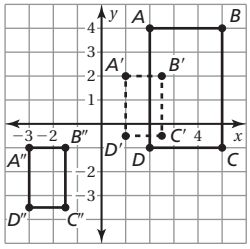
$\frac{A}{108} = \frac{25}{9}$

$A = \frac{25 \times \overset{12}{\cancel{108}}}{\underset{1}{\cancel{9}}}$

$A = 300$

The area of the TV screen is 300 square inches.

9.



The coordinates of the image are $A''(-3, -1)$, $B''\left(-1\frac{1}{2}, -1\right)$, $C''\left(-1\frac{1}{2}, -3\frac{1}{2}\right)$, and $D''\left(-3, -3\frac{1}{2}\right)$.

10. $\frac{\text{Width of singles court}}{\text{Width of doubles court}} = \frac{27}{36} = \frac{3}{4}$

$\frac{\text{Length of singles court}}{\text{Lenght of doubles court}} = \frac{78}{78} = 1$

The ratios are not equivalent, so the side lengths are not proportional. The courts are not similar.

Chapter 2 Review

1. Side QR corresponds to Side EF. So, the length of Side QR is 3 feet.

2. The perimeter of $EFGH$ is $8 + 3 + 5 + 4 = 20$ feet. Because the trapezoids are congruent, their corresponding sides are congruent. So, the perimeter of $QRST$ is also 20 feet.

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Chapter 2

3. Corresponding angles: $\angle A$ and $\angle K$, $\angle B$ and $\angle L$, $\angle C$ and $\angle M$

Corresponding sides: Side AB and Side KL, Side BC and Side LM, Side AC and Side KM

4. Corresponding angles: $\angle R$ and $\angle W$, $\angle Q$ and $\angle X$, $\angle T$ and $\angle Y$, $\angle S$ and $\angle Z$

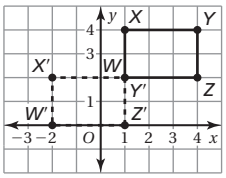
Corresponding sides: Side RQ and Side WX, Side QT and Side XY, Side TS and Side YZ, Side SR and Side ZW

5. The figures are not the same size. So, the blue figure is not a translation of the red figure.

6. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

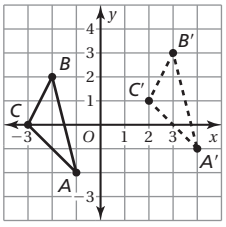
7.

Vertices of $WXYZ$	$(x - 3, y - 2)$	Vertices of $W'X'Y'Z'$
$W(1, 2)$	$(1 - 3, 2 - 2)$	$W'(-2, 0)$
$X(1, 4)$	$(1 - 3, 4 - 2)$	$X'(-2, 2)$
$Y(4, 4)$	$(4 - 3, 4 - 2)$	$Y'(1, 2)$
$Z(4, 2)$	$(4 - 3, 2 - 2)$	$Z'(1, 0)$



8.

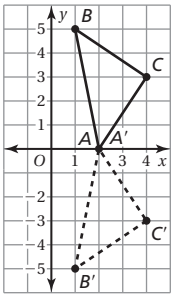
Vertices of ABC	$(x + 5, y + 1)$	Vertices of $A'B'C'$
$A(-1, -2)$	$(-1 + 5, -2 + 1)$	$A'(4, -1)$
$B(-2, 2)$	$(-2 + 5, 2 + 1)$	$B'(3, 3)$
$C(-3, 0)$	$(-3 + 5, 0 + 1)$	$C'(2, 1)$



9. If the red figure was flipped, it would not form the blue figure. So, the blue figure is not a reflection of the red figure.

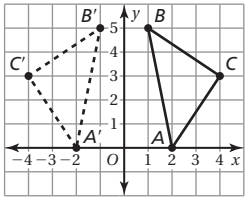
10. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection of the red figure.

11. a.



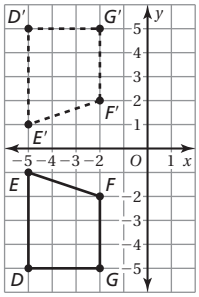
The coordinates of the image are $A'(2, 0)$, $B'(1, -5)$, and $C'(4, -3)$.

b.



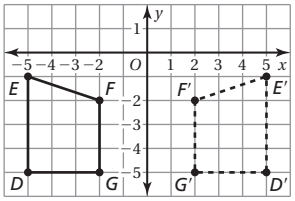
The coordinates of the image are $A'(-2, 0)$, $B'(-1, 5)$, and $C'(-4, 3)$.

12. a.



The coordinates of the image are $D'(-5, 5)$, $E'(-5, 1)$, $F'(-2, 2)$, and $G'(-2, 5)$.

b.



The coordinates of the image are $D'(5, -5)$, $E'(5, -1)$, $F'(2, -2)$, and $G'(2, -5)$.

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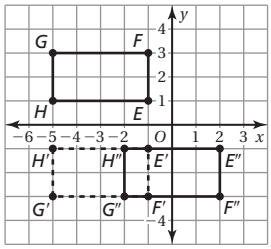
Chapter 2

13.

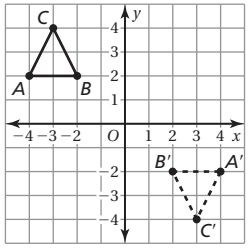


The coordinates of the image are $E''(2, -1)$, $F''(2, -3)$, $G''(-2, -3)$, and $H''(-2, -1)$.

14. The blue figure is not a rotation of the red figure.

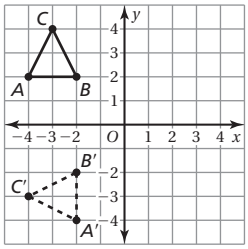
15. The blue figure is 180° (clockwise or counterclockwise) rotation of the red figure.

16.



The coordinates of the image are $A'(4, -2)$, $B'(2, -2)$, and $C'(3, -4)$.

17.



The coordinates of the image are $A'(-2, -4)$, $B'(-2, -2)$, and $C'(-4, -3)$.

18. Ratios of corresponding side lengths:

$$\frac{10}{8} = \frac{5}{4}$$
$$\frac{6}{5}$$
$$\frac{7}{6}$$

The ratios are not equivalent, so the side lengths are not proportional. The figures are not similar.

19. Ratios of corresponding side lengths:

$$\frac{12}{42} = \frac{2}{7}$$
$$\frac{8}{28} = \frac{2}{7}$$
$$\frac{6}{21} = \frac{2}{7}$$
$$\frac{8}{28} = \frac{2}{7}$$

All ratios are equivalent, so the side lengths are proportional. Corresponding angles have the same measure. So, the figures are similar.

20.
$$\frac{14}{7} = \frac{20}{x}$$
$$2 = \frac{20}{x}$$
$$2x = 20$$
$$x = 10$$

So, x is 10 inches.

21.
$$\frac{6}{x} = \frac{4}{6}$$
$$\frac{6}{x} = \frac{2}{3}$$
$$18 = 2x$$
$$9 = x$$

So, x is 9 centimeters.

22. $\dfrac{\text{Perimeter of red triangle}}{\text{Perimeter of blue triangle}} = \dfrac{6}{8} = \dfrac{3}{4}$

$$\frac{\text{Area of red triangle}}{\text{Area of blue triangle}} = \left(\frac{6}{8}\right)^2 = \left(\frac{3}{4}\right)^2 = \frac{9}{16}$$

The ratio of the perimeters is $\frac{3}{4}$ and the ratio of the areas is $\frac{9}{16}$.

23. $\dfrac{\text{Perimeter of red rectangle}}{\text{Perimeter of blue rectangle}} = \dfrac{28}{16} = \dfrac{7}{4}$

$$\frac{\text{Area of red rectangle}}{\text{Area of blue rectangle}} = \left(\frac{28}{16}\right)^2 = \left(\frac{7}{4}\right)^2 = \frac{49}{16}$$

The ratio of the perimeters is $\frac{7}{4}$ and the ratio of the areas is $\frac{49}{16}$.

24. Ratios of area $= \left(\frac{3}{4}\right)^2 = \frac{9}{16}$

The ratio of the areas of the two photos is $9 : 16$.

25. no; The figures have the same size and shape. So, the blue figure is not a dilation of the red figure.

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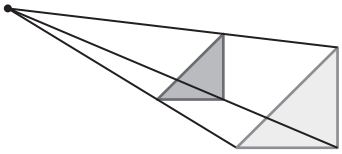
Chapter 2

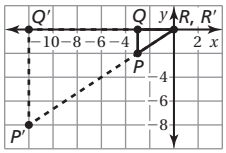
26. yes;



Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

27.

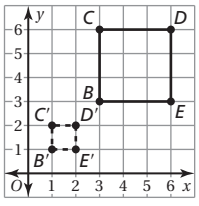
Vertices of PQR	$(4x, 4y)$	Vertices of $P'Q'R'$
$P(-3, -2)$	$(4 \bullet (-3), 4 \bullet (-2))$	$P'(-12, -8)$
$Q(-3, 0)$	$(4 \bullet (-3), 4 \bullet 0)$	$Q'(-12, 0)$
$R(0, 0)$	$(4 \bullet 0, 4 \bullet 0)$	$R'(0, 0)$



The dilation is an enlargement because the scale factor is greater than 1.

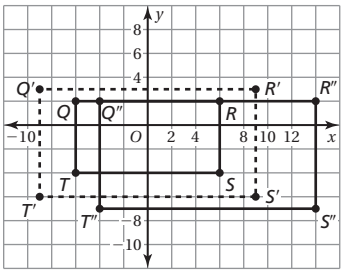
28.

Vertices of $BCDE$	$\left(\frac{1}{3}x, \frac{1}{3}y\right)$	Vertices of $B'C'D'E'$
$B(3, 3)$	$\left(\frac{1}{3} \bullet 3, \frac{1}{3} \bullet 3\right)$	$B'(1, 1)$
$C(3, 6)$	$\left(\frac{1}{3} \bullet 3, \frac{1}{3} \bullet 6\right)$	$C'(1, 2)$
$D(6, 6)$	$\left(\frac{1}{3} \bullet 6, \frac{1}{3} \bullet 6\right)$	$D'(2, 2)$
$E(6, 3)$	$\left(\frac{1}{3} \bullet 6, \frac{1}{3} \bullet 3\right)$	$E'(2, 1)$



The dilation is a reduction because the scale factor is greater than 0 and less than 1.

29.



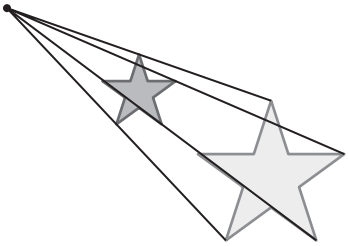
The coordinates of the image are $Q''(-4, 2)$, $R''(14, 2)$, $S''(14, -7)$, and $T''(-4, -7)$.

Chapter 2 Test

1. $\angle F$ corresponds to $\angle C$.

2. The perimeter of ABC is $6 + 5 + 4 = 15$ centimeters. Because the triangles are congruent, their corresponding sides are congruent. So, the perimeter of DEF is also 15 centimeters.

3.



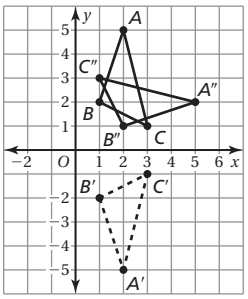
Lines connecting corresponding vertices meet at a point. So, the blue figure is a dilation of the red figure.

4. The red figure can be flipped to form the blue figure. So, the blue figure is a reflection of the red figure.

5. The red figure slides to form the blue figure. So, the blue figure is a translation of the red figure.

6. The red figure turns to form the blue figure. So, the blue figure is a rotation of the red figure.

7.



The coordinates of the image are $A''(5, 2)$, $B''(2, 1)$, and $C''(1, 3)$.

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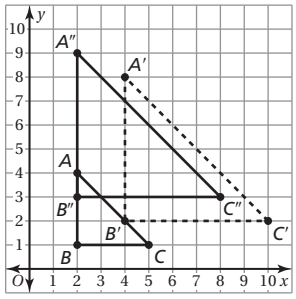
Chapter 2

8. 

The coordinates of the image are $A''(2, 9)$, $B''(2, 3)$, and $C''(8, 3)$.

9. Ratios of corresponding side lengths:

$\frac{5}{9}$

$\frac{7}{11}$

The ratios are not equivalent, so corresponding side lengths are not proportional. The parallelograms are not similar.

10. $\frac{\text{Perimeter of red trapezoid}}{\text{Perimeter of blue trapezoid}} = \frac{14}{8} = \frac{7}{4}$

$\frac{\text{Area of red trapezoid}}{\text{Area of blue trapezoid}} = \left(\frac{14}{8}\right)^2 = \left(\frac{7}{4}\right)^2 = \frac{49}{16}$

The ratio of the perimeters is $\frac{7}{4}$ and the ratio of the areas is $\frac{49}{16}$.

11. $\frac{\text{Perimeter of red figure}}{\text{Perimeter of blue figure}} = \frac{9}{12} = \frac{3}{4}$

$\frac{\text{Area of red figure}}{\text{Area of blue figure}} = \left(\frac{9}{12}\right)^2 = \left(\frac{3}{4}\right)^2 = \frac{9}{16}$

The ratio of the perimeters is $\frac{3}{4}$ and the ratio of the areas is $\frac{9}{16}$.

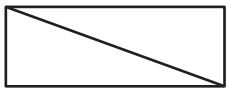
12. $\frac{\text{Length of wide screen}}{\text{Length of theater screen}} = \frac{54}{63} = \frac{6}{7}$

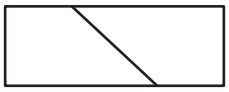
$\frac{\text{Width of wide screen}}{\text{Width of theater screen}} = \frac{36}{42} = \frac{6}{7}$

The ratios are equivalent, so the corresponding side lengths are proportional. The screens are similar.

13. You can make either two rectangles, two right triangles, or two right trapezoids.

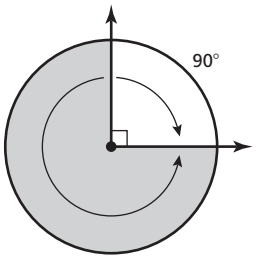
2 rectangles:

2 right triangles: 

2 right trapezoids: 

Chapter 2 Standards Assessment

1. 270°;



1 rotation = 360°

360° − 90° = 270°

2. D **3.** I **4.** C

5. G;

Vertices of ABC	$(x + 3, y - 2)$	Vertices of $A'B'C'$
$A(-2, 4)$	$(-2 + 3, 4 - 2)$	$A'(1, 2)$
$B(-2, 1)$	$(-2 + 3, 1 - 2)$	$B'(1, -1)$
$C(0, 1)$	$(0 + 3, 1 - 2)$	$C'(3, -1)$

The coordinates of the image are $A'(1, 2)$, $B'(1, -1)$, and $C'(3, -1)$.

6. C; In the fourth line of the solution, Dale should multiply each side by -3 instead of 3.

7. 15;

$\frac{\text{Area of dilated rectangle}}{\text{Area of given rectangle}} = \left(\frac{1}{2}\right)^2$

$\frac{A}{60} = \frac{1}{4}$

$A = 15$

The area of the dilated rectangle is 15 square inches.

8. F; A dilation by a scale factor of 3 means each coordinate of the rectangle is multiplied by 3. So, the coordinates of vertex C' are $(3 \bullet 3, -5 \bullet 3)$, or $(9, -15)$.

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9. B; EG does not correspond with HI.

10. F; $\frac{EF}{IJ} = \frac{FG}{JK}$

$$\frac{8}{12} = \frac{x}{21}$$
$$168 = 12x$$
$$14 = x$$

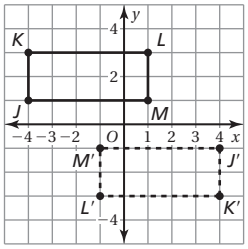
So, x is 14 inches.

11. *Part A:* translation; Triangle GLM slides to form Triangle DGH. So, Triangle DGH is a translation of Triangle GLM.

Part B: dilation; Lines connecting corresponding vertices meet at a point. So, Triangle GLM is a dilation of Triangle ALQ. Triangle GLM is a reduction of Triangle ALQ by a scale factor of $\frac{1}{4}$.

Part C: 2; Because $\frac{DF}{GH} = \frac{2}{1}$, the scale factor is 2.

12. A;



The coordinates of the image are $J'(4, -1)$, $K'(4, -3)$, $L'(-1, -3)$, and $M'(-1, -1)$.

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